HANCOCK GALILEE PTY LTD

Kevin's Corner Project Environmental Impact Statement

03 Climate

Section 03 Climate

3.1 Introduction

This section of the Environmental Impact Statement (EIS) describes rainfall patterns, humidity, air temperature, wind (speed and direction), stability class and mixing height within the region of the Kevin's Corner Coal Project (the Project).

There are three Bureau of Meteorology (BOM) stations in the region of the Project. These include:

- Clermont Serius Street monitoring site at approximately 130 kilometres (km) from the Project site;
- Barcaldine Post Office monitoring site at approximately 135 km from the Project site; and
- Emerald Airport monitoring site at approximately 165 km from the Project site.

The Clermont Serius Street and Barcaldine Post Office sites only collect daily observations, while the Emerald Airport site collects hourly observations. Due to the completeness of the Emerald data, this has been adopted for this assessment.

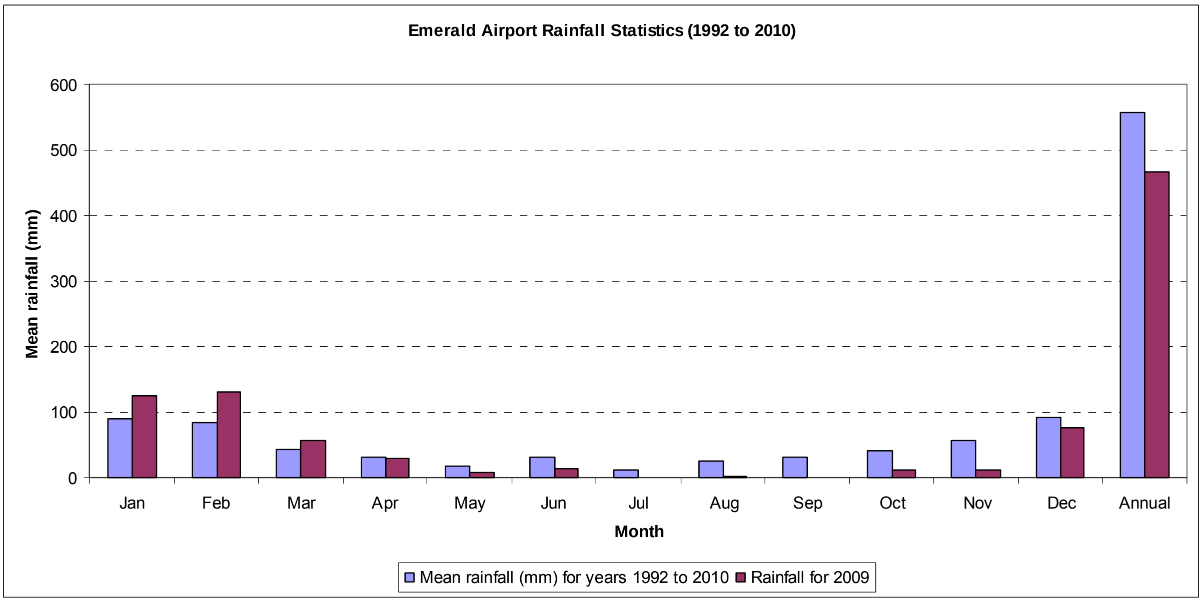
The Emerald long-term statistics alone were not sufficient for the purpose of characterising the local meteorology due to distance and completeness (stability and mixing height are not measured). The monitoring data have been supplemented with numerically simulated meteorological parameters for 2009 in order to provide a detailed description of the local meteorology. Additionally, the model output provides the site-specific parameters that were not measured. Details of the setup and application of The Air Pollution Model (TAPM) (Hurley, 2005) and the CALMET (Scire et al., 2000) models used to generate the simulated meteorological parameters are provided in Section 4.3.1 of Volume 2, Appendix O (Air Quality Report).

This section of the EIS also provides an assessment of extreme events and the Project's vulnerability to natural or induced hazards such as flooding, drought, storm events, bushfires and climate change. The potential impacts due to climatic factors are addressed in the Soils, Topography and Land Disturbance (Volume 1, Section 5); Air Quality (Volume 1, Section 13); Surface Water (Volume 1, Section 11); and Groundwater (Volume 1, Section 12) sections of the EIS.

3.2 Rainfall

Monthly mean rainfall values for the period of record 1992 to 2010 from the Emerald Airport monitoring site, and for the Project site (year 2009 as modelled with CALMET), are provided on Figure 3-1. The data presented on Figure 3-1 indicate a mean annual rainfall of approximately 556 millimetres (mm), with approximately 48% of rainfall occurring in summer.

