6.0 CLIMATE AND AIR QUALITY

This section provides a description of the climatic features and microclimate of the Study Area, including typical temperature, wind, rainfall data, and atypical meteorological conditions and their likely frequency of occurrence. Generic details of the existing air quality and the presence of pollutants are also provided.

The likelihood of air quality impacts (including potential dust and odour nuisance) on residences and ecologically sensitive areas during the construction and operation phases are discussed within this section. Commentary is also provided on the potential impacts of climate change on the proposed development. Finally, mitigation measures are provided to reduce the identified potential impacts.

6.1 EXISTING ENVIRONMENT

This section describes climate and air quality within the Kogan/Warra region, with specific mention of the impact of climate change on the proposed development.

An assessment has been conducted into the climatic conditions of the region, and the quality of air recorded adjacent to the study corridor to give some local context. The following resources were used in the preparation of this section:

- Weather data provided by the Bureau of Meteorology (BoM) and Emergency Management Australia (EMA);
- Air quality data provided by CS Energy; and
- Review of the Department of Environment and Resource Management's (DERM) Air Quality Bulletin South-East Queensland.

6.1.1 Climate

Meteorological data collected from the Dalby Airport weather station (site no. 041522; approximately 50km south-east of the Project site) between January 1992 and September 2009, indicates that the Kogan region is considered a 'Hot Dry Climate', under the BoM climate zone classification (BoM, 2009).

6.1.1.1 Rainfall & Temperature

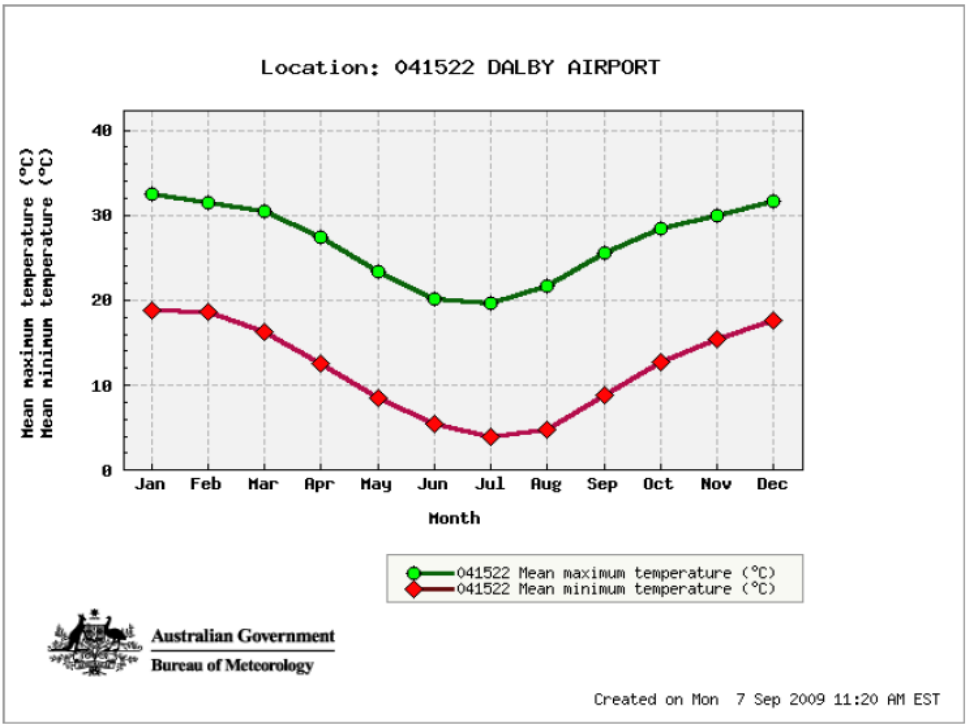
Rainfall in Southern Queensland is considered highly variable and subject to extended periods of drought, followed by intensive rainfall. Maximum temperatures often reach 30ºC in the summer months, and minimum temperatures often fall below 5ºC over winter. Table 6.1 shows the climatic averages calculated from available BoM data for records commencing in 1992 until 2009 (BoM, 2009).

