


Appendix A

Air quality impact assessment

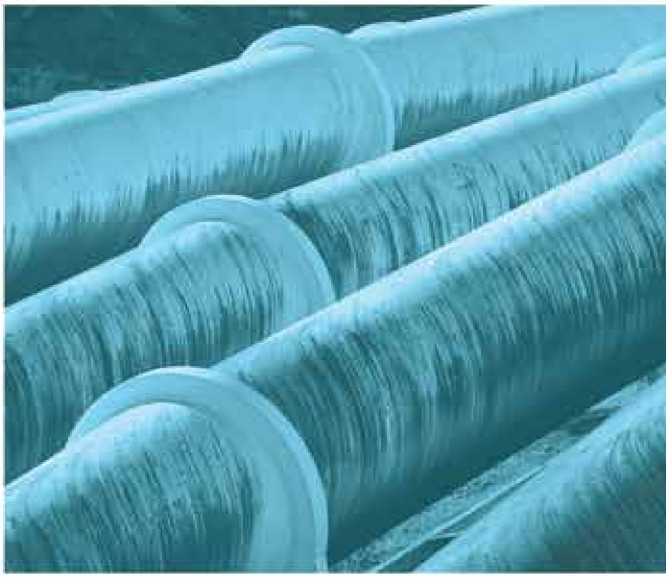




APA East Coast Grid Expansion, Moomba to Wilton Pipeline - Modification Report 1

Air Quality Impact Assessment

Prepared for APA Group
July 2021

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APA East Coast Grid Expansion, Moomba to Wilton Pipeline - Modification Report 1

Air Quality Impact Assessment

Report Number

J200919 RP#10

Client

APA Group

Date

7 July 2021

Version

v2 Final

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Executive Summary

ES1 Introduction

East Australian Pipeline Pty Ltd, part of the APA Group (APA) currently operates an underground high pressure natural gas transmission pipeline, extending from Moomba (South Australia) to Wilton (New South Wales). The Moomba to Wilton Pipeline (MWP) is the mainline part of the Moomba Sydney Pipeline (MSP). APA is proposing an expansion of transportation capacity on the East Coast Grid, linking Queensland with southern markets, by approximately 25% through additional compression and associated works on both the South West Queensland Pipeline (SWQP) and Moomba to Wilton Pipeline (MWP).

The expansion will be delivered in a number of stages. This report has been prepared to address the air quality impacts for Stage 1 and 2, which includes the construction and operation of compressor stations at Milne (MW880) and Round Hill (MW433).

ES2 Local setting and existing environment

The proposed compressor station at Round Hill (MW433) is located approximately 103 km north of Wilcannia in a remote rural location, with few distinguishing topographical or land use features and mostly void of continuous vegetation. There are no sensitive receptors within 5 km.

The Milne compressor station site (MW880) is located approximately 35 km south-west of Condobolin in a remote rural location characterised by sparse pockets of vegetation. The terrain surrounding this site is flat with few distinguishing features. The closest residential properties are located approximately 1.7 km to the north-east and 2.5 km to the south-east.

Analysis of meteorology for the study area is based on automatic weather stations located at Condobolin Airport and White Cliffs. For the key pollutants associated with the operational phase of the project there are no significant local sources that would contribute to background air quality, other than minor contributions from traffic and agricultural plant and equipment.

ES3 Construction phase assessment

For the construction phase assessment, the construction methodology, scale of impacts and standard dust mitigation measures are consistent across both compressor station sites, and therefore the risk-based assessment of potential air quality impacts is applicable to each site. The construction assessment showed that there are no sensitive human receptors within 350 m of each site and no ecological receptors within 50 m of the sites, therefore impacts from construction dust are negligible. Good practice mitigation measures for construction dust will reduce this risk further. Due to the proximity of receptor locations, the proposed construction dust mitigation measures are most relevant to the Milne (MW880) site.

ES4 Operational phase assessment

Atmospheric dispersion modelling was completed using the AERMOD model system for the operation of the compressor station at the Milne (MW880) site. Modelling results were compared against applicable NSW EPA's impact assessment criteria and a qualitative assessment of risk is also made, based on screening criteria prescribed by the Western Australian Department of Water and Environmental Regulation (DWER).

The approach for modelling is to model the worst-case emission hour for every hour of the year (in this way, the worst-case emission hour is paired with every possible meteorological condition). The highest NOx emission rate for MW880 occurs for a high load scenario (96.6%), while the highest emission rate for CO and VOC occurs for the low load scenario (18%). Emissions of SO_2 are a function of the sulphur content of the fuel, therefore emissions will be higher at higher loads (because more fuel is combusted).

When expressed as a percentage of the impact assessment criteria, the 1-hour average NO_2 concentrations are less than 1% of the impact assessment criterion. In accordance with the DWER screening criteria, if the 1-hour average concentrations are less than 10% of the impact assessment, the incremental project impacts can be screened as insignificant. For CO and SO_2, the 1-hour average concentrations are also less than 1% of the impact assessment criteria and can be screened as insignificant. For VOCs, the highest 1-hour average concentration is predicted for formaldehyde, however it is less than 10% of the impact assessment criteria and therefore can be screened as insignificant.

The predicted annual average concentrations of NO_x and SO_2, when assessed as a percentage of the impact assessment criteria, are 0.1% of the impact assessment criterion. In accordance with the DWER screening criteria, if the annual average concentrations are less than 1% of the impact assessment, the incremental project impacts can be screened as insignificant.

Additional modelling assessment was not required for the Round Hill (MW433) site. The modelling results for Milne (MW880) demonstrate that the operation of the compressor stations would result in insignificant incremental ground level concentrations. For the Round Hill (MW433) site, sensitive receptors are located at almost double the distance that was modelled for the Milne (MW880) site, therefore compliance can be inferred with confidence for Round Hill (MW433).

ES5 Cumulative assessment

There are no significant local emissions sources that would contribute to ambient background concentrations for all pollutants assessed, other than minor contributions from traffic and agricultural plant and equipment. On this basis, ambient background for these pollutants can be assumed to be very low and compliance with the impact assessment criteria can be inferred based on the minor project increment.

ES6 Greenhouse gas assessment

The significance of the project's GHG emissions is assessed by comparing with GHG accounts for NSW (131,685 kt CO_2-e) and Australia (537,446 kt CO_2-e) (AGEIS 2021). Annual average GHG emissions Stage 1 and Stage 2 during construction represent approximately 0.001% of total GHG emissions for NSW and 0.0002% of total GHG emissions for Australia, based on the National Greenhouse Gas Inventory for 2018. Annual average GHG emissions for Stage 1 operations represents approximately 0.02% of total GHG emissions for NSW and 0.006% of total GHG emissions and annual average GHG emissions for Stage 2 operations represents approximately 0.05% of total GHG emissions for NSW and 0.01% of total GHG emissions for Australia.

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1 Introduction

1.1 Background

East Australian Pipeline Pty Ltd, part of the APA Group (APA) currently operates an underground high pressure natural gas transmission pipeline, extending from Moomba (South Australia) to Wilton (New South Wales), a distance of approximately 1,299 kilometres (km). The Moomba to Wilton Pipeline (MWP) is the mainline part of the Moomba Sydney Pipeline (MSP) and was constructed in 1976.

Initially, the pipeline was owned and operated by the Pipeline Authority, a Commonwealth agency, and generally regulated under the *Pipeline Authority Act 1973*. The MWP is now owned and operated by APA; it was gazetted as State Significant Infrastructure (SSI) on 11 December 2020 and is authorised by Pipeline Licence No. 16 (PL16).

The MWP currently operates at a forward haul capacity of approximately 489 terajoules per day (TJ/day) (AEMC 2021).

1.2 Project overview and context

NSW imports the majority of its natural gas from other states, and a gas shortfall on Australia's east coast is predicted by Winter 2023, with demand for gas forecast to outstrip supply.

APA is proposing an expansion of gas transportation capacity on its East Coast Grid that links Queensland to southern markets ahead of projected potential 2023 supply risks. Expansion would be through the construction of additional compressions stations and associated works on both the South West Queensland Pipeline (SWQP) and MWP in NSW.

The expansion will be delivered in a number of stages. The first stage of expansion works includes the construction of a single site of compression on each of the SWQP and MWP and will increase Wallumbilla to Wilton capacity by 12%. The first stage is targeted for commissioning in the first quarter of 2023 ahead of forecast southern state winter supply risks identified in the 2021 Australian Energy Market Operator (AEMO) Gas Statement of Opportunities (AEMO 2021).

The second stage of expansion works (an additional site on the SWQP and on the MWP) will add a further 13% capacity and will be staged to meet customer demand.

APA is undertaking engineering and design works on a potential third stage (three additional compressor locations on the MWP) of the East Coast Grid to add a further 25% transportation capacity. All up, these proposed capacity expansions would mean that the entirety of NSW peak demand could be met by gas flowing from northern sources.

The proposed East Coast Grid Expansion (the project) presents an optimal opportunity to maximise gas supply via existing infrastructure with minimal impact.

The five compressor stations for the East Coast Grid Expansion will be constructed at the following locations on the MWP:

- Modification 1:
  - Stage 1:
    - MW880 – Milne approximately 35 km south-west of Condobolin.
  - Stage 2:
    - MW433 – Round Hill approximately 103 km north of Wilcannia.
- Modification 2:
  - Stage 3:
    - MW162 – Binerah Downs approximately 68 km north-west of Tibooburra.
    - MW300 – Mecoola Creek approximately 70 km south-east of Tibooburra.
    - MW733 – Gilgunnia approximately 63 km south-west of Nymagee.

This report has been prepared to address the air quality impacts for Stage 1 and 2 of the expansion works and to support Modification Report 1. As such, only the air quality impacts at MW433 and MW880 have been assessed in this report. A separate report will be prepared to support Stage 3 in Modification Report 2.

1.3 Report purpose and method

EMM Consulting Pty Limited (EMM) has been commissioned to prepare an air quality and greenhouse gas assessment (AQGHGA) for the construction and operation of the project. This assessment has been prepared in general accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (NSW EPA 2017), and includes the following:

- description of the existing air quality and meteorological environment;
- identification of potential emissions to air during construction and operation of the project;
- assessment of potential impacts arising from emissions to air during construction and operation of the project;
- estimation of greenhouse gas (GHG) emissions and benchmarks against GHG accounts for NSW and Australia; and
- appropriate mitigation measures to reduce the impacts from the project.

1.4 Study area and scope

The assessment presents a qualitative risk-based assessment of potential air quality impacts for construction and a quantitative assessment of potential air quality impacts for operations. The assessment approach is applicable to each compressor station.

The compressor stations are located in remote and sparsely populated rural areas. The proposed Stage 1 site at Milne (MW880) has two receptor locations (ie occupied residences) within 2.5 km. The proposed Stage 2 site at Round Hill (MW433) has no receptor locations within approximately 4.5 km.

For the construction phase assessment, the construction methodology, scale of impacts and standard dust mitigation measures is consistent across both compressor station sites, and therefore the risk-based assessment of potential air quality impacts is applicable to each site. Due to the proximity of receptor locations, any proposed construction dust mitigation measures are most relevant to Milne (MW880).

For the operational phase, the assessment focuses on the Milne (MW880) site and a quantitative assessment of potential air quality impacts is presented. Assuming compliance is demonstrated for the Milne (MW880) site, compliance can also be assumed for the Round Hill (MW433) site. Although local dispersion conditions would differ, any uncertainty or variation in dispersion conditions across the sites is offset by a separation distance to occupied residences that is double that of the Milne (MW880) site.

