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Adani Mining Pty Ltd

NORTH GALILEE BASIN RAIL PROJECT

Environmental Impact Statement

Chapter 10 Air quality

November 2013

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10. Air quality

10.1 Purpose of chapter

This chapter documents the air quality assessment of the North Galilee Basin Rail Project (NGBR Project). The scope of the air quality assessment was defined by the following tasks:

- Description of existing air quality and meteorology
- Dispersion modelling of NGBR Project emissions to air, including
  - Particulate matter of less than 10 micron (PM_{10})
  - Particulate matter of less than 2.5 micron ($PM_{2.5}$)
  - Total suspended particulates (TSP)
  - Deposited dust
  - Nitrogen dioxide (NO_2)
  - Sulphur dioxide (SO_2)
- Assessment of the NGBR Project emissions against the relevant air quality objectives at potential sensitive receptors.

Existing background air quality and dispersion modelling is documented in detail in Volume 2 Appendix I Air quality, and presented in summary in this chapter.

This air quality chapter was prepared in accordance with the Terms of Reference (TOR) for the NGBR Project. A table that cross-references the contents of this chapter and the TOR is included as Volume 2 Appendix A Terms of Reference cross-reference.

All mitigation and management measures identified within this chapter are included within Volume 2 Appendix P Environmental management plan framework.

10.2 Methodology

10.2.1 Study area

The study area for this air quality assessment included the NGBR Project footprint, including the final rail corridor (nominally 100 m wide) and ancillary activities, and nearest potential sensitive receptors identified within approximately six kilometres of the preliminary investigation corridor (nominally 1,000 m wide). Potential quarry areas were also considered as dust sources, however impacts were only considered at the identified sensitive receptors within the study area.

10.2.2 Data sources

The air quality assessment relied on the following data sources:

- North Galilee Basin Railway Concept Design Report (Aarvee Associates 2013)
- Weather records at the following Bureau of Meteorology stations
  - Twin Hills Post Office (036047)
  - Collinsville Post Office (035019)
  - Millaroo DPI (Department of Primary Industries research station) (033090)
  - Bowen Airport (033257)

- Local meteorology for model input
  - Cassiopeia Station (473000 mE, 7576000 mN, GDA94)
  - Suttor Creek (585600 mE, 7635900 mN, GDA94)
  - Collinsville South – Sonoma Mine (589747 mE, 7717080 mN, GDA94)
  - Bogie River (580540 mE, 7764097 mN, GDA94)
  - Bowen (625728 mE, 7785873 mN, GDA94)
- Local ambient pollution data used to characterise existing background concentrations
  - Published ambient PM_{10} and $PM_{2.5}$ statistics for a greenfield Industry Partner Site in the Bowen Basin (Wiebe *et al.* 2011)
  - Published US Environment Protection Authority (USEPA) PM_{10} to TSP ratio
  - Published dust deposition rates from the Ensham Central Project (Katestone Environmental, 2006), located within the Bowen Basin
  - Published ambient TSP; dust deposition rate, NO_2 and SO_2 percentile statistics for the Queensland Department of Environment and Heritage Protection (DEHP) Townsville ambient site at Pimlico
  - Published ambient PM_{10} and $PM_{2.5}$ percentile statistics for the DEHP Toowoomba North monitoring site, for the purpose of applying ratios to Townsville data.

10.2.3 Legislation and guidelines

Legislation and guidelines relevant to this air quality report are as follows:

- *Environmental Protection Act 1994* (Qld)
- *Environmental Protection (Air) Policy 2008* (Air EPP)
- National Environment Protection (Ambient Air Quality) Measure (Air NEPM)
- National Environment Protection (Air Toxics) Measure (Air Toxics NEPM)
- NSW Department of Environment and Conservation Approved methods for modelling and assessment of air pollutants in NSW (NSW DEC 2005).

Air quality assessment criteria were developed with reference to the above legislation and guidelines (refer Section 10.2.5). A general explanation of the above legislation is also provided in Volume 1 Chapter 20 Legislation and approvals.

10.2.4 Desktop assessment

Existing air quality of the study area was determined by a literature review of published ambient pollution information (refer Section 10.2.2). Existing meteorology of the study area was determined based on Bureau of Meteorology (BOM) rainfall, temperature and humidity data (refer Section 10.2.2). Wind speed, direction, atmospheric stability and mixing height developed using MM5, CALMET and TAPM models.