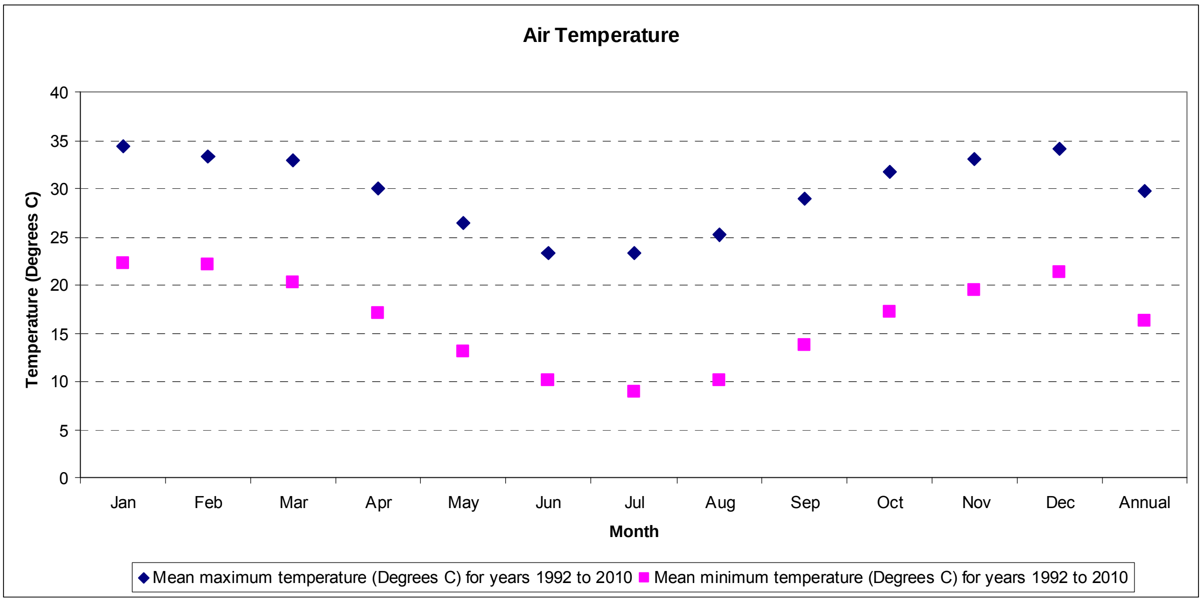
Figure 3-1 Emerald Airport rainfall statistics (1992 to 2010)



3.3 Air Temperature

The region surrounding the Project area typically has hot days during summer, with mean maximum daytime temperatures around 35°C, falling to 23°C during the winter months. Overnight temperatures are generally cool throughout the year and cold during the winter months, with mean minimum daily temperatures of 9°C in July, rising to greater than 22°C between December, January and February. The long-term temperature statistics for the period of record 1992 to 2010 are provided on Figure 3-2.

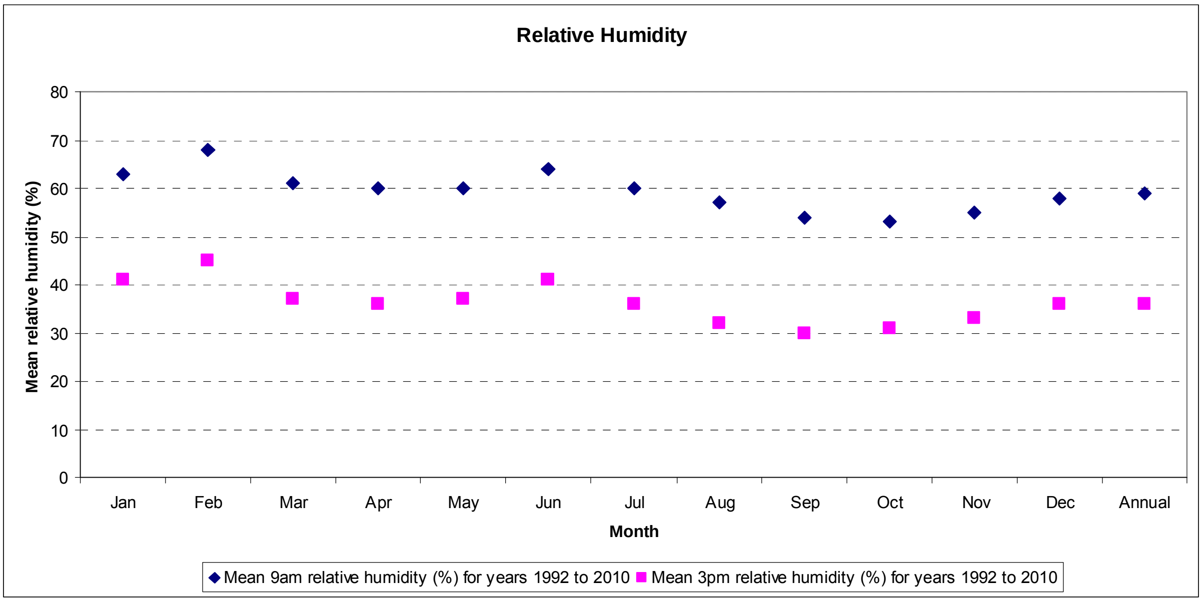
Figure 3-2 Emerald Airport air temperature statistics (1992 to 2010)



3.4 Relative Humidity

Mean 9:00 am relative humidity is generally highest from February to July and lowest from September to December, ranging from approximately 52% in October to 68% in February. Mean 3:00 pm relative humidity is lower than 9:00 am relative humidity throughout the year, ranging from 30% in September up to 45% in February. The lowest 3:00 pm relative humidity is from August to October. The 9:00 am and 3:00 pm relative humidity long-term statistics for the period of record 1992 to 2010 are provided on Figure 3-3.