TABLE 6.1 AVERAGE CLIMATIC DATA RECORDS FOR DALBY AIRPORT

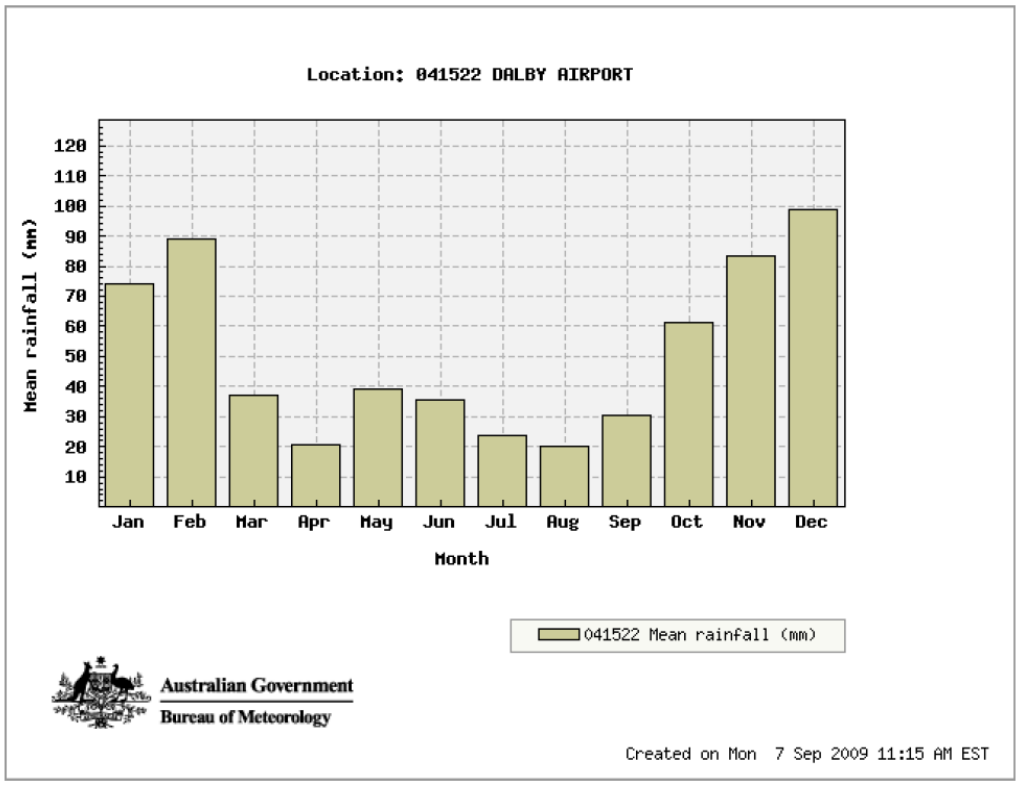
CLIMATE OBSERVATION	DALBY AIRPORT CLIMATE RECORDS
Annual Mean Daily Minimum Temperature (°C)	12.0
Annual Mean Daily Maximum Temperature (°C)	26.8
Annual Mean Rainfall (mm)	608.3
Annual Mean Number of Rain Days (days)	55

The climatic variation between months and between seasons within a period of a year is also important to note. The graphs below outline the monthly average rainfall and temperature for the wider area (as recorded at Dalby Airport).

GRAPH 6.1 MONTHLY MEAN MINIMUM & MAXIMUM TEMPERATURES (°C) FOR THE GREATER DALBY REGION



GRAPH 6.2 MONTHLY MEAN RAINFALL (MM) FOR THE GREATER DALBY REGION



6.1.1.2 Wind

Wind motion characteristics are highly variable both in speed and direction. Wind patterns are generally defined by atmospheric distribution. However, locally, wind is influenced by the time of day, height above ground level and surrounding terrain (BoM, 2009). Wind is often studied by frequency analysis rather than averages and is represented by wind roses to provide a rapid appraisal of the frequency of wind speed and direction.

Annual wind data collected by the Dalby Airport weather station indicated that the Project site is typically subjected to prevailing easterly winds for most of the year, with the average wind speed of approximately 12km per hour (BoM, 2009). Details of wind direction and velocity are shown in Figure 6.1 and Figure 6.2. The data consists of 5980 (9am) and 5968 (3pm) observations from 1992 to 2008. The following should be noted when interpreting this data:

- The percentage of calm conditions is represented by the size of the circle in the centre of the wind rose;
- Each branch of the rose represents the direction from which the wind is coming (north at top of diagram);
- The thickness and colour of the branches represent the wind speed ranges in 10km/hr increments. A thicker segment represents a faster wind speed; and
- The length of each branch segment represents the percentage of wind in that wind speed range, blowing from that particular direction.