2 Project and site description

2.1 Compressor station details

The East Coast Grid Expansion in NSW will be facilitated by the construction of five compressor stations along the length of the MWP. This modification report addresses the construction and operation of two compressor stations: Stage 1 (MW880) and Stage 2 (MW433).

Each compressor station will include:

- an enclosed gas turbine driven compressor unit;
- microturbine;
- compressor inlet / scrubber;
- a control equipment building;
- two fuel gas skids;
- air compressors and receivers;
- associated piping, electrical equipment, instrumentation, and controls;
- a station vent; and
- small accommodation and maintenance buildings for operations.

All facilities will be installed on driven piles or supported on structural steel skids over gravel sheeting, with the exception of the accommodation and maintenance buildings which will be constructed on concrete slab.

Both of the proposed sites for the compressor stations are on land owned by APA, with MW433 being approximately 380 m x 400 m with an area of 15.5 hectares (ha), and MW880 being approximately 400 m x 400 m with an area of 16 ha. The compressor station will have a final footprint of approximately 1.5 ha.

2.1.1 Construction

Each compressor station will require a construction footprint of approximately 3.5 ha, which will be reduced to approximately 1.5 ha for operations.

At MW433, the temporary construction workforce required to build the compressor station will be accommodated in a temporary accommodation camp, with mobilisation and demobilisation of the workforce to and from Broken Hill airport for each roster. The temporary accommodation camp will measure approximately 100 m x 100 m, with an additional 100 m x 100 m for waste water treatment. A smaller accommodation unit for operations will be included within the operational footprint on the compressor station.

At MW880, there are two options for the accommodation of the construction workforce. The preferred option is to house the workforce in short-term accommodation in Condobolin (42 km by road from the site), with potential overflow accommodation in West Wyalong (85 km by road from the site), if required. Workers will be driven to and from site each day, with between one and four buses and between five and eight cars required per day, depending on workforce numbers. The alternative option is to use a temporary accommodation camp on site (as per MW433), where mobilisation and demobilisation of the workforce will be to and from Dubbo airport for each roster.

Waste water from the construction camp (if used) will be treated and disposed of via spray irrigation on site.

Construction materials and supplies (including food and services for the temporary accommodation camps) will be sourced from relevant suppliers and transported to site. APA will use local suppliers where practicable.

At MW880, water will likely be purchased under a commercial arrangement from Lachlan Shire Council, or another local provider and transported to site by 25 kilolitre (kL) water truck. At MW433, there are two options for water supply – accessing groundwater on site, and/or purchasing water under a commercial arrangement from a local water provider and transporting it to site by 25 kL water truck. APA is investigating options to access groundwater under the relevant water sharing plans and regulations. If accessing groundwater at MW433 is feasible, then all regulatory requirements for water licences will be met, and any further assessments and approvals will be undertaken and applied for prior to water abstraction. If accessing groundwater is not feasible for all or part of the project, then the commercial purchase and transport will become the default water supply option.

The majority of construction activities will take place between 7:00 am and 6:00 pm, seven days per week. During the commissioning phase, activities will also take place between 7:00 am and 6:00 pm, seven days per week, however for the final two weeks, commissioning activities will be 24-hours per day.

i Construction activities

Construction of the compressor stations will include the following activities:

- mobilisation of construction equipment;
- establishment of access (where required);
- establishment of construction camp accommodation and associated facilities;
- establishment of access to water supply;
- site bulk earthworks including build up to match existing levels;
- installation of steel piles;
- installation of all equipment items, skids and buildings;
- installation of associated steel structures, prefabricated piping, electrical equipment, instrumentation and controls;
- supply and install communication and controls infrastructure;
- demobilisation of construction equipment;
- rehabilitation of temporary disturbance areas; and
- pre-commissioning and commissioning of compressor station.

ii Workforce

The construction of the compressor stations will require an average workforce of 40 with a peak of 80 personnel over the 12-month period. All roles are likely to be drive-in-drive-out (DIDO) or fly-in-fly-out (FIFO) and based at the construction camp when on site. The anticipated roster is three weeks on followed by one week off.

There are expected to be five contracts put out to tender for the construction and commissioning of the compressor stations:

- earthworks and civil works;
- establishment of the construction camp and associated waste water treatment system;
- piling;
- structural, mechanical, piping, electrical and instrumentation construction (SMPEI); and
- compressor station pre-commissioning and commissioning.

In addition to the contractor workforce, APA will have a project team on site to manage the works.

The anticipated workforce associated with each contract is outlined in Table 2.1 below.

Table 2.1 Construction and commissioning workforce

Entity	Average workforce	Peak workforce
APA Project Team	4	10
Earthworks	10	15
Piling	6	6
SMPEI Construction	30	50
Construction Camp	8	16
Pre-commissioning and Commissioning	10	14

The anticipated workforce distribution over the 12-month construction and commissioning program is presented in Table 2.2.

Table 2.2 Monthly construction and commissioning workforce distribution

1	2	3	4	5	6	7	8	9	10	11	12
20	28	28	37	47	65	68	59	49	39	18	18

2.1.2 Operation

i Activities

The compressor stations are designed to operate remotely without onsite staff for most of their working life. They will be operated remotely from APA's control centre in Brisbane, and can operate up to 24 hours per day, seven days per week.

Typical operations activities will involve minor maintenance, calibrations, inspections, equipment performance checks, or equipment repair if needed. Operation activities will be typically carried out during daylight hours, unless an emergency requires urgent works at night. Site personnel will carry out inspections ranging from daily inspections to more rigorous inspections that may vary from one month to 4 years apart, dependent on the works. Detailed maintenance plans will be prepared for all sites.

Regulatory compliance checks will be carried out on different equipment as prescribed in applicable standards but will typically vary from one to four-year intervals subject to the equipment types. Compliance checks may include emissions testing, hazardous area compliance assessments, pressure vessel inspections, and electrical safety checks.

Major services and engine overhauls will be carried out at five-to-ten-year intervals subject to equipment condition, manufacturer's recommendations and run hours.

Once complete, the compressor stations will have an average design life of approximately 25 years. APA will continue to monitor the condition of equipment up to and beyond the end of life to ensure equipment is sound and fit for further service. Continued operation beyond the nominal design life will be subject to specific equipment condition and plant fitness assessments. The compressor station will be decommissioned when there is no further economic potential to continued use.

ii Workforce

The compressor stations are designed to operate as unmanned facilities. The typical site workforce for operation activities is expected to be one to two people.

Larger groups of up to five people associated with major services or overhauls will be required to minimise the time the compressor station is offline.

The operations workforce will comprise existing APA employees, who are unlikely to be resident locally. Additional specialist servicing will be carried out by a mix of local contractors and interstate/international based depending on the complexity of the task.

2.2 Site and surrounding area

The proposed compressor station at Round Hill (MW433) is located in a remote rural location with few distinguishing topographical or land use features and mostly void of continuous vegetation. There are no sensitive receptors within 5 km.

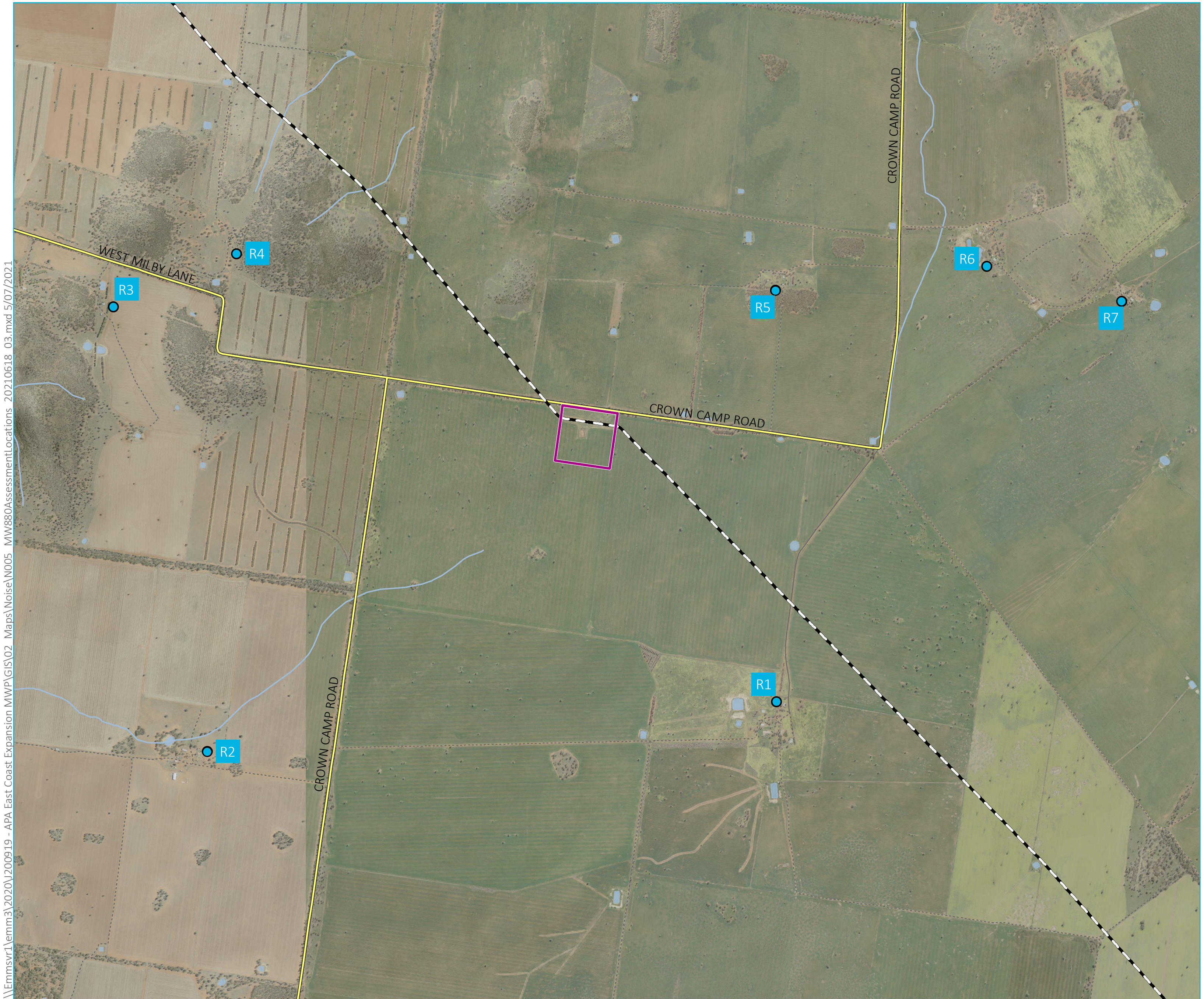
The Milne compressor station site (MW880) is also located in a remote rural location characterised by sparse pockets of vegetation. The terrain surrounding this site is flat with few distinguishing features. The closest residential properties are located approximately 1.7 km to the north-east and 2.5 km to the south-east.

As discussed previously, the assessment focuses on the Milne (MW880) site and a quantitative assessment of potential air quality impacts is presented. Assuming compliance is demonstrated for the Milne (MW880) site, compliance can also be assumed for the Round Hill (MW433) site.

The nearest representative sensitive receptors to the Milne site have been identified (referred to in this report as assessment locations). Details are provided in Table 2.3 and their locations are shown in Figure 2.1.