Figure 3-3 Emerald Airport relative humidity statistics (1992 to 2010)

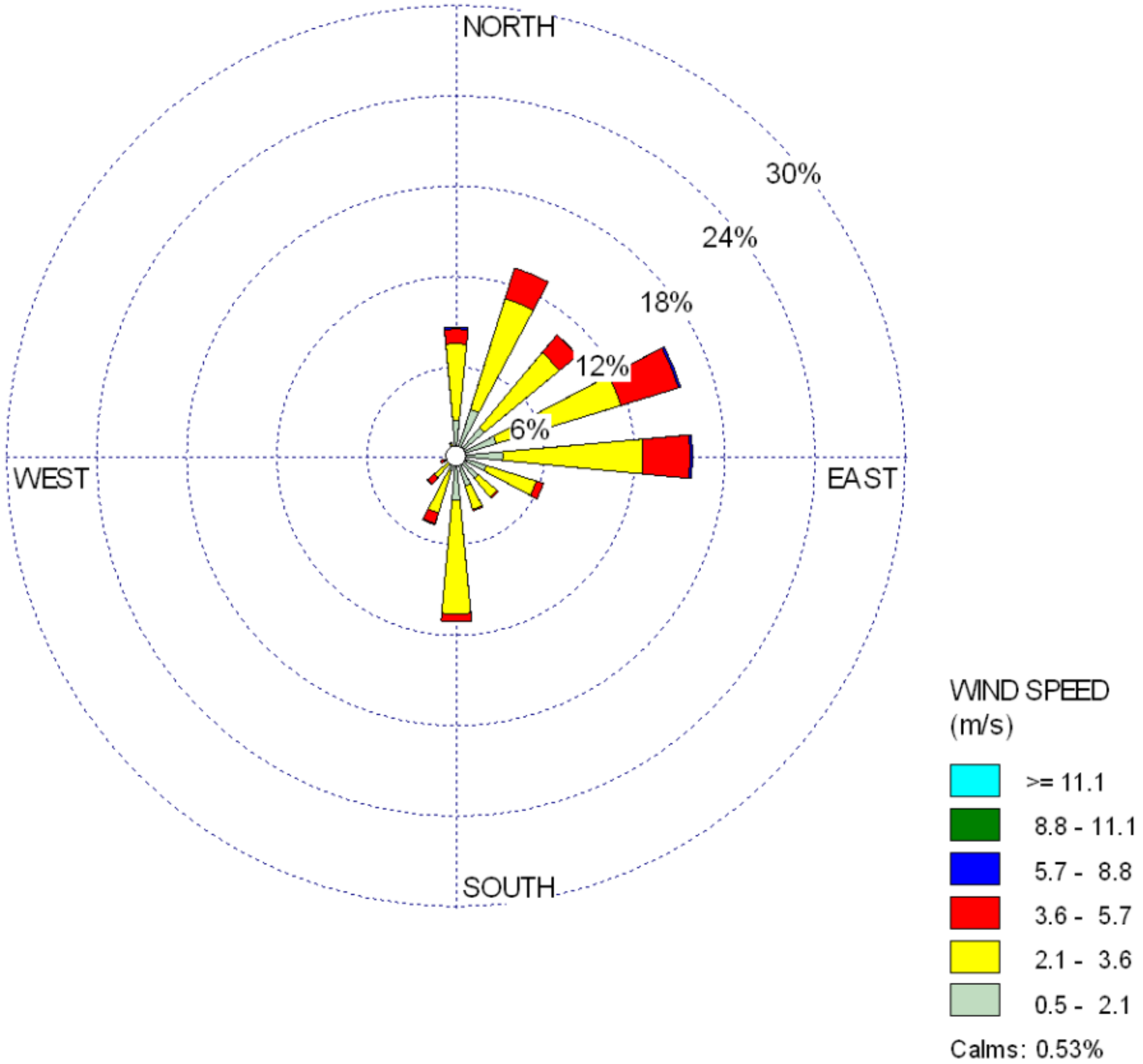


3.5 Wind

The hourly records of wind speed and wind direction were generated using the CALMET data, as the available Emerald long-term statistics in relation to wind speed and wind direction did not show good agreement with the wind statistics from the numerically simulated site-specific wind fields. The Emerald monitoring station is approximately 165 km southwest of the Project site.

Wind speed and wind direction data have been summarised for 2009, using the modelled data generated by CALMET. A wind rose that presents the wind speed and direction data for all hours is shown on Figure 3-4. Typical winds at the Project site are predominately from the east through to northeast. The wind speed reaches 6.6 metres per second (m/s) from the east, and is on average 2.6 m/s. The site is characterised by occasional light winds from the southeast and very infrequent winds from the west.

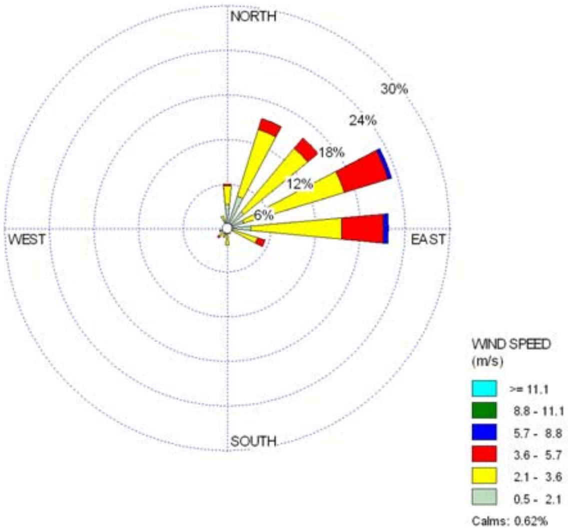
Figure 3-4 Wind rose for all hours - Kevin's Corner Project, CALMET 2009