A review of the 9am and 3pm wind roses indicates that winds in the Dalby region are predominantly easterly throughout the year. The BoM wind data indicates that the conditions are calmer in the mornings (19% calm), than in the afternoon (9% calm), and the average wind speed is approximately 2km/hr stronger in the afternoon.

FIGURE 6.1 MEAN ANNUAL 9AM WIND SPEED VS DIRECTION FOR DALBY AIRPORT (1992-2008) (BOM, 2005A)

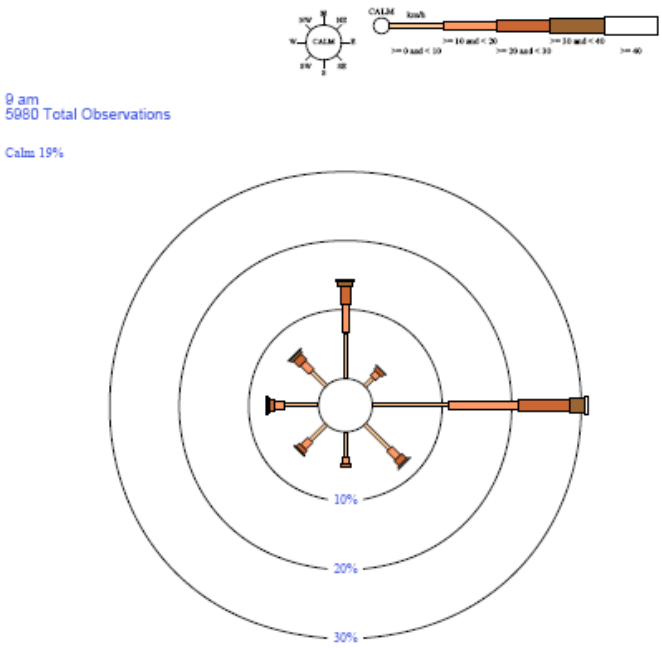
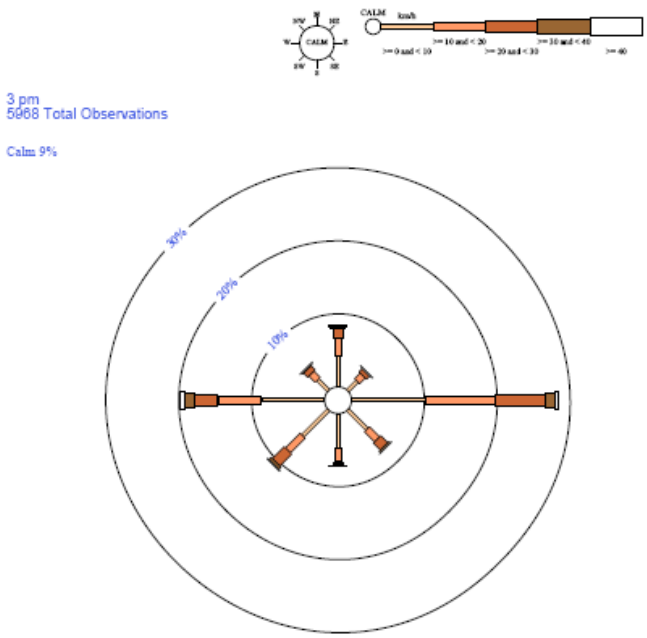


FIGURE 6.2 MEAN ANNUAL 3PM WIND SPEED VS DIRECTION FOR DALBY AIRPORT (1992-2008) (BOM, 2005A)



6.1.1.3 Extreme Weather Events

A review of atypical weather events was completed using databases from the Bureau of Meteorology (BOM) and Emergency Management Australia (EMA) and is summarised in Table 6.2. The later is accepted to include all Australian natural disasters from the late 1900s to present.

TABLE 6.2 SUMMARY OF PREVIOUS EXTREME WEATHER EVENTS FOR STUDY AREA

DATE	EVENT	DETAILS
01/02/1981	Flood	Dalby: Flooding and stormy conditions in the wake of an ex-tropical cyclonic depression resulted in heavy damage to approximately 2000 homes that were flooded. Crop damage and considerable erosion also resulted.
01/01/1983	Severe storm	Chinchilla: Severe Storm (incl Tornado), approx $3.5million in damages / insurance claims.
24/11/1998	Severe storm	Dalby: Winds up to 90km/h and more than 3,300 lightning strikes were recorded in 2 hours. Roofs were ripped off houses and power cut to most of the population.
18/12/1998	Severe storm	Minor damage to trees & houses was reported at Dalby, Laidley, Esk & Toogoolawah.
26/01/2007	Severe storm	Dalby: Winds estimated at 100km/h and hail averaging 3cm in diameter.
7-12/10/2007	Severe storm	Chinchilla: Severe storms that occurred over a six day period. Storm damage sustained included roof damage, fallen trees and water damage etc.
16-22/11/2008	Severe storms & flooding	Dalby Regional and Central Highlands Regional Council granted Natural Disaster Relief and Recovery Arrangements (NDRRA) funding. Dalby.