Table 2.3 Air quality assessment locations

Station	Assessment location ID	Lot/address	Coordinates (MGA)			Distance and direction from site
			Zone	Easting (m)	Northing (m)	
MW880	MW880-R1	3208 Crown Camp Road	55	504346	6303586	~2.5 km south-east
	MW880-R2	2557 Crown Camp Road	55	500259	6303227	~3.5 km south-west
	MW880-R3	1276 West Milby Lane	55	499585	6306422	~3.5 km west
	MW880-R4	1515 Clarries Lane	55	500470	6306804	~2.7 km west-northwest
	MW880-R5	3341 Crown Camp Road	55	504341	6306539	~1.7 km northeast
	MW880-R6	3368 Crown Camp Road	55	505859	6306714	~3 km northeast
	MW880-R7	7241 The Gipps Way	55	506825	6306464	~4 km northeast



KEY
- Compressor site
- Sensitive receiver location
- Moomba to Wilton pipeline
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Waterbody

INSET KEY
- NPWS reserve
- State forest

Source: EMM (2021); DFSI (2017); GA (2011); ASGC (2006); LPI (2021)

Assessment locations surrounding the Milne site

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Air quality impact assessment
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Figure 2.1

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3 Pollutants and assessment criteria

3.1 Introduction

The key emissions sources and pollutants applicable to the construction of the project include:

- fugitive dust from clearing, excavation, material handling, movement of plant and equipment, and wind erosion of exposed surfaces, comprising:
  - total suspended particulate matter (TSP);
  - particulate matter less than 10 micrometres (µm) in aerodynamic diameter (PM_{10}); and
  - particulate matter less than 2.5 µm in aerodynamic diameter ($PM_{2.5}$);
- diesel exhaust emissions from construction equipment, comprising:
  - $PM_{2.5}$;
  - oxides of nitrogen (NO_x)[1], including nitrogen dioxide (NO_2);
  - sulphur dioxide (SO_2);
  - carbon monoxide (CO); and
  - volatile organic compounds (VOCs).

For the operational phase, the key pollutants associated with the combustion of natural gas are oxides of nitrogen (NO_x), carbon monoxide (CO), sulphur dioxide (SO_2) and volatile organic compounds (VOCs). Operational emissions would be emitted from the ventilation stacks associated with each compressor.

3.2 Applicable air quality assessment criteria

The NSW EPA's impact assessment criteria, as documented in Section 7 of the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (NSW EPA 2017), are presented in Table 3.1 (common or 'criteria' air pollutants) and Table 3.2 (principal and individual toxic air pollutants).

For the pollutants listed in Table 3.1, the assessment criteria are applied at the nearest existing or likely future sensitive receptor[2]. Typically, the following must be reported the pollutants in Table 3.1:

- the incremental impact (ie the predicted impact due to the project alone); and
- the total impact (ie the incremental impact plus the existing background concentration). Guidance on the selection of background concentrations is provided in NSW EPA (2017).

1 By convention, NO_x = Nitrous oxide (NO) + NO_2.

2 NSW EPA (2016) defines a sensitive receptor as a location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area.

TSP, which relates to airborne particles less than around 50 micrometres (µm) in diameter, is used as a metric for assessing amenity impacts (reduction in visibility, dust deposition and soiling of buildings and surfaces) rather than health impacts (NSW EPA 2013). Dust deposition impacts are derived from TSP emission rates and particle deposition calculations in the dispersion modelling process.

Particles less than 10 µm in diameter, accounted for in this assessment by PM_{10} and $PM_{2.5}$, are a subset of TSP and are fine enough to enter the human respiratory system and can therefore lead to adverse human health impacts. The NSW EPA impact assessment criteria for PM_{10} and $PM_{2.5}$ are therefore used to assess the potential impacts of airborne particulate matter on human health.

Table 3.1 Impact assessment criteria – common pollutants

Pollutant	Averaging period	Impact assessment criteria
TSP	Annual	90 µg/m³
PM_{10}	24-hour	50 µg/m³
	Annual	25 µg/m³
$PM_{2.5}$	24-hour	25 µg/m³
	Annual	8 µg/m³
Dust deposition	Annual	2 g/m²/month (project increment only)
		4 g/m²/month (cumulative)
NO_2	1-hour	246 µg/m³
	Annual	62 µg/m³
CO	15-minute	100 mg/m³
	1-hour	30 mg/m³
	8-hour	10 mg/m³
SO_2	10-minute	712 µg/m³
	1-hour	570 µg/m³
	24-hour	228 µg/m³
	Annual	60 µg/m³

Notes: µg/m³: micrograms per cubic metre

In the case of the short-term criteria (1-hour NO_2, 24-hour PM_{10} and 24-hour $PM_{2.5}$), the total prediction must be reported as the 100th percentile (ie the highest) value. At some locations, the background concentrations can exceed the impact assessment criteria. This is most commonly the case for PM_{10} and $PM_{2.5}$, which are affected by events such as bushfires and dust storms. In such circumstances, there is a requirement demonstrate that no additional exceedances of the impact assessment criteria will occur as a result of the proposed activity and that best management practices will be implemented to minimise emissions of air pollutants as far as is practical.

There are no impact assessment criteria for total VOCs, however impact assessment criteria are prescribed for various individual toxic and odorous VOCs, and some of the more commonly assessed substances are presented in Table 3.2. Impact assessment criteria for VOCs are applied at and beyond the boundary of the emitting source, with the incremental impact (ie predicted impacts due to the pollutant source alone) reported as the 99.9th percentile concentration for an averaging period of 1 hour.

Table 3.2 Impact assessment criteria – VOCs

Pollutant	Averaging period	Impact assessment criteria
Individual VOCs		
Benzene	1-hour (99.9th percentile)	29 µg/m^3
Formaldehyde	1-hour (99.9th percentile)	20 µg/m^3
Toluene	1-hour (99.9th percentile)	360 µg/m^3
Xylene	1-hour (99.9th percentile)	190 µg/m^3

3.3 Screening criteria and assessment of risk

Typically, air quality impacts assessments will assess compliance against the impact assessment criteria presented in Table 3.1 and Table 3.2, with the assessment of risk based on whether compliance with these impact assessment criteria is achieved or not. For this study, a qualitative assessment of risk was also made, based on criteria used in other jurisdictions for screening out insignificant impacts.

The NSW EPA do not prescribe criteria for screening out insignificant impacts, however in Western Australia, the WA Department of Water and Environmental Regulation (DWER) has developed draft guidelines for air emissions, outlining the use of screening concentrations (SC) to screen out emission sources as insignificant (DWER 2019). The SC are expressed as a percentage of their air quality guidelines values (AGVs). For annual averages, the SC are <1% of the AGV, for 24-hour averages, the SC are <3% of the AGV and for 1-hour averages, the SC are <10% of the AGV.

The WA screening concentrations are consistent with those referenced in the UK for permitting, where the Environment Agency allows for screening out insignificant impacts if the contribution from a source is less than 1% of the annual standard and less than 10% of the short-term standard (Environment Agency 2011).

4 Existing environment

4.1 Meteorology and climate

Meteorological mechanisms govern the generation, dispersion, transformation and eventual removal of pollutants from the atmosphere. To adequately characterise the dispersion meteorology of a region, information is needed on the prevailing wind regime, ambient temperature, rainfall, relative humidity, mixing depth and atmospheric stability.

Analysis of meteorology for the study area is based on automatic weather stations (AWS) operated by the Bureau of Meteorology (BoM) summarised in Table 4.1.

Table 4.1 Regional meteorological monitoring sites

Site	Location relative to the project sites
Condobolin Airport AWS	~40 km north east of Milne (MW880)
White Cliffs AWS	~50 km south west of Round Hill (MW433)

4.1.1 Regional winds

Annual wind roses for 2018 for the regional monitoring sites are presented in Figure 4.1. Regional variation in wind direction is evident while mean wind speeds range from 3.6 metres per second (m/s) to 4.9 m/s. Mean wind speeds are noticeably higher and the frequency of calm winds (wind speeds less than 0.5 m/s) noticeably lower at the White Cliffs site.

4.1.2 Rainfall

Precipitation is important to air pollution, as it impacts on dust generation potential and represents a removal mechanism for atmospheric pollutants. Fugitive emissions may be harder to control during low rainfall years while drier periods may also result in more frequent dust storms and bushfire activity, resulting in higher regional background. Rainfall also acts as a removal mechanism, lowering pollutant concentrations by removing them more efficiently than during dry periods.

Monthly rainfall data were obtained from the regional monitoring sites in Table 4.1 and the monthly variation in rainfall is illustrated in Figure 4.2. As expected, monthly mean rainfall decreases with increasing distance inland. Rainfall for the Condobolin area is moderate to low, with mean annual rainfall of 437 millimetres (mm), decreasing to 255 mm for White Cliffs.