The study area was subsequently divided into five meteorological regions, based on the above parameters. Exhaust emissions, particulate emissions and deposited dust were estimated using AUSROADS and AUSPLUME models, for three representative one kilometre track segments within each meteorological region. Technical information on the model parameters is provided in Volume 2 Appendix I Air quality.

Operation of the NGBR Project was considered at maximum capacity (100 mtpa), comprising 14 loaded and 14 unloaded train movements in a 24 hour period. Locomotives were conservatively considered to be of an emissions-intensive Tier 0 manufacturing standard.

Nearest potential sensitive receptors were identified within approximately six kilometres of the preliminary investigation corridor for the NGBR Project. For the purpose of this air quality assessment, sensitive receptors were defined as locations with high sensitivity to changes in background air quality concentrations. This may consist of residential dwellings (homesteads) and non-residential premises including schools, shops, offices, churches and structured recreational areas. Industrial premises were excluded as a sensitive receptor as they typically are more tolerant to changes in air quality.

Five temporary construction camps will be established on sites adjacent to the final rail corridor to meet estimated workforce accommodation demands. For the purposes of this assessment, temporary construction camps were not considered as sensitive receptors however they are locations which will trigger the implementation of mitigation measures to protect the occupant's general health and safety. Therefore they have been included in the discussion on potential impacts and mitigation Section 10.4.

Further details regarding the location, size and layout of the temporary construction camps has been included within Volume 1 Chapter 2 Project description.

Identified existing sensitive receptors are listed in Section 10.3.1. Further detail on the identification and characterisation of sensitive receptors is provided in Volume 1 Chapter 3 Land use and tenure and Volume 1 Chapter 4 Scenic amenity and lighting.

10.2.5 Impact assessment

Table 10-1 summarises the air quality criteria applied in the assessment of impacts of the NGBR Project at identified sensitive receptors.

Air quality criteria, excluding the criterion for deposited dust, were developed in accordance with the Air EPP, which incorporates standards from the Air NEPM and Air Toxics NEPM. The criterion for deposited dust was sourced from the Approved methods for modelling and assessment of air pollutants in NSW, published by the NSW Office of Environment and Heritage (DEC 2005), which is adopted by the Department of Environment and Heritage Protection (DEHP).

For the purpose of this air quality assessment, an impact was defined as the NGBR Project causing any of the below criteria to be exceeded at a sensitive receptor.

Table 10-1 Air quality criteria summary

Indicator	Environmental value	Air quality objective	Period
TSP	Health and wellbeing	90 µg/m^3 [(a)]	1 year
PM_{10}	Health and wellbeing	50 µg/m^3 [(a) (b)]	24 hours
$PM_{2.5}$	Health and wellbeing	25 µg/m^3 [(a)]	24 hours
		8 µg/m^3 [(a)]	1 year
Deposited Dust	Protecting aesthetic environment	2 g/m^2 [(c) (d)]	1 month
		4 g/m^2 [(c) (e)]	1 month
Benzene	Health and wellbeing	10 µg/m^3 [(a)]	1 year
Carbon Monoxide	Health and wellbeing	11,000 µg/m^3 [(a)]	8 hours
Formaldehyde	Health and wellbeing	54 µg/m^3 [(a)]	24 hours
	Protecting aesthetic environment	110 µg/m^3 [(a)]	30 minutes
Nitrogen dioxide	Health and wellbeing	250 µg/m^3 [(a) (f)]	1 hour
		62 µg/m^3 [(a)]	1 year
	Health and biodiversity of ecosystems	33 µg/m^3 [(a)]	1 year
Sulphur dioxide	Health and wellbeing	570 µg/m^3 [(a) (f)]	1 hour
		230 µg/m^3 [(a) (g)]	1 day
		57 µg/m^3 [(a)]	1 year
	Protecting agriculture	32 µg/m^3 [(a)]	1 year
	Health and biodiversity of ecosystems (for forests and natural vegetation)	22 µg/m^3 [(a)]	1 year
Toluene	Health and wellbeing	4,100 µg/m^3 [(a)]	24 hours
		410 µg/m^3 [(a)]	1 year
	Protecting aesthetic environment	1,100 µg/m^3 [(a)]	30 minutes
Xylenes	Health and wellbeing	1,200 µg/m^3 [(a)]	24 hours
		950 µg/m^3 [(a)]	1 year

[a] Queensland Air EPP (2008)
[b] Five exceedances of the 24-hour average are allowed in a year
[c] NSW Approved Methods for the modelling and assessment of air pollutants in NSW (2005)
[d] Maximum increase in deposited dust level, based on annual average of monthly observations
[e] Maximum total deposited dust level, based on annual average of monthly observations
[f] A one hour exceedance is allowed on one day each year
[g] One exceedance of the 24-hour average is allowed in a year

10.2.6 Limitations

The level of detail of the air quality assessment was limited to the information provided in the North Galilee Basin Railway Concept Design Report (Aarvee Associates 2013), as outlined in Volume 1 Chapter 2 Project description.