The data shows that severe storms (including high winds, hail and inundation with flash flooding) are the most common atypical events for the area, with an average of 10 to 25 thunder days (Figure 6.3) and 2 to 3 ground lightning strikes per square km per year (Figure 6.4)

FIGURE 6.3 AUSTRALIAN AVERAGE ANNUAL THUNDER DAYS (BOM, 2005C)

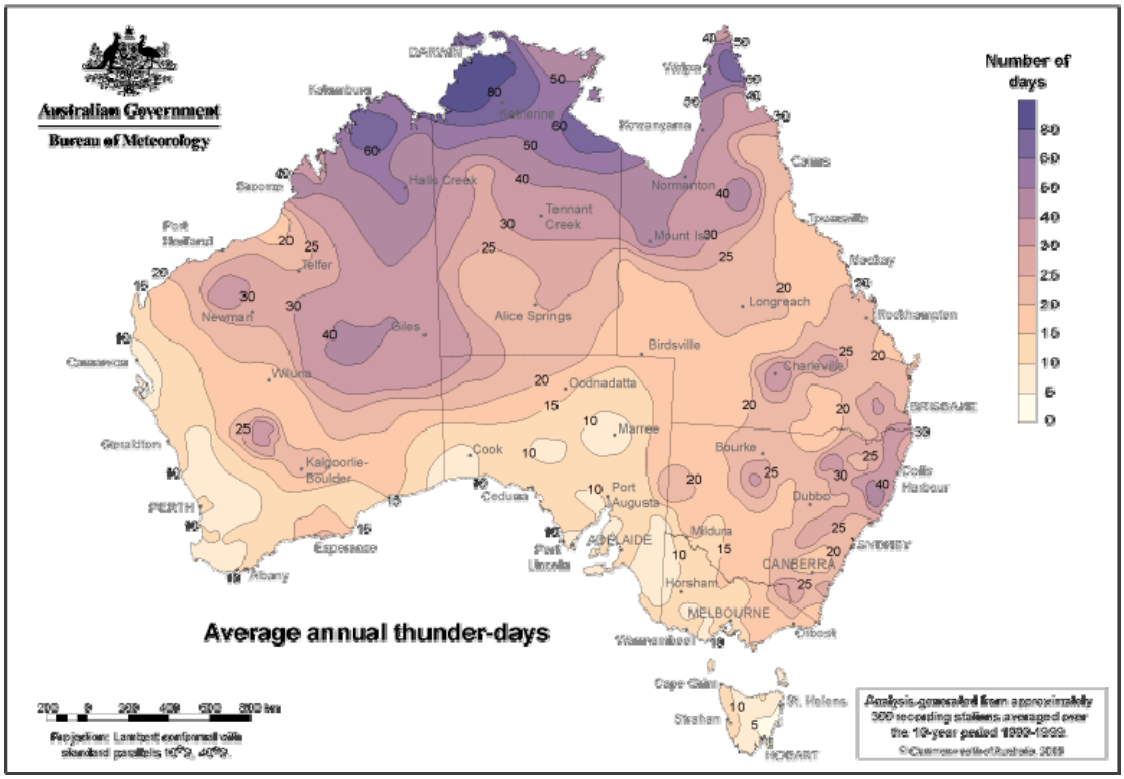


FIGURE 6.4 AUSTRALIAN AVERAGE ANNUAL LIGHTNING GROUND FLASH DENSITY (BOM, 2005B)