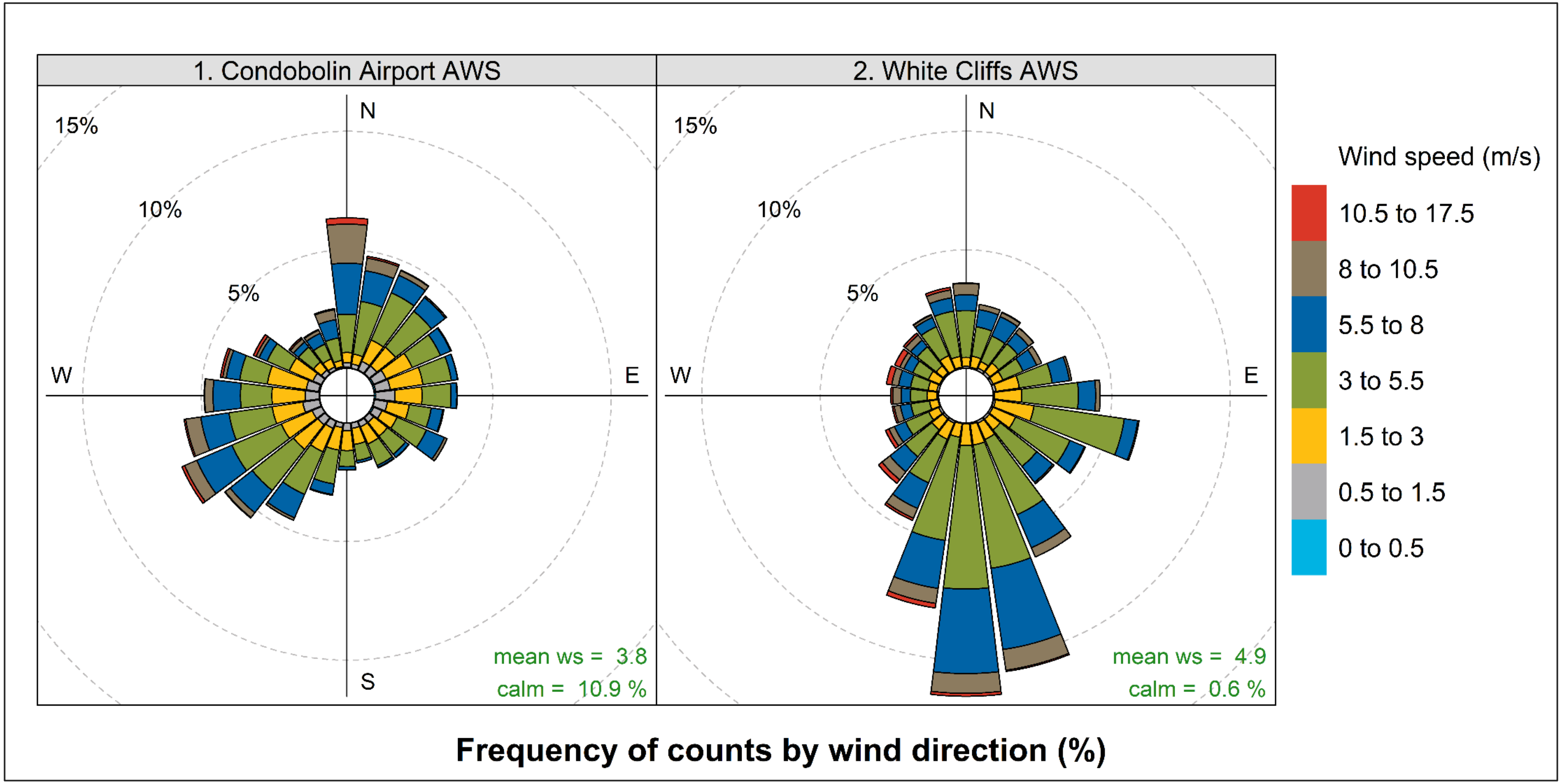

Figure 4.1 **Wind roses for the regional monitoring sites (BoM)**

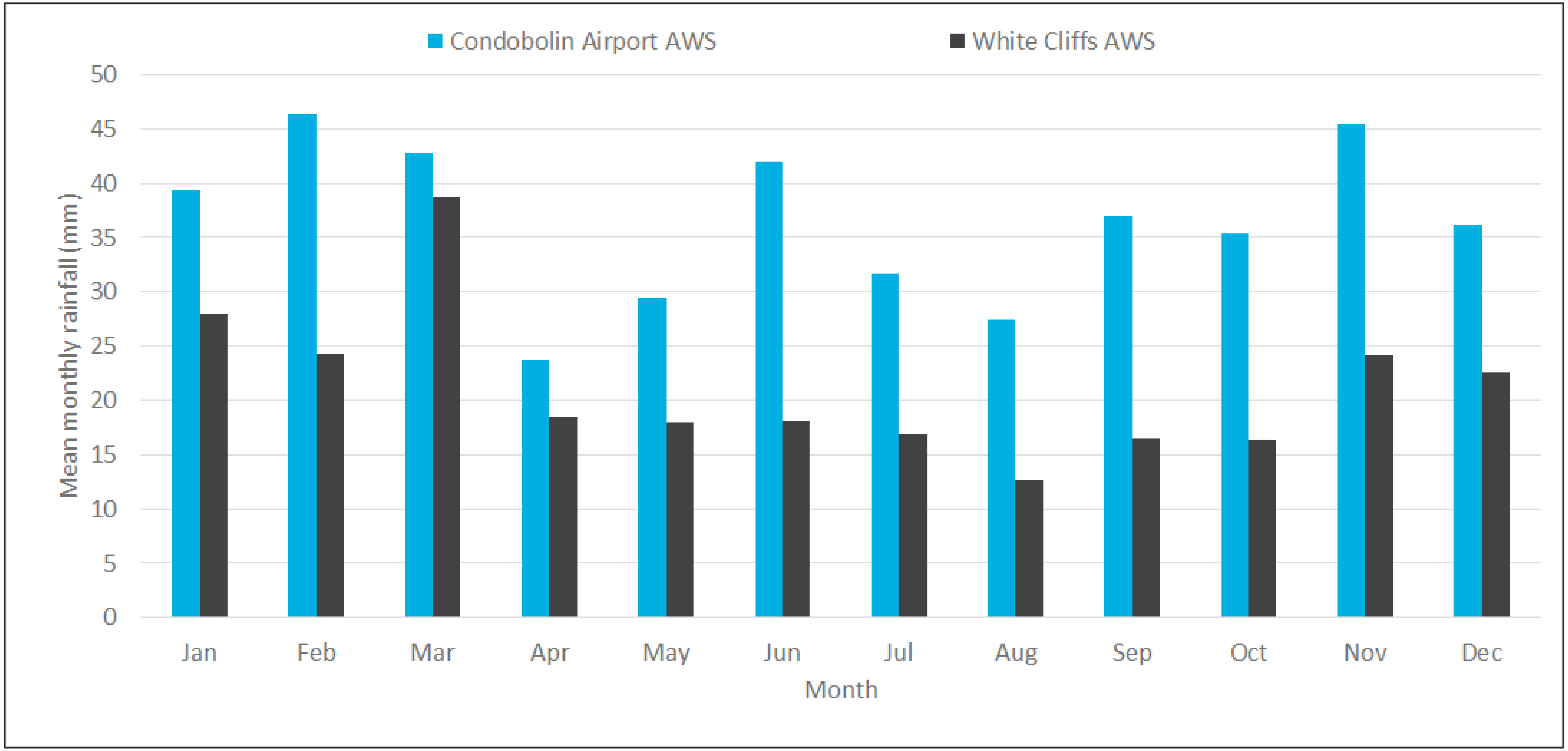

Figure 4.2 **Monthly mean rainfall for the regional monitoring sites**

4.2 Meteorological modelling

Atmospheric dispersion modelling for this assessment uses the AMS[3]/USEPA[4] regulatory model (AERMOD) (model version v19191). In the absence of local meteorological data for the MW880 (Milne) site, the meteorological inputs for AERMOD were generated using the AERMET meteorological processor based on data generated by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) TAPM meteorological modelling module. Meteorological data from the Condobolin Airport AWS was used as observations for the TAPM run.

Meteorological parameters were extracted from TAPM at the MW880 (Milne) site and used within the AERMET pre-processor in the 'onsite' pathway. Parameters extracted from TAPM included wind speed and direction, temperature, relative humidity, solar radiation, and mixing height. The difference in temperature between two heights (50−10 m) was extracted from the TAPM profile files and upper air data was read directly from the surface file. Atmospheric pressure was taken from Condobolin Airport and cloud data was taken from Cobar Airport AWS.

4.2.1 Selection of a representative dataset for modelling

Eight years of hourly data from Condobolin Airport were reviewed and annual wind roses for the period 2012 to 2019 are presented in Figure 4.3. The analysis shows consistency in wind direction, average wind speed and percentage occurrence of calm winds (less than or equal to 0.5 m/s). The high degree of consistency in winds across all years indicates that any calendar year would be suitable for modelling. The inter-annual variation in temperature is presented Figure 4.4. The box and whisker plots show monthly median temperature and the monthly quantile ranges (5/95 and 25/75). The plots demonstrate that temperatures measured across each year are consistent and therefore representative when compared with this recent period of measurements.

The calendar year 2018 was selected for modelling.

3 AMS - American Meteorological Society

4 USEPA - United States Environmental Protection Agency

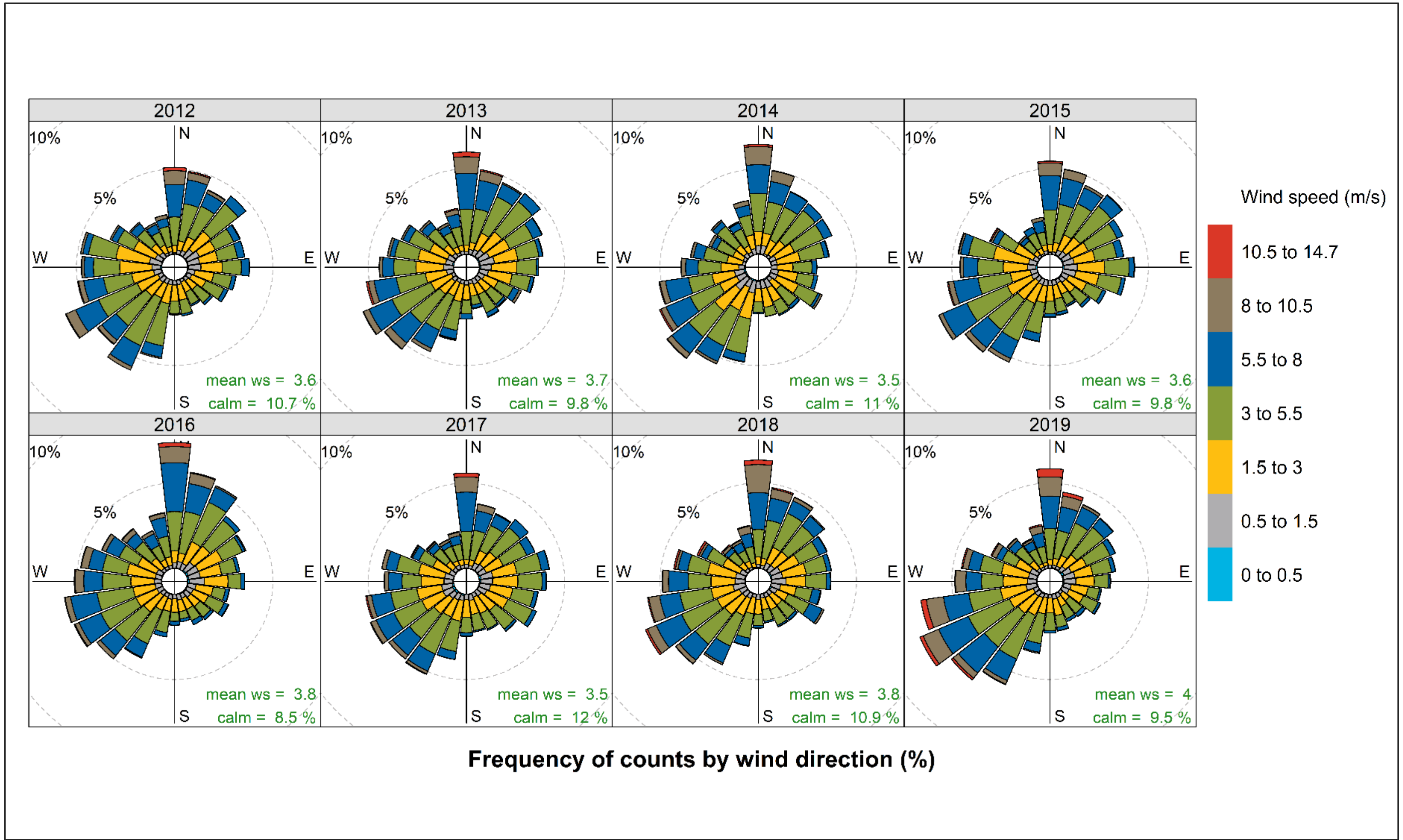

Figure 4.3 Annual wind roses for Condobolin Airport (BOM)