No background air quality monitoring was conducted within the final rail corridor prior to the preparation of this report. A review of publicly available data for central Queensland was therefore carried out to provide appropriate background concentrations. Conservative choices were made when defining the background to ensure a high degree of confidence in the robustness of the assessment.

NGBR Project emissions inherited the built-in assumptions of the applied meteorology and dispersion modelling software.

10.3 Existing environment

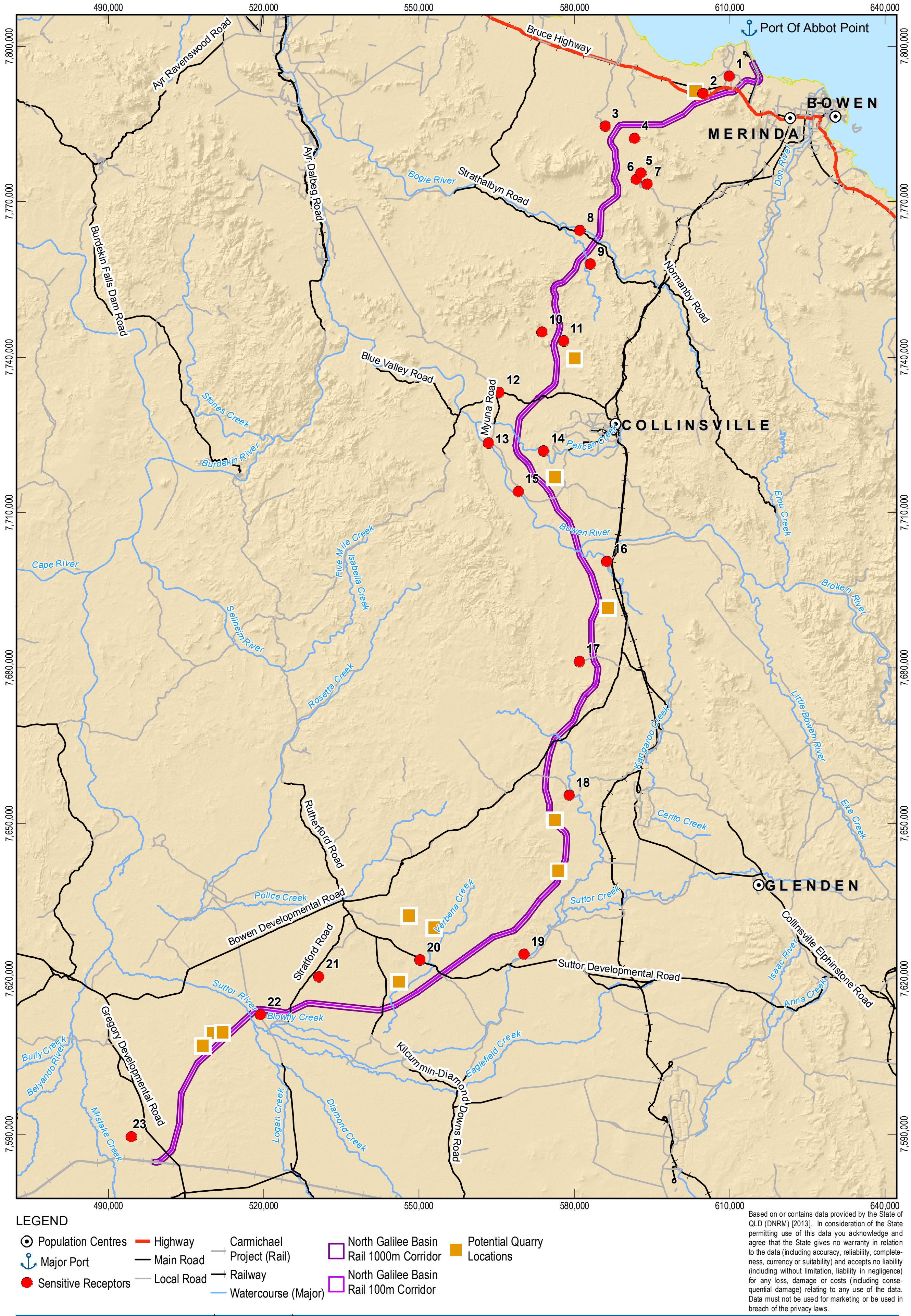
10.3.1 Sensitive receptors

The nearest sensitive receptors within approximately six kilometres of the preliminary investigation corridor were considered (refer Section 10.2.4). No non-residential premises were located within the study area.