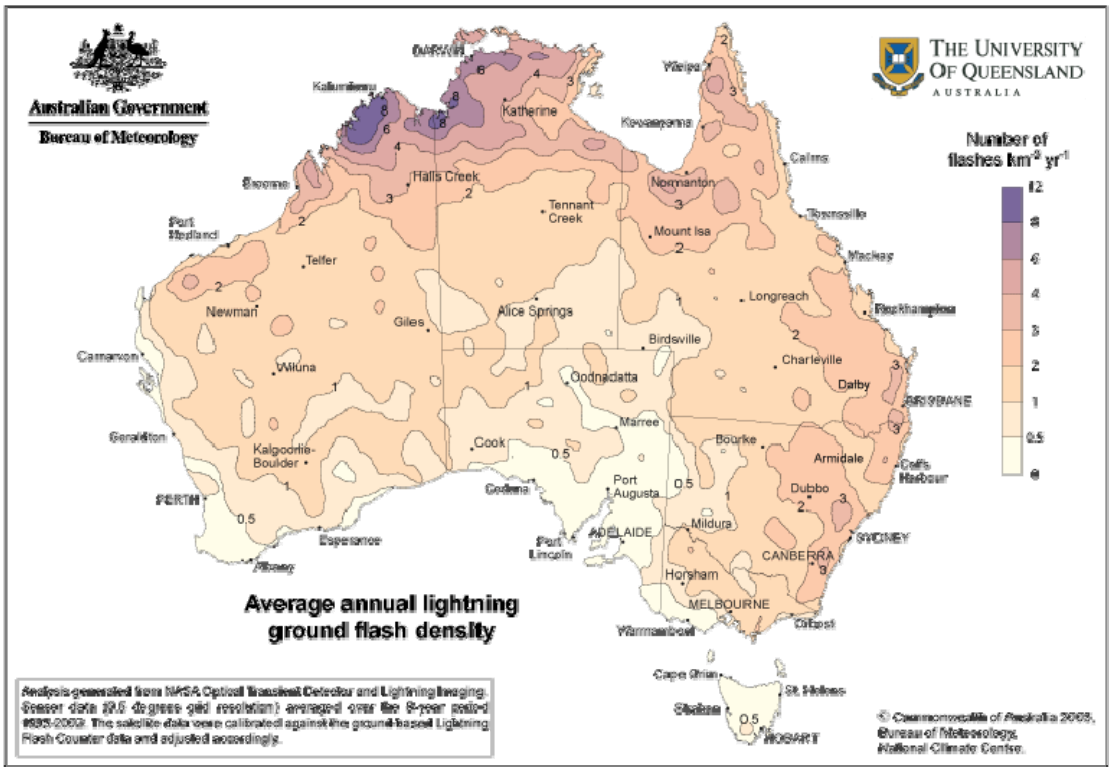
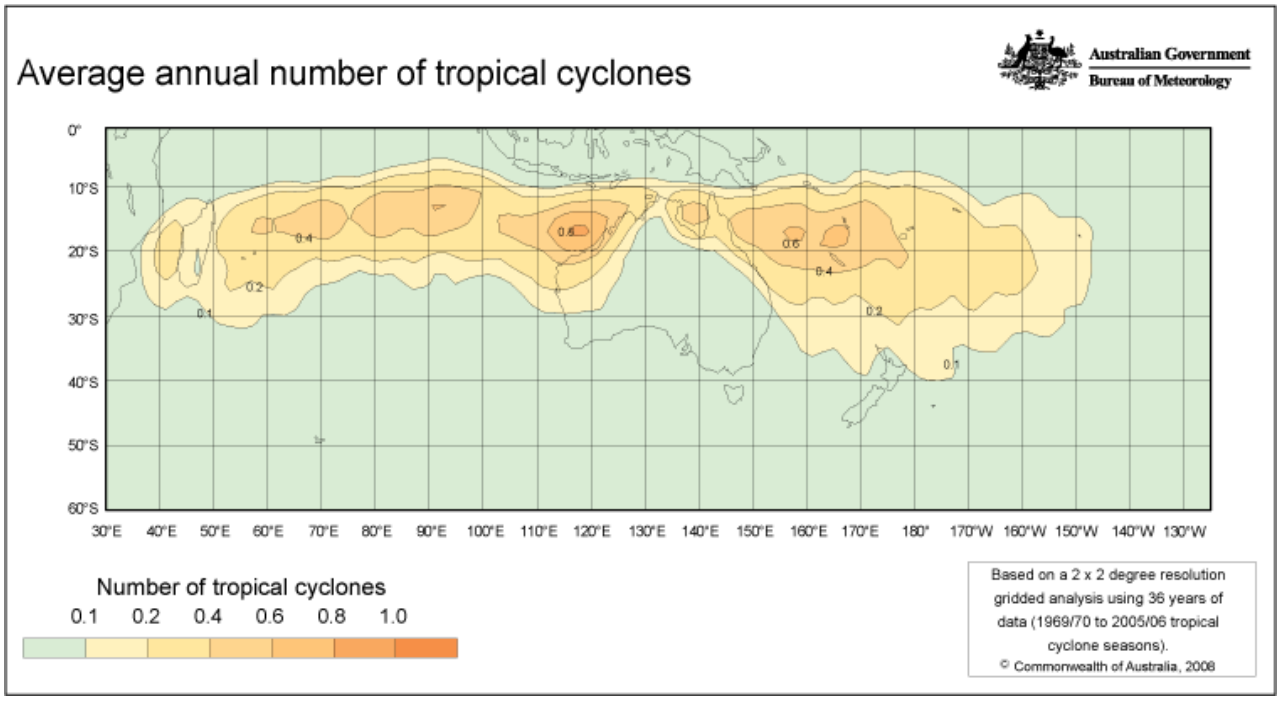