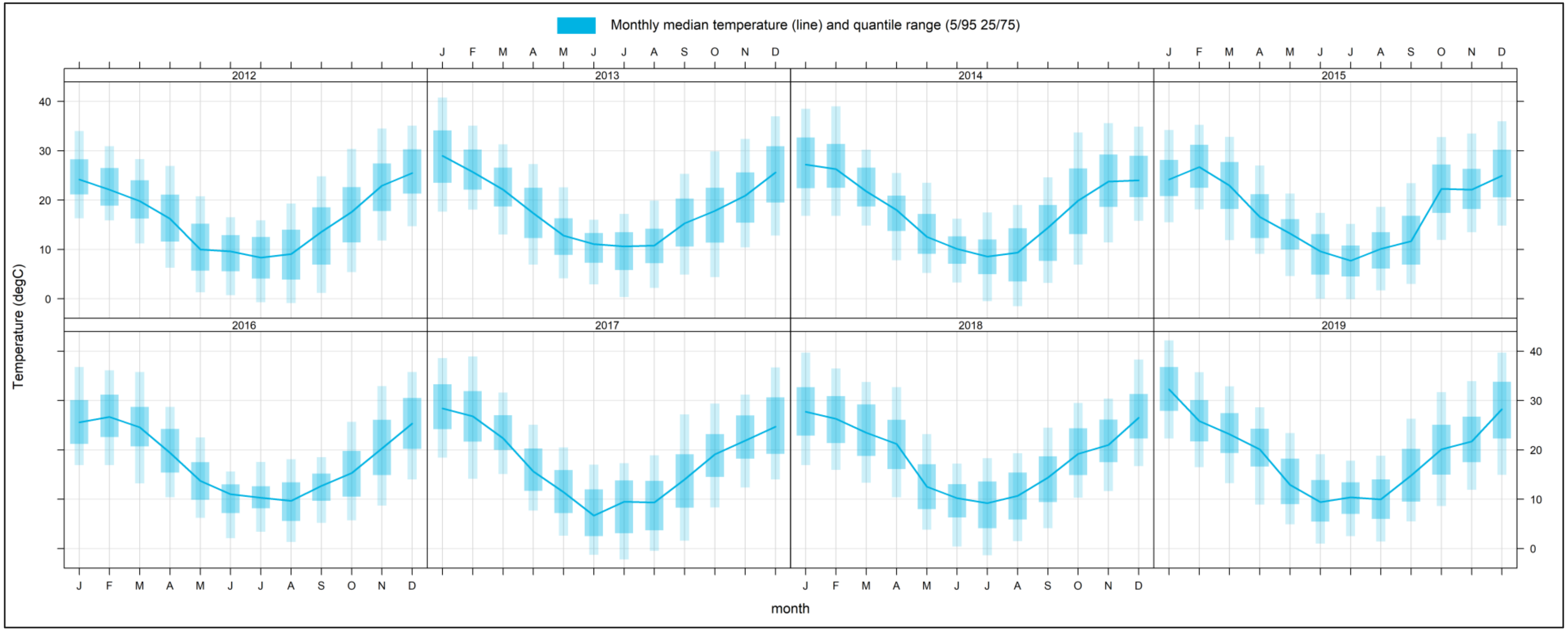

Figure 4.4 **Interannual variation in temperature for Condobolin Airport**

4.2.2 TAPM predicted winds for the Milne site

An annual wind rose created from wind speed and direction data extracted from TAPM at the Milne site is shown in Figure 4.5 and compared with the closest observations at Condobolin Airport. The wind rose for Milne shows that winds are recorded from all directions with a dominantly south-southwest flow. Annual average wind speeds (2.9 m/s) and frequency of calm conditions (0.8%) are lower than the observations at Condobolin Airport.

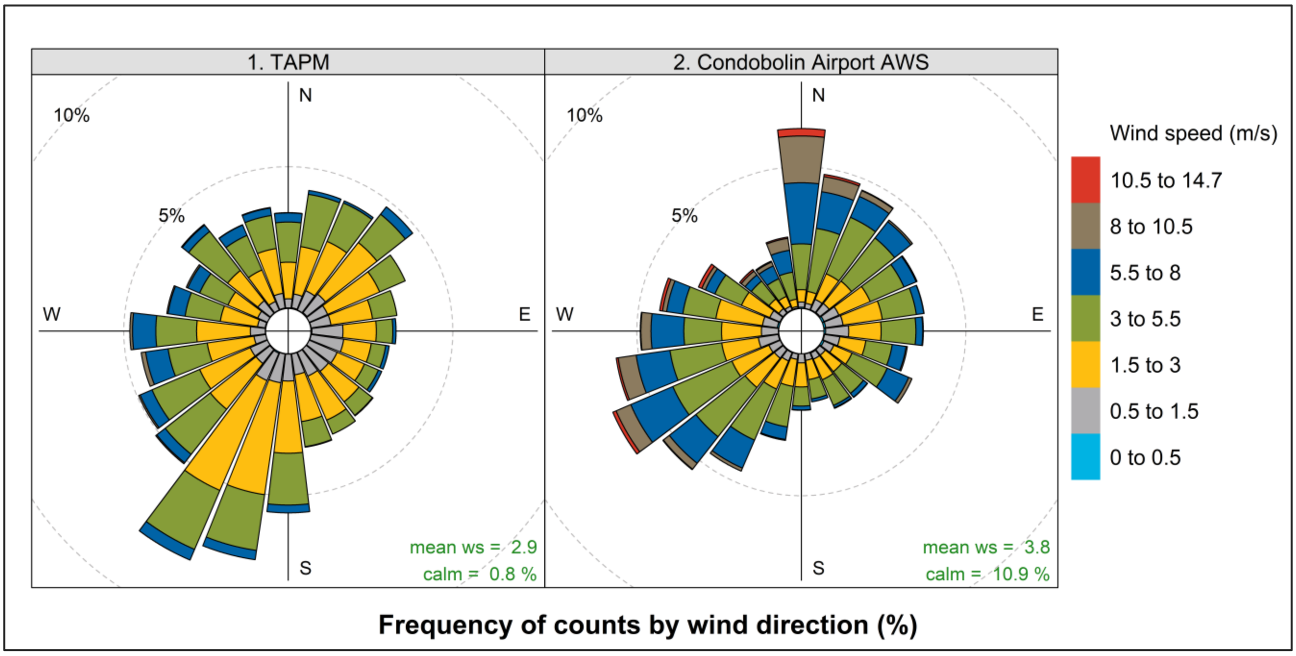

Figure 4.5 TAPM wind rose for the Milne site (BOM)

4.2.3 Atmospheric stability and mixing depth

Atmospheric stability refers to the degree of turbulence or mixing that occurs within the atmosphere and is a controlling factor in the rate of atmospheric dispersion of pollutants.

The Monin-Obukhov length (L) provides a measure of the stability of the surface layer (ie the layer above the ground in which vertical variation of heat and momentum flux is negligible; typically, about 10% of the mixing height). Negative L values correspond to unstable atmospheric conditions, while positive L values correspond to stable atmospheric conditions. Very large positive or negative L values correspond to neutral atmospheric conditions.

Figure 4.6 illustrates the diurnal variation of atmospheric stability, derived from the Monin-Obukhov length calculated by AERMET. The diurnal profile shows that atmospheric instability increases during the daylight hours as the sun generated convective energy increases, whereas stable atmospheric conditions prevail during the night-time. This profile indicates that the potential for effective atmospheric dispersion of emissions would be greatest during daytime hours and lowest during evening through to early morning hours.

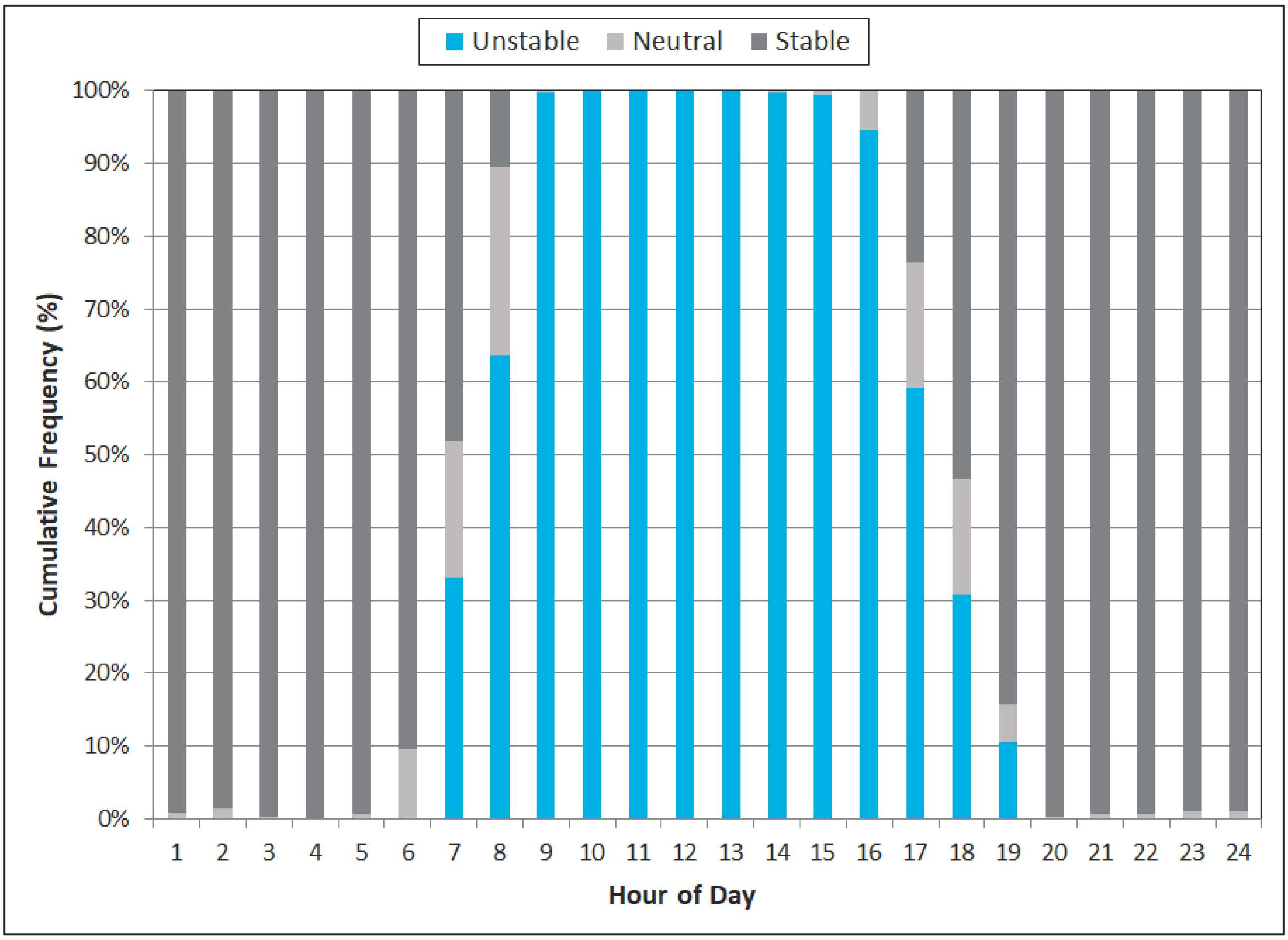

Figure 4.6 CALMET-calculated diurnal variation in atmospheric stability

Mixing depth refers to the height of the atmosphere above ground level within which air pollution can be dispersed. The mixing depth of the atmosphere is influenced by mechanical (associated with wind speed) and thermal (associated with solar radiation) turbulence. Similar to the Monin-Obukhov length analysis above, higher daytime wind speeds and the onset of incoming solar radiation increases the amount of mechanical and convective turbulence in the atmosphere. As turbulence increases, so too does the depth of the boundary layer, generally contributing to higher mixing depths and greater potential for the atmospheric dispersion of pollutants.

Figure 4.7 presents the hourly-varying atmospheric boundary layer depths generated by AERMET. Greater boundary layer depths occur during the daytime hours, peaking in the mid to late afternoon.