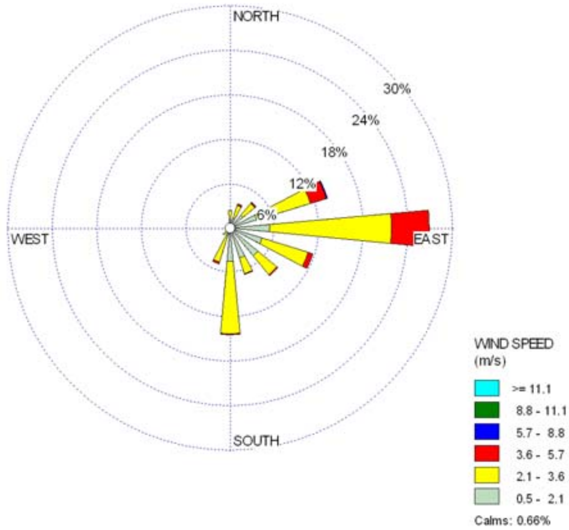
Analysis of wind speed and direction data for each season in 2009 is shown as wind roses on Figure 3-5. The data show that average winter wind speeds were 2.4 m/s, with wind directions varying from the north, northeast and southerly directions. Average spring wind speeds were 2.9 m/s, with a predominant northeast wind direction. Summer winds tend to be from the northeast through to the east, with an average wind speed of 2.7 m/s. Average wind speed in the region in autumn was 2.3 m/s, with the majority of winds from the east.

Figure 3-5 Seasonal wind roses - Kevin's Corner Project, CALMET 2009

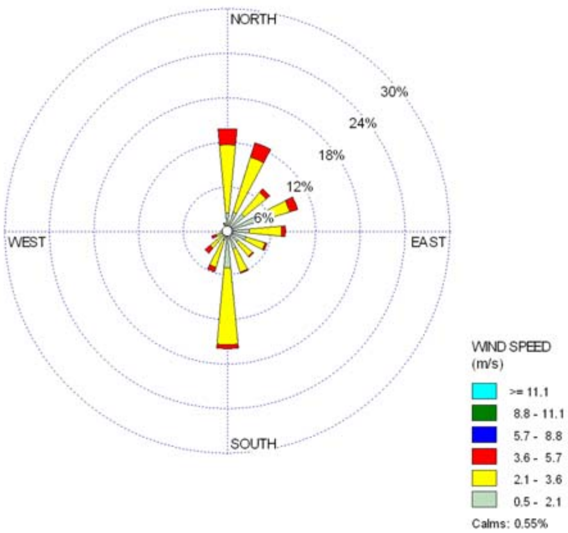
Summer (D-J-F)



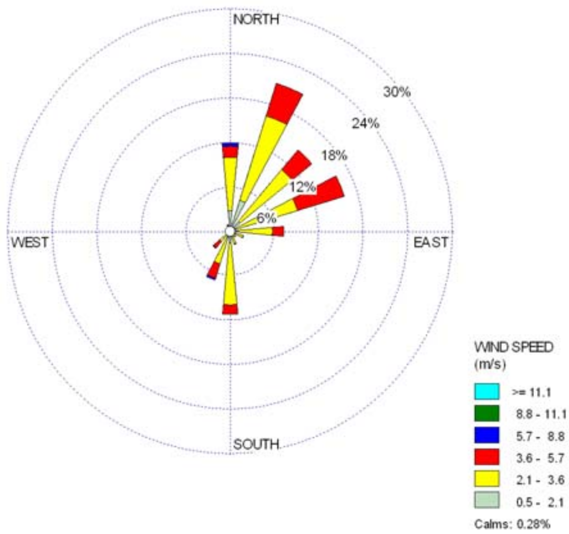
Autumn (M-A-M)



Winter (J-J-A)



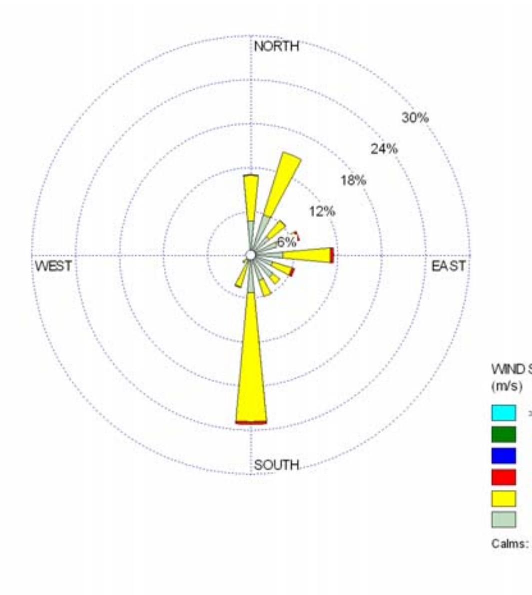
Spring (S-O-N)



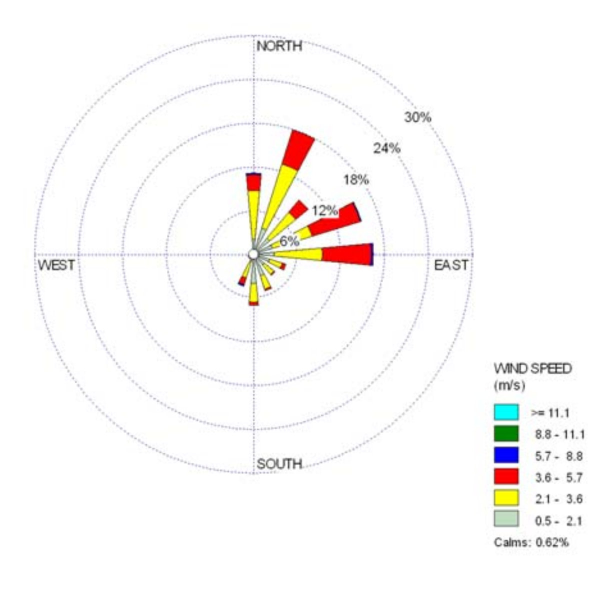
The wind patterns through the day are presented on Figure 3-6. Early morning winds are characterised by low to moderate wind speeds, predominantly below 3.6 m/s, with wind mainly coming from the south or north-northeast. Mid-morning winds show increasing strengths of predominantly up to 5.7 m/s, and generally from the north to east. Winds in the afternoon are characterised by the easterly direction, with wind strengths of up to 6.6 m/s. Night-time winds are generally from the east-northeast direction, with wind speeds of up to 5.4 m/s.