FIGURE 6.5 AUSTRALIAN AVERAGE ANNUAL TROPICAL CYCLONE INCIDENTS (BOM, 2006)



6.1.2 Air Quality

CS Energy's Kogan Creek Whyte air quality monitoring station is located immediately west of the study alignment, in the far western corner of the study area. The monthly summaries of the ambient air quality data from June 2008 to 2009 is provided below.

TABLE 6.3 CS ENERGY AIR QUALITY DATA

MONTH/ YEAR	NO PPB	NO2 PPB	NOX PPB	SO2 PPB	O3 PPB	PM25 µG/M^3	PM10 µG/M^3
Jun 2008	0	1	2	1	19	3	11
Jul 2008	0	1	1	0	20	2	9
Aug 2008	0	1	1	0	24	3	13
Sept 2008	0	1	1	0	24	7	22
Oct 2008	0	1	1	0	22	6	16
Nov 2008	0	2	2	0	22	6	17
Dec 2008	0	1	1	1	24	7	15
Jan 2009	-2	1	-2	1	19	5	15
Feb 2009	0	1	1	1	22	6	16
Mar 2009	0	1	1	1	18	4	21
Apr 2009	1	0	1	0	14	2	13
May 2009	0.1	0.6	0.7	0.5	19.9	5	14
Jun 2009	0.3	0.4	0.8	0.2	17.6	2	8
Annual	0.0	0.9	0.9	0.4	20.4	4.5	14.6

The daily average data collected from the Kogan Creek Whyte monitoring station shows no exceedances in ambient guidelines with the exception of Particulate Matter 2.5 micron (PM2.5), and Particulate Matter 10 micron (PM10) values as follows:

- 25 November 2008 – PM2.5 value of 25 equals Environment Protection Policy Air (EPP) Air Quality Objective of 25; PM10 value of 49 is just below EPP Objective of 50;
- 16 September 2008 – PM2.5 of 29 above objective of 25; PM10 value of 123 well above objective of 50; and
- 17 September 2008 – PM2.5 of 16 below objective of 25, but PM10 of 53 above objective of 50.

The Objective for PM10 allow for an exceedance on 5 days per annum for environmental values to still be protected. The 2008-2009 data provided is consistent with this objective.

High values may be a result of a combination of number of factors including regional dust storms, local ploughing of fields, unsealed roads, mining/petroleum activities and the nearby Kogan Creek Power Station.

In addition to this, DERM monitors air quality in south-east Queensland, with the closest monitoring station to the Project being located at Toowoomba (approximately 140km to the south-east). The most recent (April 2009) Air Quality Bulletin South-east Queensland reported that pollutant levels within the Toowoomba area are generally consistent with pollution levels across the South-east Queensland and reflects air quality of a metropolitan area (DERM, 2009). The bulletin also reported that pollutant levels did not exceed the relevant standards contained in the Commonwealth National Environment Protection (Ambient Air Quality) Measure (Air NEPM), the monitoring investigation levels contained in the Commonwealth National Environment Protection (Air Toxics) Measure or EPP (Air) visibility goal.

6.2 POTENTIAL IMPACTS

This section outlines a number of potential impacts relevant to the Project, including the impact of climate change on the proposed development, and the impact the proposed development may have on the ambient air quality.

6.2.1 Climate

The Australian Greenhouse Office (now Department of Climate Change) document "Climate Change: An Australian Guide to the Science and Potential Impacts" summarises the risks of climate change to include changes in rainfall pattern and intensities and bushfire patterns, increase in the average global surface temperature and sea level rise. For infrastructure, modelling suggests climate change impacts will be noticeable by 2030, with significant risks to property and plant by 2070 unless appropriate adaptation measures are undertaken.