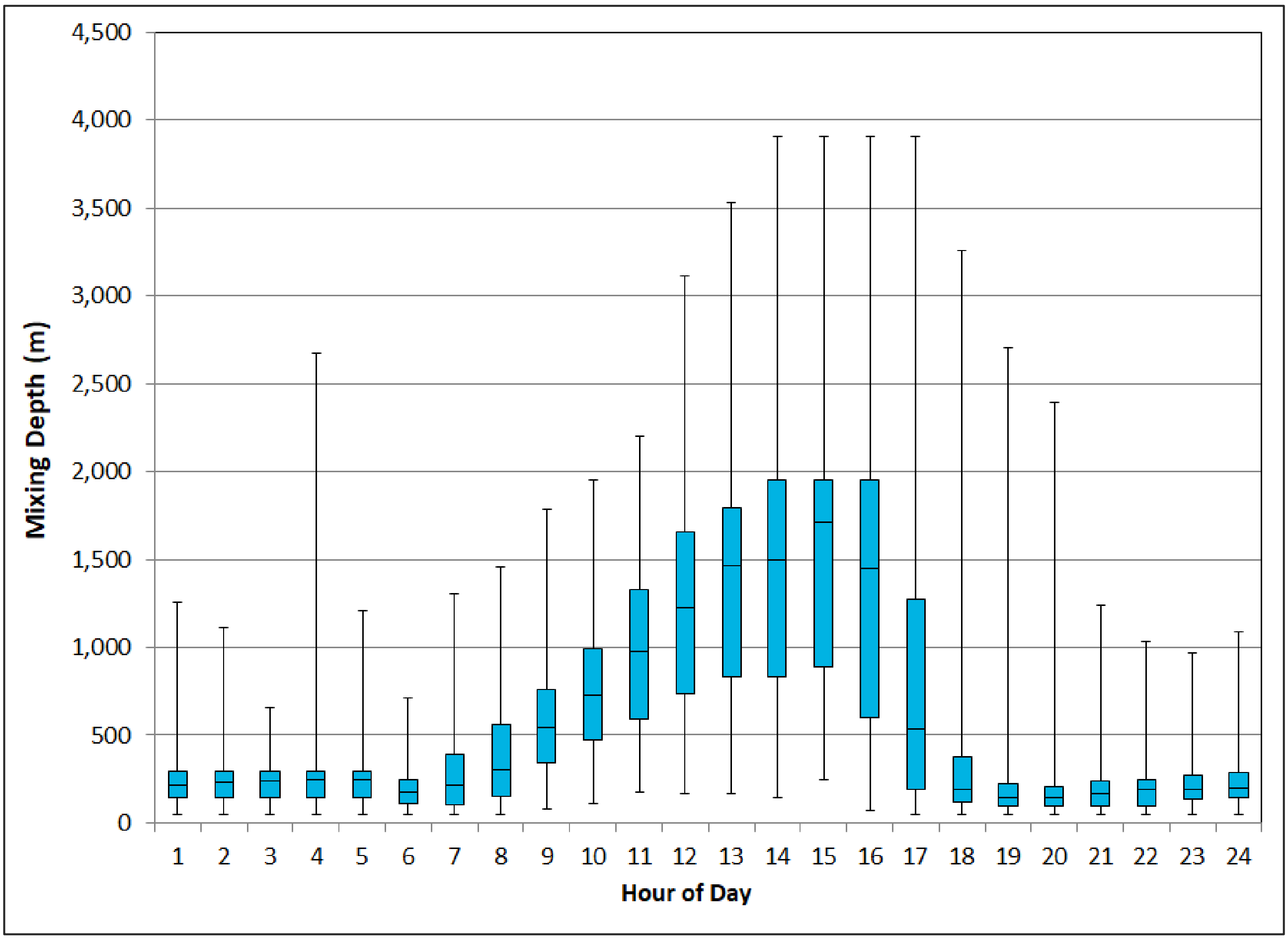

Figure 4.7 CALMET-calculated diurnal variation in atmospheric mixing depth

4.3 Baseline air quality

To demonstrate compliance with impact assessment criteria, consideration of cumulative impact is required to assess how a project will interact with existing and future sources of emissions. There are no proposed or existing major projects in the vicinity of the proposed sites that would result in cumulative impacts during the construction or operation of the project. Similarly, there are no commercial or industrial facilities in the vicinity of the proposed sites that either report to the National Pollutant Inventory (NPI) or hold an environment protection licence (EPL) issued by the NSW EPA. Assessment of cumulative impacts therefore focuses on the existing baseline or background air quality.

The air quality environment for the proposed sites is expected to be primarily influenced by fugitive dust during dry conditions, from agricultural activity and continental scale wind erosion from exposed ground, and to a lesser extent, local traffic travelling along sealed and unsealed roads, seasonal emissions from wood heaters or burning and episodic emissions from bushfires.

The closest NSW Department of Planning, Industry and Environment (DPIE) air quality monitoring station (AQMS) is located at Orange, approximately 200 km east of the Milne (MW880) site, and is unlikely to be representative of the existing background concentration in the vicinity of the Milne site. There are no other DPIE AQMS located in far-west NSW that can be used to describe and characterise ambient air quality.

However, the Community DustWatch network, also operated by DPIE, measures dust (as PM_{10}) via a network of instruments at DustWatch Nodes (generally using TSI DustTraks). The data are not used to report on air quality and health-related issues, rather, measurements are used as an indicator for land management (ie adequacy of ground cover in delivering healthy soils, clean air, functioning ecosystems and agricultural production). The Community DustWatch network includes 'nodes' at Condobolin and White Cliffs, recording hours of dust activity, defined as PM_{10} concentrations >25 µg/m³.

During 2018 at Condobolin there were 61 hours of the year where the reported PM_{10} concentrations were greater than 25 µg/m³, increasing to 107 hours White Cliffs (this increase is to be expected, as dryer conditions increase with distance inland). While these data cannot be used to derive a baseline for air quality assessment, they are useful to provide some context to the existing air quality environment for the risk-based assessment of construction phase impacts.

For the key pollutants associated with the operational phase (NO_x, CO, VOCs) there are no significant local sources that would contribute to background air quality, other than minor contributions from traffic and agricultural plant and equipment. On this basis, the ambient background for these pollutants can be assumed to be very low or negligible.

5 Construction phase impact assessment

5.1 Introduction

Construction works at the compressor stations will include:

- establishment of access (where required);
- establishment of construction camp accommodation and associated facilities;
- access to water supply;
- site bulk earthworks including build up to match existing levels;
- supply and install of Civil, Structural, Mechanical, Electrical and Instrumentation packages;
- the installation of new compressor station ventilation outlets;
- supply and install fuel gas conditioning skid including immersion heater, filter, meter and regulators; and
- supply and install communication and controls infrastructure.

The main air pollution and amenity issues[5] at construction sites are:

- annoyance due to dust deposition (soiling of surfaces) and visible dust plumes;
- elevated particulate matter less than 10 µm in aerodynamic diameter (PM_{10}) concentrations due to dust-generating activities; and
- particulate matter exhaust emissions from diesel-powered construction equipment[6].

Very high levels of dust deposition can also damage plants and affect the diversity of ecosystems.

Dust emissions can occur during the preparation of the land (eg demolition and earthmoving) and during construction itself. They can vary substantially from day to day depending on the level of activity, the specific operations being undertaken, and the weather conditions. The risk of dust impacts from a construction site is related to the following:

- the nature of the activities being undertaken;
- the duration of the activities;
- the size of the site;
- the meteorological conditions (wind speed, direction and rainfall), as adverse impacts are more likely to occur downwind of the site and during drier periods;

5 There are other potential impacts, such as the release of heavy metals, asbestos fibres or other pollutants during the demolition of certain buildings. These issues need to be considered on a site by site basis (IAQM 2014).

6 Exhaust emissions from on-site plant and site traffic are unlikely to have a significant impact on local air quality, and in the majority of cases they will not need to be quantitatively assessed (IAQM 2014).

- the proximity of receptors to the activities;
- the sensitivity of the receptors to dust; and
- the adequacy of the mitigation measures applied to reduce or eliminate dust generation.

5.2 Construction assessment

The proposed compressor station sites were considered in an assessment of potential construction dust impacts. The assessment follows the *Guidance on the Assessment of Dust from Demolition and Construction* published by the Institute of Air Quality Management in the United Kingdom (IAQM 2014). This guidance has been applied for construction projects in NSW and accepted by the NSW EPA as a progressive approach to assessing the particulate matter impact risk associated with short term construction and demolition projects.

The IAQM assessment procedure considers four main types of activities at construction sites: demolition, earthworks, construction and vehicle track-out. Impacts are considered based on annoyance due to dust soiling, the risk of health effects due to an increased exposure to PM_{10}, and harm to ecological receptors. The assessment is used to define appropriate mitigation measures to ensure that there will be no significant residual effects.

The key steps in the procedure are as follows:

- Step 1 – a screening requirement for a detailed assessment based on the proximity of surrounding receptors;
- Step 2 – an assessment of the risk of dust impacts and the sensitivity of surrounding receptors;
- Step 3 – a determination of site-specific mitigation;
- Step 4 – consideration of residual effects and significance; and
- Step 5 – an assessment report (this document).

Step 1 of the method specifies that a detailed construction dust assessment should be undertaken if:

- a human receptor[7] is located within 350 m of the site boundary;
- an ecological receptor[8] is located within 50 m of the site boundary; or
- a human/ecological receptor is within 50 m of a route used by construction vehicles up to 500 m from a site entrance.

There are no human receptors located within 350 m of any of the compressor station sites. There are also no sensitive ecological receptors within 50 m of the sites or human or ecological receptors within 50 m of construction routes. Therefore, the risk assessment does not proceed past Step 1 and the risk of adverse effects due to construction dust is considered negligible for all sites. Regardless of risk levels, it is good practice to ensure that mitigation measures are in place to minimise construction dust as far as possible (see Section 5.3).

7 A 'human receptor' refers to any location where a person or property may experience the adverse effects of airborne dust or dust soiling, or exposure to PM_{10} over a time period relevant to air quality standards and goals. In terms of annoyance effects, this will most commonly relate to dwellings, but may also refer to other premises such as museums, galleries, vehicle showrooms, food manufacturers, electronics manufacturers, amenity areas and horticultural operations.

8 An 'ecological receptor' refers to any sensitive habitat affected by dust soiling. This includes the direct impacts on vegetation or aquatic ecosystems of dust deposition, and the indirect impacts on fauna (eg on foraging habitats).

5.3 Mitigation measures

A construction environmental management plan (CEMP) will be prepared which will outline measures to manage dust and other emissions. These may include but are not limited to the measures listed in Table 5.1. Justification for the selection of mitigation measures is based on what would be considered good practice mitigation for construction projects.

Table 5.1 Mitigation measures – construction emissions

Impact	Mitigation measure	Responsibility	Timing
Reporting and record keeping	• Develop appropriate communications in the stakeholder engagement plan to notify the potentially impacted residences of the project (duration, types of works, etc), relevant contact details for environmental complaints reporting. • A complaints management system should be maintained throughout the construction phase which should include any complaints related to dust. Where a dust complaint is received, the details of the response actions to the complaint should be detailed in the register.	Contractor	Establish communications and complaints management system prior to the commencement of construction. Ongoing reporting and record keeping throughout the duration of construction activities.
Dust generation - general	• Provide an adequate water supply on the construction site for effective dust/particulate matter suppression/mitigation. • Avoid site runoff of water or mud.	Contractor	Throughout the duration of construction activities.
Materials handling	• Prevention of truck overloading to reduce spillage during loading/unloading and hauling.	Contractor	Throughout the duration of construction activities.
Soil stripping	• Soil stripping will be limited to areas required for extraction / construction of foundations, etc.	Contractor	Throughout the duration of construction activities.
Exposed areas	• Only the minimum area necessary will be disturbed. • Exposed areas will be stabilised as soon as practicable.	Contractor	Throughout the duration of construction activities.
Dust generation from vehicles moving on unpaved roads	• Watering of main haulage routes as required. • Routes to be clearly marked and speed limits enforced. • Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	Contractor	Throughout the duration of construction activities.
Vehicle fuel combustion emissions	• Ensure proper maintenance and tuning of all equipment engines. • Ensure vehicles switch off engines when not in use.	Contractor	Throughout the duration of construction activities.