Figure 3-6 Wind roses by hour of day - Kevin's Corner Project, CALMET 2009

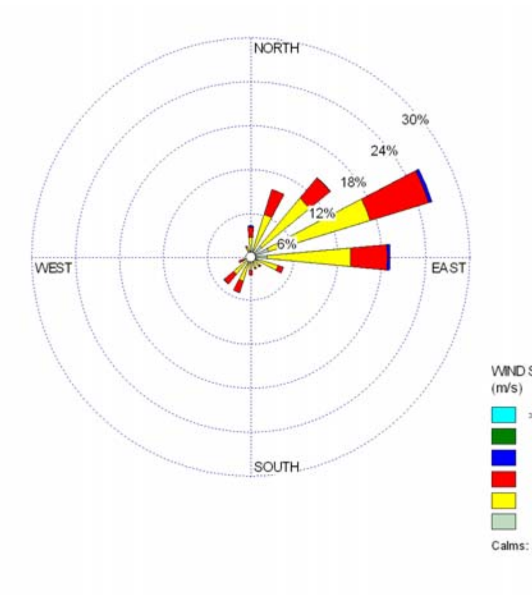
00-05 Hours



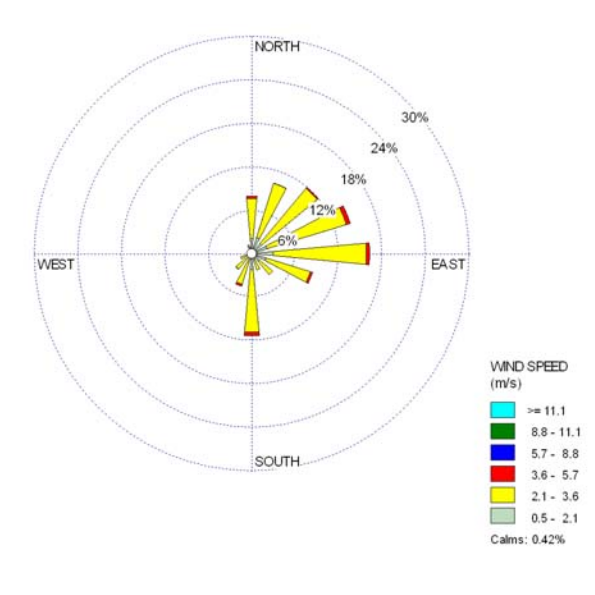
06-11 Hours



12-17 Hours



18-23 Hours



3.6 Stability Class

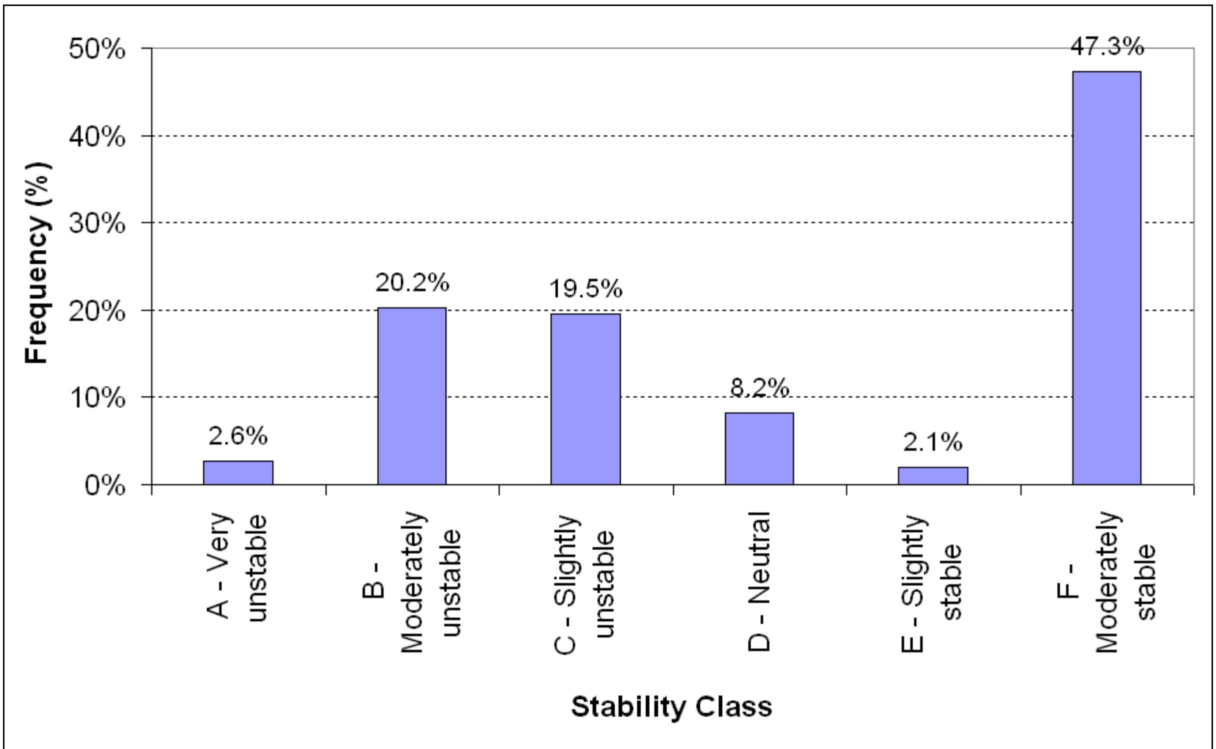
Stability of the atmosphere is determined by a combination of horizontal turbulence, caused by the wind, and vertical turbulence, caused by the solar heating of the ground surface. Stability cannot be measured directly; instead it must be inferred from available information, or generated using a model.