The report also documents a need for infrastructure and the built environment to adapt to a medium to high certainty of changes to magnitude and frequency of extreme weather events. In these circumstances the risk of weather and climatic conditions exceeding design criteria (resulting in damage and increased 'wear and tear' on the structures) are considered significant.

As the useful design lifespan of the project infrastructure is expected to be 50 years, design of the structures will need to plan for changes in environmental conditions.

Quantitative assessment of the magnitude and scope of the changes to our climate have been undertaken previously by the CSIRO and the BoM. The *Climate Change in Australia — Technical Report 2007* and associated website provides climate change projections for Australia based on the Intergovernmental Panel on Climate Change (IPCC) modelling, which is based on various assumptions regarding demographic, economic and technological variables influencing future emissions profiles.

In 2009 more specific information for the Eastern Downs Region was updated and presented as part of the ClimateQ report (QLD Office of Climate Change, 2009).

Generally this data indicates 2070 peak summer temperature to be in the range of 2 to 5^{o}C above current values (relative to 1980-1999), with a 2 to 5% reduction in summer rainfall. Some additional climatic factors from the document are described in the below table. All values are 50th percentile or median values from the various modelled scenarios under a high, fossil fuel intensive emissions profile.

TABLE 6.4 PROJECTED CLIMATE CHANGE IN PROJECT AREA (CSIRO ET AL, 2007) (OCC, 2009)

	CURRENT	2030 PROJECTION	2050 PROJECTION	2070 PROJECTION
Summer Temp	18.6 - 31.8°C	+1°C (+0.6 – 1.4°C)	+1.9°C (+1.2 – 2.8°C)	+3.1°C (+2.0 – 4.6°C)
Annual Temp	12 – 26.8°C (max 41.7°C)	+1°C (+0.7 – 1.4°C)	+2°C (+1.3 – 2.8°C)	+3.2°C (+2.1 – 4.5°C)
Summer Rainfall	262 mm (42.5% of total)	-1% (-10 – +10%)	-1% (-19 – +19%)	-2% (-29 – +30%)
Annual Rainfall	694mm	-3% (-11 – +5%)	-6% (-21 – +10%)	-9% (-32 – +16%)
Annual Relative Humidity	50 – 60%	-0.5 – +0.5%	-0.5 – +0.5%	-0.5 – 1%
Annual Solar Radiation	15 – 19 MJ/m^3	-1 – +1%	-1 – +1%	-1 – +1%
Wind speed	11.1 – 12.8 km/h	-2-+2%	+2-5%	+5-10%
Evaporation	6.2 mm / day	+3% (+2 – 5%)	+7% (+4 - 10%)	+11% (+7 - 15%)

6.2.2 Regulatory Environment

International Policy

The Intergovernmental Panel on Climate Change (IPCC) is the international body responsible for review and assessment of the scientific research into climate change since 1990. The most recent (2007) review (the IPCC Fourth Assessment Report) concluded that:

- Warming of the climate system is unequivocal;
- Most of the warming in the past 50 years is 'very likely' (more than 90% probability) due to the observed increase in greenhouse gas concentrations from human activities such as the burning of fossil fuels and land use change; and
- It is 'very likely' that changes in the global climate system will continue well into the future, and that they will be larger than those seen in the recent past.

International cooperation on Greenhouse Gas (GHG) emissions is managed under an international treaty called the United Nations Framework Convention on Climate Change (UNFCCC). It is under this treaty that the first targets for reduction of GHG emissions was established in 1997, the Kyoto Protocol.

Under the Kyoto protocol an average global emission reduction of 5.2% from 1990 levels is targeted for the five year period ending 2012 (first commitment period is 2008 – 2012). Australia's target under the scheme is to impede emissions growth to 108% of 1990 levels (Department of Climate Change, 2008).

National Policy

Domestically, the Commonwealth Government have committed to emission cuts of 60% by 2050. Originally proposed for implementation in mid 2011, the Carbon Pollution Reduction Scheme (CPRS) is a market based

cap and trade system with the target to reduce Australia's emission. In April 2010 the timeline for implementation on any CPRS was extended until at least 2013. Therefore the potential impact of the proposed CPRS on the project is likely to be primarily in the increased costs of goods and services associated with the 'flow on' effect of carbon charges in the supply chain post 2013. Use of less carbon-intensive products will reduce this impact.