5.4 Summary of commitments

The following commitments will minimise air quality impacts associated with the project:

Table 5.2 Summary of commitments – air quality

Stage	Commitment ID	Commitment
Construction	GE-01	The approved construction footprint, including vegetation clearing extent and environmental or heritage features within the construction footprint, will be clearly demarcated and identified during the construction stage with survey pegs and at some locations with flagging, bunting, barrier mesh or similar. No go zones will be clearly marked and communicated as such.
Construction	GE-03	Rehabilitation of disturbed areas will commence progressively as soon as practicable during and after construction, and will be carried out in accordance with the SWMP and Landcom (2004).
Construction Operation	GE-04	A complaints management system will be put in place that documents: • name of persons receiving complaint; • name of person making the complaint; • date and time of complaint; • nature of the complaint; • actions taken to rectify; • actions to minimise risk of reoccurrence; and • name of person(s) responsible for undertaking the required actions.
Construction	GE-05	All project personnel will complete an induction that will include environmental and heritage management requirements.
Construction Operation	GE-06	Nearby landholders will be provided a dedicated point of contact for the duration of the project.
Construction	AQ-01	Stabilisation of exposed soils will be undertaken as soon as practicable, and dust suppression undertaken as required using water sprays, water extension agents, soil stabilising polymers or other media on: • unpaved work areas subject to traffic or wind; • exposed soil; • main haulage routes, as required; • sand, spoil and aggregate stockpiles; and • during the loading and unloading of dust generating materials. When water is used for dust suppression, it will not be applied in a way that causes ponding or runoff.
Construction	AQ-02	Construction vehicles with potential for loss of loads (such as dust or litter) will not be overloaded and will be covered when using public roads.
Construction Operation	AQ-03	Plant and equipment will be maintained in good condition to minimise ignition risk, fuel consumption, spills and air emissions that may cause nuisance.
Construction Operation	AQ-04	Plant, equipment and vehicle engines will be switched off when not in use.
Design Construction Operation	SE-01	The existing stakeholder engagement plan will continue to be implemented to facilitate ongoing consultation with relevant stakeholders, including local businesses, throughout the project so that stakeholders have access to information regarding the nature of the proposed project activities and their likely impacts.

6 Operational phase impact assessment

6.1 Emissions

The operation of the gas pipeline and compressor stations will vary according to gas demand, which is often driven by weather conditions (ie higher heating demand in winter) and working days (ie less demand on weekends). Gas flows (and the associated operation of compressor stations) will therefore vary on a seasonal, weekly and daily basis. Demand is highest during the winter period, typically April through to late September, and during this window there may be periods when all proposed compressor stations need to be operational. Variation in demand will also dictate the operational load under which the turbines operate.

The typical intraday operational load for each stage of the development is as follows:

- Stage 1 - MW880 operating at loads between ~60% and >~95%; and
- Stage 2 - MW880 operating at loads between ~30% and >~95% and MW433 operating at loads >80%.

Emissions data were provided by the turbine supplier (Solar Turbines) for the Mars100-C65 which will be used at both MW880 and MW433. Emission estimates were provided for different operating loads and summarised in Table 6.1. As shown in Table 6.1, the highest NOx emission rate for MW880 occurs for the 96.6% load scenario (shown in bold), while the highest emission rate for CO and VOC occurs for the low load scenario (18%) (shown in bold). Emissions of SO_2 are a function of the sulphur content of the fuel, therefore emissions will be higher at higher loads (because more fuel is combusted).

As described in Section 3.2, there are short-term (1-hour average) impact assessment criteria prescribed for the key pollutants of concern, therefore the approach for modelling is to model the worst case emission hour for every hour of the year (in this way, the worst case emission hour is paired with every possible meteorological condition). It is noted that the worst-case emission hour under the low load scenario may not happen very often, therefore the approach provides a conservative assessment of impacts. It is also noted that this is a very conservative approach for comparing against the long-term (annual) average impact assessment criteria.

The emission rates shown in bold in Table 6.1 are used for modelling.

Table 6.1 Emissions data for Mars100-C65

Compressor model	Location	Load (%)	Ambient temperature (°C)	Emission rates (kg/hr)				Emission rates (g/s)			
				NO_x	CO	VOC	SO_2	NO_x	CO	VOC[1]	SO_2
Mars-100-C65	MW880	18	20	3.2	58	80		0.9	**16.1**	**22.2**	
		30	20	3.7	27	68		1.0	7.5	18.9	
		40	20	4.1	2.5	57		1.1	0.7	15.8	
		96.1	20	7.4	5.9	1.7	0.009	**2.1**	1.6	0.5	**0.003**
	MW433	20	20	3.4	62	84		0.9	17.2	23.3	
		30	20	3.8	28	69		1.1	7.8	19.2	
		40	20	4.2	2.5	58		1.2	0.7	16.1	

Note: 1 Reported as UHC (unburnt hydrocarbons) in the emission data

A summary of the stack parameters assumed for modelling are presented in Table 6.2.

Table 6.2 Stack parameters assumed for modelling

Location	Easting (m)	Northing (m)	Stack height (m)	Stack diameter (m)	Temperature (K)	Exit velocity (m/s)
Milne	502991	6305594	17.3	2.3	750	17

6.2 Dispersion model selection and configuration

The atmospheric dispersion modelling completed for this assessment used the AERMOD dispersion model (version v19191). AERMOD is designed to handle a variety of pollutant source types, including surface and buoyant elevated sources, in a wide variety of settings such as rural and urban as well as flat and complex terrain.

The compressor exhaust stack for MW880 was modelled as a conventional circular stack source. Building wake effects were not included.

The project increment ground level concentrations (GLCs) were predicted for each assessment location in the vicinity of MW880. Gridded GLCs were also predicted over a modelling domain of approximately 8 km x 8 km with a 200 m spacing and used to extract the maximum predicted ground level concentration across the entire modelling domain. It is noted that contour plots have not been generated as the predicted project increments are minor.

6.3 Incremental results for Milne (MW880)

The predicted maximum 1-hour average GLCs from the compressor stack at Milne (MW880) are presented in Table 6.3. The predicted GLCs are presented as the maximum prediction across all assessment locations for criteria pollutants and as the maximum prediction across the entire modelling domain for the individual VOCs.

Modelling predictions for individual VOCs are derived from total VOCs based on the weight percentages for the individual species provided in the US EPA speciation profiles for gas combustion, as follows:

- benzene = 0.11%;
- formaldehyde = 0.81%;
- toluene = 0.04%; and
- isomers of xylene = 0.02%.

Ground level concentrations are also expressed as a percentage of the impact assessment criteria and, as discussed in Section 3.3, a qualitative assessment of risk is presented in accordance with DWER (2019) screening concentrations.

When expressed as a percentage of the impact assessment criteria, the 1-hour average NO_2 concentrations is less than 1% of the impact assessment criterion at the worst affected assessment location. In accordance with the DWER screening criteria, if the 1-hour average concentrations are less than 10% of the impact assessment, the incremental project impacts can be screened as insignificant. It is noted that the comparison uses predicted NO_x concentrations to compare against the impact assessment criteria for NO_2 (ie assumes instantaneous and 100% conversion to NO_2). If the atmospheric conversion of NO_x to NO_2 was accounted for, the modelling predictions would be even lower. The conversion of NO_x to NO_2, using the NSW EPA’s ozone limiting method, requires background monitoring data for ozone and NO_2, which is not available for the local area and therefore not possible for this screening level assessment. Regardless, the screening assessment indicates that NO_2 concentrations at the assessment locations are insignificant and would not result in exceedances of the impact assessment criteria.

For CO and SO_2, the 1-hour average concentrations are also less than 1% of the impact assessment criteria at the point of maximum prediction and therefore impacts can be screened as insignificant. For VOCs, the highest 1-hour average concentration is predicted for formaldehyde, however this is also less than 10% of the impact assessment criteria at the point of maximum prediction and therefore impacts can be screened as insignificant.

Table 6.3 Maximum 1-hour ground level concentrations (GLC) (µg/m³)

Pollutant	Impact assessment criteria (µg/m³)	Predicted GLC (µg/m³)	Prediction as % of criteria
NO_2	246	2.2	0.9%
CO	30,000	16.7	0.1%
SO_2	570	0.003	0.0005%
Total VOCs	NA	23.0	NA
Benzene	29	0.2	0.6%
Formaldehyde	20	1.2	6.1%
Toluene	360	0.1	0.02%
Xylenes	190	0.03	0.02%

The predicted annual average GLCs for NO_x and SO_2 are presented in Table 6.4. When assessed as a percentage of the impact assessment criteria, the annual average NO_2 and SO_2 concentrations are 0.1% of the impact assessment criterion at the worst affected assessment location. In accordance with the DWER screening criteria, if the annual average concentrations are less than 1% of the impact assessment, the incremental project impacts can be screened as insignificant.

Table 6.4 Annual average ground level concentrations (GLC) (µg/m³)

Pollutant	Impact assessment criteria (µg/m³)	Predicted GLC (µg/m³)	Prediction as % of criteria
NO_2	62	0.05	0.1%
SO_2	60	0.04	0.1%

6.3.1 Cumulative assessment

As described in Section 4.3, there are no significant local emissions sources that would contribute to ambient background concentrations for NO_2, CO and SO_2, other than minor contributions from traffic and agricultural plant and equipment. On this basis, ambient background for these pollutants can be assumed to be very low and compliance with the impact assessment criteria can be inferred based on the minor project increment.

6.4 Qualitative assessment for Round Hill (MW433)

Additional modelling assessment was not required for the Round Hill (MW433) site. The modelling results for Milne (MW880) demonstrate that the operation of the compressor stations would result in insignificant incremental ground level concentrations. For the Round Hill (MW433) site, sensitive receptors are located at almost double the distance that was modelled for the Milne (MW880) site, therefore compliance can be inferred with confidence for Round Hill (MW433).

It is noted that the emission rates for CO and VOCs for MW433 under low load (20%) are slightly higher than the modelled emission rates for the Milne (MW880) site; however, for Stage 2, MW433 will operate at much higher loads and therefore the actual emissions for these pollutants will be lower than what was modelled.

7 Greenhouse gas assessment

7.1 Introduction

For accounting and reporting purposes, GHG emissions are defined as 'direct' and 'indirect' emissions. Direct emissions (also referred to as Scope 1 emissions) occur within the boundary of an organisation and as a result of that organisation's activities. Indirect emissions are generated as a consequence of an organisation's activities but are physically produced by the activities of another organisation (DoEE 2020).

Indirect emissions are further defined as Scope 2 and Scope 3 emissions. Scope 2 emissions occur from the generation of the electricity purchased and consumed by an organisation. Scope 3 emissions occur from all other upstream and downstream activities, for example the downstream extraction and production of raw materials or the upstream use of products and services.

Scope 3 is an optional reporting category (Bhatia et al 2010) and should not be used to make comparisons between organisations, for example in benchmarking GHG intensity of products or services. Typically, only major sources of scope 3 emissions are accounted and reported by organisations. Specific scope 3 emission factors are provided in the NGAF workbook for the consumption of fossil fuels and purchased electricity, making it straightforward for these sources to be included in a GHG inventory, even though they are a relatively minor source.

Greenhouse gas emissions are presented as carbon dioxide equivalents (CO_2-e) and include emissions of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide N_2O) calculated based on the Global Warming Potentials (GWPs) adopted by the Parties to the UN Framework Convention on Climate Change and its Kyoto Protocol.

7.2 Emissions sources and scope of the assessment

Scope 1 emissions during construction are associated with the combustion of fuel (diesel) by onsite plant and equipment. Scope 1 emissions during the operation phase of the project includes emissions associated with the combustion of gas within the compressor stations and venting during maintenance or blowdowns. The sites are designed to operate as unmanned facilities with compliance and maintenance checks occurring infrequently. Therefore, other Scope 1 emissions from maintenance are expected to be minor. There would be no electricity consumed during construction or operations, therefore Scope 2 emissions are not reported. Scope 3 emissions during construction and operation are also expected to be minimal and not reported.