The Pasquill-Gifford scale defines stability on a scale from A to G, with stability class A being the least stable, occurring during strong daytime sun, and stability class G being the most stable condition, occurring during low wind speeds at night. For any given wind speed, stability may be characterised by two or three categories depending on the time of day and the amount of cloud present.

In air quality models such as CALMET, the stability classes F and G are combined. Stability class data for 2009 have been summarised using the modelled data generated by CALMET (Figure 3-7). This showed that for the Project, stability class F occurred most frequently (47.3%) in 2009, indicating that the dominant conditions were moderately to very stable, with very little lateral and vertical diffusion. Typically under class F stability, the wind direction tends to deviate by only a small amount, frequently resulting in poor dispersion conditions.

The frequency of strongly convective (unstable) conditions at the Project site, represented by stability class A, is relatively low at 2.6% of hours in the year.

Figure 3-7 Frequency of stability class for Kevin's Corner Coal Project, CALMET 2009

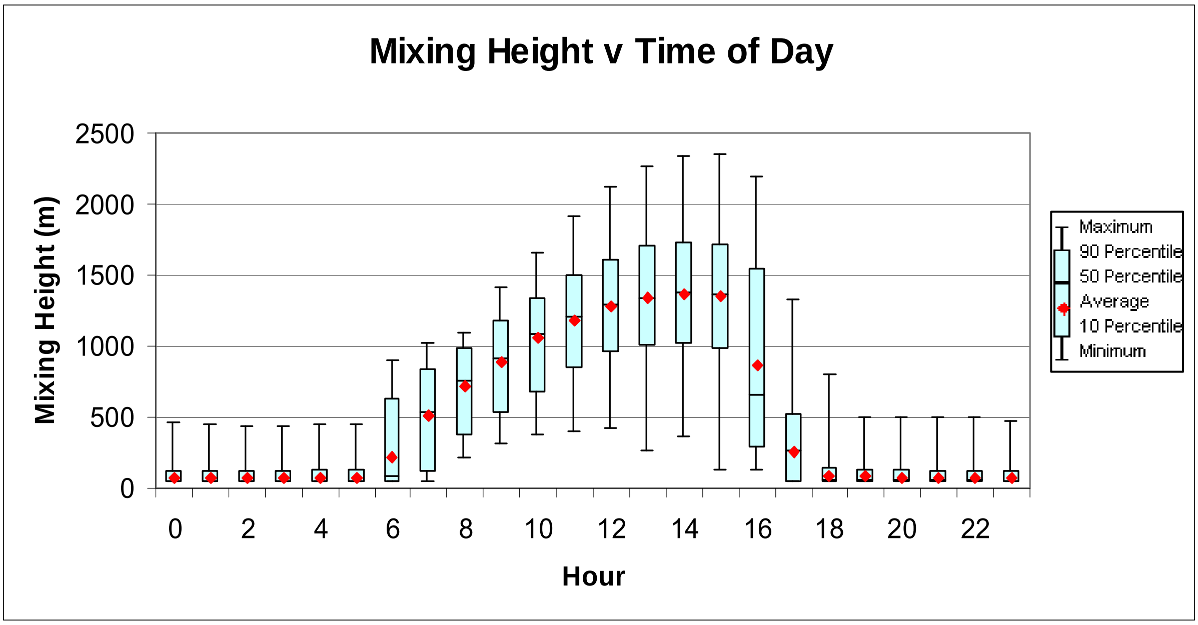


3.7 Mixing Height

Mixing height quantifies the vertical height of mixing in the atmosphere and is a modelled parameter that is not typically measured. Mixing height data have been summarised for 2009 using the modelled data generated by CALMET. Figure 3-8 represents the mixing height against time of day for the Project. The graph represents the typical growth of the boundary layer, whereby mixing height is generally lowest late at night/early morning and highest during early afternoon (in this case 2:00 pm). The mixing height decreases in the afternoon, and particularly after sunset, due to the change from surface heating from the sun to a net heat loss overnight.

On average, mixing heights during the morning hours range from 250 m to 1,335 m (7:00 am to 11:00 am) above ground level, while the average afternoon mixing heights range from 1,466 m to 73 m (1:00 pm to 6:00 pm) above ground level. Low mixing heights typically translate to stagnant air with low vertical motion, whilst high mixing heights are associated with vertical mixing and effective dilution of pollutants.