Twenty-three potential sensitive receptors (homesteads) were identified within the study area (refer Figure 10-1). The nearest sensitive receptor to the centreline of the NGBR Project final rail corridor was approximately 1.1 km distant, whereas the average distance of all identified sensitive receptors was approximately 3.7 km. Table 10-2 lists all identified potential sensitive receptors.

Table 10-2 Sensitive receptors

Sensitive receptor	Easting	Northing	Distance to centreline of final rail corridor (m)
Homestead 1	609916	7794255	2,740
Homestead 2	604874	7790877	1,202
Homestead 3	585906	7784622	2,248
Homestead 4	591656	7782269	2,631
Homestead 5	592845	7775614	4,730
Homestead 6	591975	7774322	3,826
Homestead 7	594112	7773398	5,724
Homestead 8	581086	7764508	3,622
Homestead 9	583141	7758004	2,121
Homestead 10	573776	7744903	2,927
Homestead 11	577907	7743136	1,564
Homestead 12	565463	7733205	6,208
Homestead 13	563357	7723411	5,366
Homestead 14	574094	7721935	3,913
Homestead 15	569153	7714138	4,313
Homestead 16	586276	7700615	3,869
Homestead 17	580954	7681237	2,822
Homestead 18	579067	7655503	4,170
Homestead 19	570319	7624819	4,981
Homestead 20	550182	7623709	4,744
Homestead 21	530696	7620414	5,209
Homestead 22	519416	7613045	1,109
Homestead 23	494429	7589483	6,634



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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Adani Mining Pty Ltd

North Galilee Basin Rail Project

Sensitive receptors and emissions sources

Job Number 41-26457
Revision A
Date 29 Aug 2013

Figure 10-1

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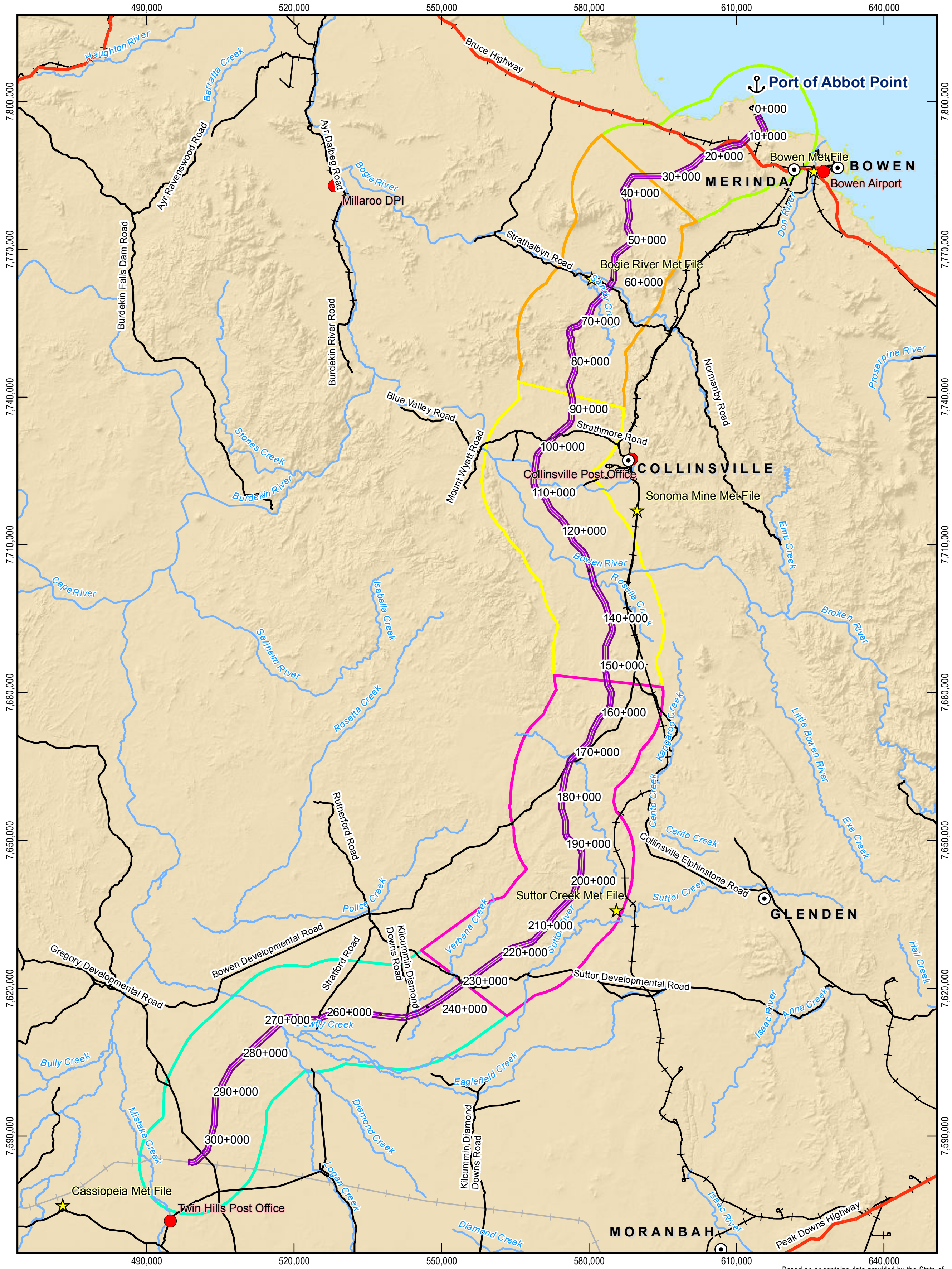
145 Ann Street Brisbane QLD 4000 Australia **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com **W** www.ghd.com