GHG emissions are estimated for each stage of development, as follows:

- Stage 1 - construction and operation of the Milne (MW880) site; and
- Stage 2 – construction of the Round Hill (MW433) site and simultaneous operation of both the Milne (MW880) and Round Hill (MW433) site.

The GHG emissions sources considered in this assessment is summarised in Table 7.1.

Table 7.1 Summary of GHG emission sources included in assessment

Stage	Phase	Source	Type
Stage 1	Construction	Onsite fuel combustion for construction of MW880	Scope 1
	Operation	Gas combustion in compressor station at MW880	Scope 1
		Gas venting during maintenance or blowdowns at MW880	Scope 1
Stage 2	Construction	Onsite fuel combustion for construction of MW433	Scope 1
	Operation	Gas combustion in compressor station at MW880 and MW433	Scope 1
		Gas venting during maintenance or blowdowns at MW880 and MW433	Scope 1

7.3 Estimated GHG emissions

7.3.1 Scope 1 GHG emissions from diesel use during construction of the compressor sites

Scope 1 GHG emissions are estimated using the methodologies outlined in the National Greenhouse Accounts Factors (NGAF) workbook (DoEE 2020) and using fuel energy contents and emission factors for diesel from Table 3 of the NGAF workbook (2020). The total estimated diesel consumption for the construction period (~9 months) is 415,000 litres per compressor station. The estimated annual Scope 1 emissions for diesel use during the construction phase is 1,125 tonnes CO_2-e for Stage 1 and 1,125 tonnes CO_2-e for Stage 2.

7.3.2 Scope 1 GHG emissions from the operation of compressor sites

Scope 1 GHG emissions from natural gas combustion during operations were estimated using the methodologies outlined in the NGAF workbook and using fuel energy contents and emission factors for natural gas distributed in a pipeline from Table 2 of the NGAF workbook.

The natural gas consumption for each compressor station has been estimated pro-rata based on an estimated consumption for MW880 at high load (>95%) of approximately 2,400 kilograms per hour (kg/hr).

An estimate of annual gas consumption for Stage 1 and Stage 2 is made based on the following simplistic assumptions:

- Stage 1 - MW880 operating at high load (>90%) for winter period (5 months from May to September) with a gas consumption rate of 2,400 kg/hr and at low load (20%) for remaining 7 months with a gas consumption rate of approximately 500 kg/hr; and

- Stage 2 - MW880 and MW433 operating at high load (>90%) for winter period (5 months from May to September) with a gas consumption rate of 2,400 kg/hr and at low load (20%) for remaining 7 months with a gas consumption rate of approximately 500 kg/hr.

Based on these assumptions, the annual gas consumption for MW880 is estimated at approximately 11,000 tonnes per year or 16 million m^3 per year. Using the using fuel energy contents and emission factors for natural gas, the estimated annual Scope 1 emissions for natural gas combustion at is 31,885 t CO_2-e per year for Stage 1 (MW880 only) and 63,864 t CO_2-e per year for Stage 2 (MW880 and MW433).

In addition to gas combustion, vented emissions occur from the release of natural gas inside a pressure vessel, pipeline, or other equipment during maintenance, blowdowns or purging. The amount of vented gas is estimated as 500 kg per site per year. Assuming a global warming potential of 28, this equates to annual emissions of 14 t CO_2-e for Stage 1 (MW880 only) and 28 t CO_2-e per year for Stage 2 (MW880 and MW433).

7.3.3 Significance of emissions

A summary of the GHG emissions for construction and operations are presented in Table 7.2. The significance of the project's GHG emissions is assessed by comparing with GHG accounts for NSW (131,685 kt CO_2-e) and Australia (537,446 kt CO_2-e) (AGEIS 2021).

Table 7.2 Summary of Scope 1 emissions for operations (t CO_2-e) per year

Stage	Source	t CO_2-e per year	% of NSW GHG accounts	% of Australian GHG accounts
Stage 1 construction	Fuel consumption (MW880)	1,125	0.001%	0.0002%
Stage 1 operation	Gas combustion (MW880)	31,885	0.02%	0.006%
	Venting (MW880)	14		
Stage 2 construction	Fuel consumption (MW433)	1,125	0.001%	0.0002%
Stage 2 operation	Gas combustion (MW880 and MW433)	63,789	0.05%	0.01%
	Venting (MW880 and MW433)	28		

7.4 GHG emission management

7.4.1 Operations

Approximately 16% of APA's total emissions result from the combustion of natural gas in compressor stations (APA 2020[9]) and the largest GHG emission source associated with this project. As part of a strategy for managing the potential impacts from climate change, APA have developed a Carbon Management Plan which identifies opportunities to improve GHG emission management, including emission reductions and offsets. APA has also established an emission reduction working group to focus on emission reduction opportunities in infrastructure development, which would include this project.

7.5 Construction

The following commitments will minimise greenhouse gas impacts associated with the construction of the project:

Table 7.3 Summary of commitments – greenhouse gas

Stage	Commitment ID	Commitment
Construction	GH-01	Material handling will be efficiently scheduled and planned to minimise fuel consumption.
Construction Operation	GH-02	10% blended ethanol fuel will be used for petrol-powered light vehicles, where practicable.
Construction	GH-03	Services and materials (aggregates etc.) will be sourced locally, where practicable.
Design, Construction	GH-04	Low carbon alternatives will be procured where practicable (use of lower carbon cement alternatives etc.).

9 APA 2020 Sustainability Report - https://www.apa.com.au/globalassets/about-apa/sustainability/sustainability-reports/apa-2020-sustainability-report.pdf

8 Conclusion

A qualitative risk-based assessment was completed for the construction of the compressor station sites. Operational impacts were quantitatively assessed at the Milne (MW880) site and a qualitative assessment of compliance presented for the Round Hill (MW433) site, inferred from the modelling results for Milne (MW880).

The construction assessment showed that there are no sensitive human receptors within 350 m and no ecological receptors within 50 m of both sites, therefore impacts from construction dust are negligible. Good practice mitigation measures for construction dust will reduce this risk further.

Atmospheric dispersion modelling was completed using the AERMOD model system for the operation of the compressor station at the Milne (MW880) site. Modelling results were compared against applicable NSW EPA's impact assessment criteria and a qualitative assessment of risk is also made, based on criteria used in other jurisdictions for screening out insignificant impacts.

The approach for modelling is to model the worst-case emission hour for every hour of the year (in this way, the worst-case emission hour is paired with every possible meteorological condition). The highest NOx emission rate for MW880 occurs for a high load scenario (96.6%), while the highest emission rate for CO and VOC occurs for the low load scenario (18%). Emissions of SO_2 are a function of the sulphur content of the fuel, therefore emissions will be higher at higher loads (because more fuel is combusted).

When expressed as a percentage of the impact assessment criteria, the 1-hour average NO_2 concentrations are less than 1% of the impact assessment criterion. In accordance with the DWER screening criteria, if the 1-hour average concentrations are less than 10% of the impact assessment, the incremental project impacts can be screened as insignificant. For CO and SO_2, the 1-hour average concentrations are also less than 1% of the impact assessment criteria and can be screened as insignificant. For VOCs, the highest 1-hour average concentration is predicted for formaldehyde, however it is less than 10% of the impact assessment criteria and therefore can be screened as insignificant.

The predicted annual average concentrations of NO_x and SO_2, when assessed as a percentage of the impact assessment criteria, are 0.1% of the impact assessment criterion. In accordance with the DWER screening criteria, if the annual average concentrations are less than 1% of the impact assessment, the incremental project impacts can be screened as insignificant.

There are no significant local emissions sources that would contribute to ambient background concentrations for all pollutants assessed, other than minor contributions from traffic and agricultural plant and equipment. On this basis, ambient background for these pollutants can be assumed to be very low and compliance with the impact assessment criteria can be inferred based on the minor project increment.

Additional modelling assessment was not required for the Round Hill (MW433) site. The modelling results for Milne (MW880) demonstrate that the operation of the compressor stations would result in insignificant incremental ground level concentrations. For the Round Hill (MW433) site, sensitive receptors are located at almost double the distance that was modelled for the Milne (MW880) site, therefore compliance can be inferred with confidence for Round Hill (MW433).

The significance of the project's GHG emissions is assessed by comparing with GHG accounts for NSW (131,685 kt CO_2-e) and Australia (537,446 kt CO_2-e) (AGEIS 2021). Annual average GHG emissions Stage 1 and Stage 2 during construction represent approximately 0.001% of total GHG emissions for NSW and 0.0002% of total GHG emissions for Australia, based on the National Greenhouse Gas Inventory for 2018. Annual average GHG emissions for Stage 1 operations represents approximately 0.02% of total GHG emissions for NSW and 0.006% of total GHG emissions for Australia. Annual average GHG emissions for Stage 2 represents approximately 0.05% of total GHG emissions for NSW and 0.01% of total GHG emissions for Australia.

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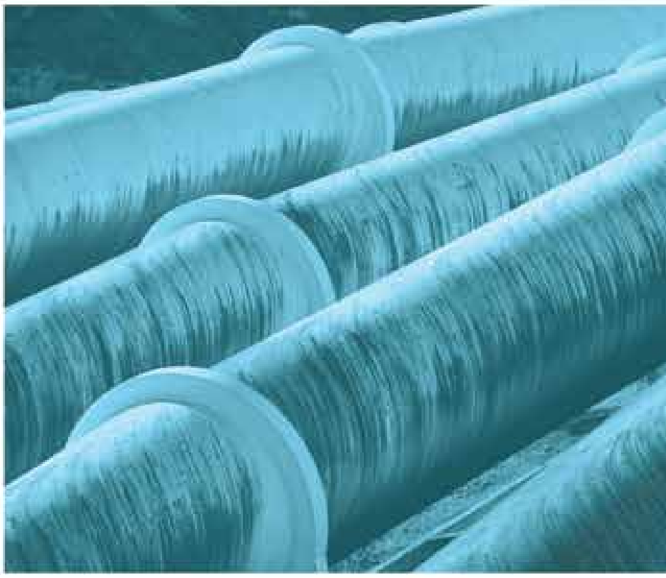
Abbreviations

AGVs	Air quality guidelines values
APA	APT Pipelines Pty Limited
Approved Methods for Modelling	*Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*
AQGHGA	Air quality and greenhouse gas assessment
AQMS	Air quality monitoring station
AWS	Automatic weather station
BoM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
CH_4	methane
CO	carbon monoxide
CO_2-e	Carbon dioxide equivalent
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DoEE	Department of Environment and Energy
DPIE	Department of Planning, Industry and Environment
EMM	EMM Consulting Pty Ltd
EPA	Environment Protection Authority
EPL	Environment protection licence
GHG	Greenhouse gas
GLCs	Ground-level concentrations
GWP	Global Warming Potentials GWPs
MSP	Moomba Sydney Pipeline
MWP	Moomba to Wilton Pipeline
NGAF	National Greenhouse Accounts Factors
NO_x	Oxides of nitrogen
NSW	New South Wales
N_20	Nitrous oxide
PM_{10}	Particulate matter less than 10 microns in aerodynamic diameter
$PM_{2.5}$	Particulate matter less than 2.5 microns in aerodynamic diameter
SC	Screening concentrations

SO_2	Sulfur dioxide
SWQP	South West Queensland Pipeline
TAPM	The Air Pollution Model
TSP	Total suspected particulates
UK	United Kingdom
US-EPA	United States Environmental Protection Agency
VOC	Volatile organic compounds
WA DWER	WA Department of Water and Environmental Regulation



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