Figure 3-8 Mixing height by time of day for Kevin's Corner Coal Project, CALMET 2009



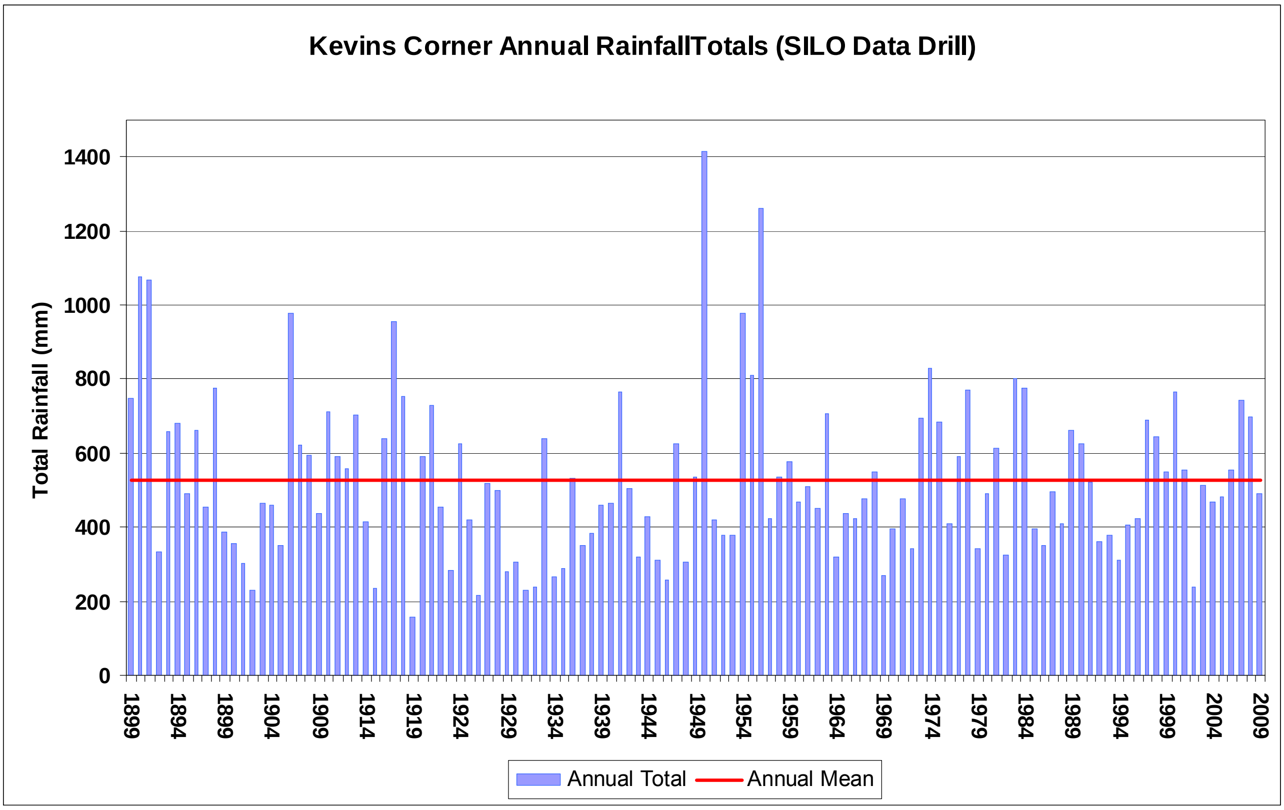
3.8 Extremes of Climate

This section describes the Project's vulnerability to natural hazards such as drought, flooding, bushfires, storm events and climate change.

3.8.1 Drought

An examination of a Bureau of Meteorology SILO data drill generated for the Project site (23.05 S, 146.50 W) indicates that annual rainfall totals are highly variable and that consecutive years of below average rainfall (droughts) are relatively common. Figure 3-9 shows that significant recent drought periods include the years 2002 – 2005, 1991 – 1996 and 1985 – 1988.

Figure 3-9 Annual rainfall totals (1889 – 2009) (SILO Data Drill)



3.8.2 Flooding

The Sandy Creek catchment is on the eastern slopes of the Great Dividing Range and at approximately 23 degrees latitude. The region is characterised with semi-arid climate, yet can also be prone to infrequent widespread high rainfall events that can occur in tropical regions. The area is approximately 350 km from the coast (direct line distance), which limits frequency of typical tropical weather influences from the coast to reach the Sandy Creek catchment in most years, and hence this characterises the typical semi-arid climate that is commonly observed in the region.

There is reasonable potential for major tropical rainfall events to infrequently extend inland to the Project area. Rainfall recording stations (which are effectively point estimates) indicate that large tropical rainfall weather systems may typically occur at a point location in the region with an average frequency of 20 to 30 years. Review of historical spatial rainfall maps shows that the spatial extents of infrequent large tropical storms will not always align directly with the catchment extents and will often produce partial area effects on flooding (i.e. moderate to significant flood caused by high rainfall over only part of the catchment). Idealised flood-producing mechanisms in the Sandy Creek catchment (i.e. extreme floods) would require the combination of an infrequent large tropical storm to occur in the area, and the spatial extents of the storm to extend across the entire catchment. Although data are limited, it is inferred that maximum flood-producing mechanisms in the Sandy Creek catchment probably occurs with a frequency of about 1:100 years.

A detailed surface water study was completed for the Project (refer to Volume 2, Appendix M). The study included an assessment of the hydrology of the Project's catchment area, flood modelling and a geomorphologic impact assessment. Hydrological and hydraulic models were developed and used to determine flood behaviour for frequent and large design floods.

3.8.3 Storm Events

The Sandy Creek catchment area is subject to frequent storm activity; and as part of the Hydrology Technical Report, a range of design event durations were modelled to determine the critical duration of storm events. The results of this work can be found in Volume 2, Appendix M2 of this EIS. Additionally, the impacts of storm events on the capacity of wastewater containment systems (e.g. site bunding and stormwater management infrastructure) are addressed in Volume 2, Appendix M3.