The National Greenhouse and Energy Reporting Scheme (NGERS) will underpin the CPRS, providing the emissions data on which obligations under the CPRS will be based. In order to satisfy any NGERS obligations (which may be either project specific or contribute to corporate level reporting), appropriate fuel and energy information needs to be collected by each sub-contractor involved with the projects construction.

The Mandatory Renewable Energy Target (MRET) requires electricity retailers and other wholesale purchases to ensure a proportion of their generation originates from non-fossil fuel sources. This target was recently increased from the original goal of a 2% increase on 1997 levels (by 2010) to the equivalent of 20% generation by 2020.

It should be noted that Powerlink has a non-discriminatory obligation to generators to provide connection to its grid. The energy source and generation type is not a consideration to Powerlink and is therefore not included in any targets of GHG calculations for Powerlink.

While MRET may not directly impact on the construction of the proposed substation and transmission line, it may impact the types and scale of renewable generation applying for interconnection into the system. As some renewable energy sources (such as wind, solar etc.) can be intermittent in nature, this can impact on the operation and security of some electrical infrastructure.

State Policy

Queensland has reiterated the Federal Government's GHG reduction target of 60% by 2050. The Queensland State Government has produced a number of policy documents regarding climate change adaptation, such as Climate Smart 2050 and the South-East Queensland Climate Change Management Plan. While not all directly applicable to the proposed transmission line and substation, the following recent policy and legislative releases (relevant to climate change) demonstrate the awareness of and rapid movement to address the management of climate change risk:

- Sustainable Planning Act 2009;
- South East Queensland Regional Plan 2009-2031;
- Draft South East Queensland Climate Change Management Plan;
- Climate Q: towards a greener Queensland (the State's Climate Change Strategy);
- The Queensland Government has set itself a target to cut Queenslanders' carbon footprint by one third by 2020;
- Premier's Council on Climate Change;
- Review of State Planning Policy 1/03 – Mitigating the adverse impact of flood, bushfire and landslide; and
- Queensland Renewable Energy Plan.

6.2.3 Air Quality

Seven sensitive receptors (dwellings) have been identified from aerial photography and regional investigations within 750m of the transmission line (refer to Section 3.1).

During the construction phase of the Project, traffic movements, unsealed access tracks, bulk earthworks and `vegetation clearing have the potential to cause dust nuisance. During construction, fugitive dust may occur in areas where bare soil is left exposed. The impact of this dust generation through vegetation clearing is considered marginal due to the size of the development footprint.

Dust is not expected to be a significant nuisance to ecologically sensitive areas, or to the neighbouring residents, again due to the size of the development footprint. The emission of particulates and gaseous pollutants from vehicle exhausts, compressors and construction equipment is not likely to exceed health guidelines due to the low intensity of the construction activity. Nonetheless, prior to construction activities, landholders that may be potentially affected by fugitive dust will be notified. Maintenance activities are unlikely to cause a dust nuisance due to low traffic volumes and especially once ground cover/low growing vegetation has had an opportunity to establish.

The proposed development is not expected to result in significant increases in odour during construction, operation or maintenance phases. The burning of vegetation will be restricted, where possible. In the event of necessary burning, odour is not expected to be a significant issue however the neighbouring landholders will be notified prior to burning activities and appropriate approvals/permits obtained.

6.3 MITIGATION MEASURES

6.3.1 Air Quality

Dust nuisance will be minimised by avoiding construction activities in areas with soils prone to erosion (e.g. sodic soils). In areas where erosion prone soils cannot be avoided, techniques would be employed to reduce dust emissions during both the construction and operational phases, as listed below:

- Reduce the need for unsealed access tracks by utilising sealed or gravelled access roads where possible and reducing the length of the unsealed access tracks (i.e. position access tracks off existing roads which are close to the proposed alignment). Powerlink to gravel access roads when the need for gravelling is identified (dependent on ground conditions);
- Reduce unauthorised vehicle movements on access tracks (e.g. by the use of gates and signs);
- Application of mulch on exposed areas during construction; and
- In sensitive areas, use of recycled water (where available) during construction to minimise dust originating from traffic movement on access roads, bulk earthworks and other activities.

During the maintenance phase, speeds will be limited on unsealed access tracks and will be further reduced in dry, windy weather, so as to reduce fugitive dust. Dust is not expected to be a significant issue post-construction, as traffic movement will be minimised and access tracks/easement clearing will be allowed to naturally revegetate.

Further detailed measures are outlined in the EMP (see Appendix G).