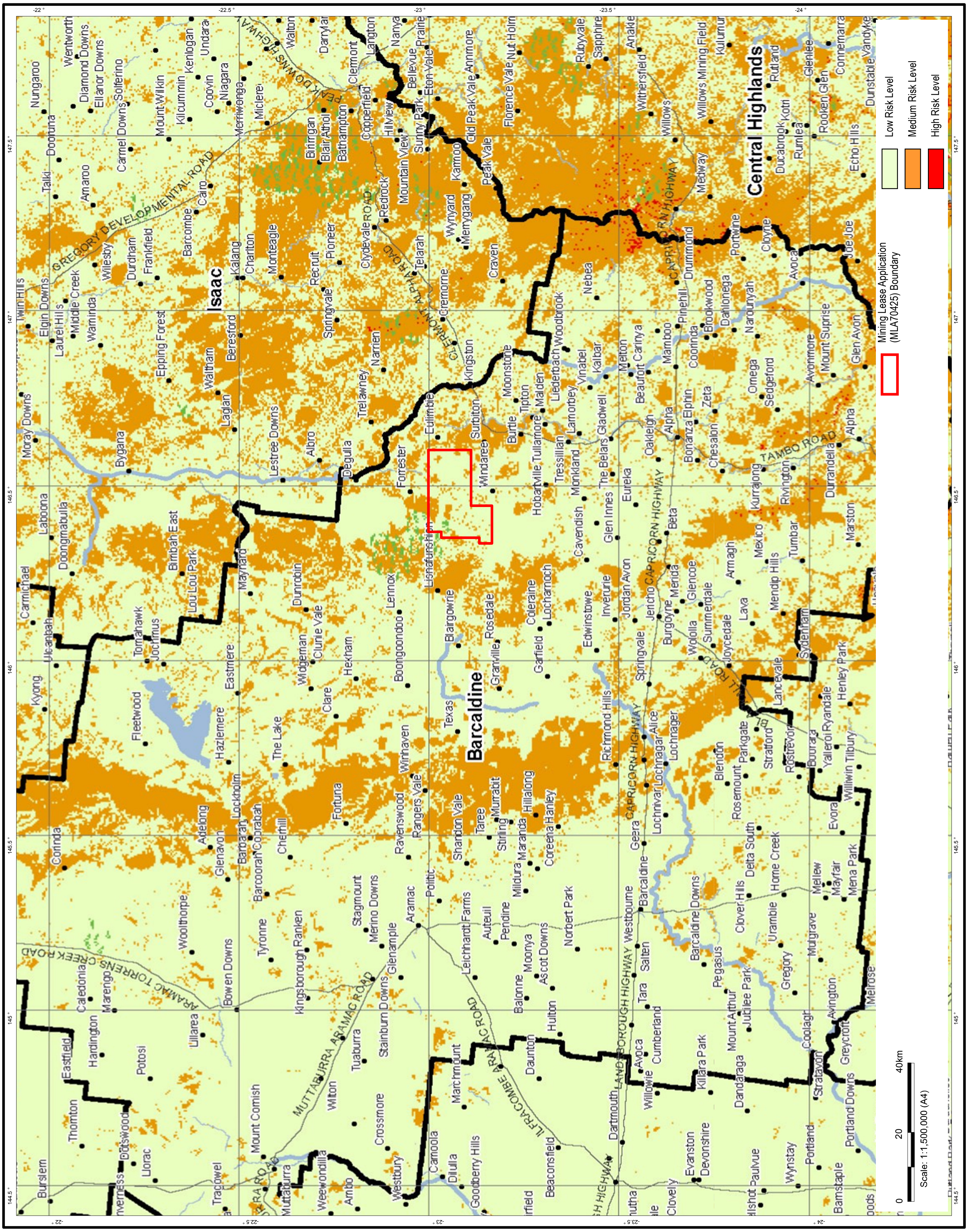
3.8.4 Bushfires

The climate factors that exert most influence over bushfire weather are temperature, winds, and humidity (BOM, 2009). A combination of high temperature, high winds, and low humidity increases fire danger. In Queensland, spring (particularly late spring) brings a combination of these climate factors that constitute the fire season. During winter, the temperatures and rainfall are low. In summer, while the temperatures are at their hottest, the rainfall also increases, reducing the risk of a significant fire. In the period between winter and summer, the fuel is very dry from the lack of rainfall during the winter months and the temperatures increase.

The Rural Fire Service (RFS) and Queensland Fire and Rescue Service have modelled the bushfire risk for Barcaldine Regional Council (RFS, 2008) (refer to Figure 3-10). The Project area is primarily classified as having a low (yellow) to medium (orange) bushfire risk. There are no high (red) bushfire risk areas identified in the vicinity of the Project. This risk modelling examined factors of slope, aspect and vegetation.

3.8.5 Climate Change

The Project's vulnerabilities to climate change have been addressed by conducting a risk assessment on the impacts of reduced rainfall and increased temperatures, rainfall intensity, storm severity, number of windy days, and risk of flooding. The methodology and results of this assessment are presented in Volume 1, Section 14. The proposed risk management strategies to allow the Project to adapt to future climate change are also presented in that section.



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Datum: GDA94, MGA Zone55

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Kevin's Corner Project
Environmental Impact Statement

BUSHFIRE RISK
FOR THE GENERAL
PROJECT LOCATION
(RURAL FIRE SERVICE, 2008)

Job Number	4262 6660
Revision	B
Date	12-09-2011

Figure: 3-10

File No: 42626660-g-1080.wor