Data source: GA: Populated Places, Railway, Watercourse/2007; Adani: NGBR Corridor 13/05/2013, NGBR Corridor 06/06/2013, Carmichael Project (Rail) 18/06/2013, Quarry Locations/2013; Adani\GA\GHD: Sensitive Receptors/2013; DNRM: Roads/2010. Created by:MS

10.3.2 Meteorological regions

The broad description of the existing climate of the NGBR Project provided by BOM data is included in Volume 1 Chapter 17 Climate and natural hazards. Dispersion of air emissions is mainly dependent on the meteorological parameters of wind speed, direction, atmospheric stability and mixing height. These parameters are described in Section 10.3.3 to Section 10.3.5 for each of the following five meteorological regions crossed by the NGBR Project (refer Figure 10-2):

- Coastal region
- Bogie River region
- Bowen River region
- Newlands region
- Isaac region.



LEGEND

- Population Centres
- Major Port
- Chainage Points
- Climate Stations
- AUSPLUME Met File Locations
- Highway
- Main Road
- Carmichael Project (Rail)
- Railway
- Watercourses (Major)
- Meteological Boundaries
- Bogie River Region
- Bowen River Region
- Coastal Region
- Isaac Region
- Newlands Region
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor

Based on or contains data provided by the State of QLD (DNRM) [2013]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Adani Mining Pty Ltd
North Galilee Basin Rail Project

Job Number	41-26457
Revision	A
Date	21 Aug 2013

Meteorological regions

Figure 10-2

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145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

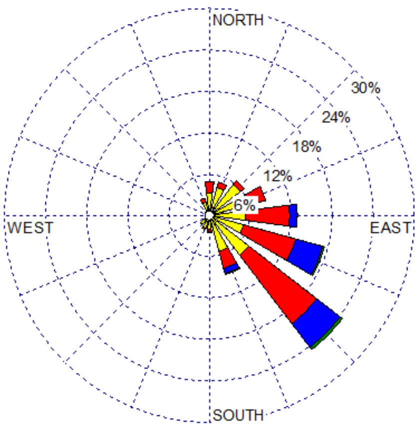
Data source: GA: Populated Places, Railway, Watercourse/2007; Adani: NGBR Corridor 13/05/2013 NGBR Corridor 06/06/2013, Camichael Rail Project/2012, Chainage/2013; BOM: Climate Sections/2013 Meteological Boundaries/2013; GHD: AUSPLUME Met File Locations/2013; DNRM: Roads/2010. Created by:MS

10.3.3 Wind speed and direction

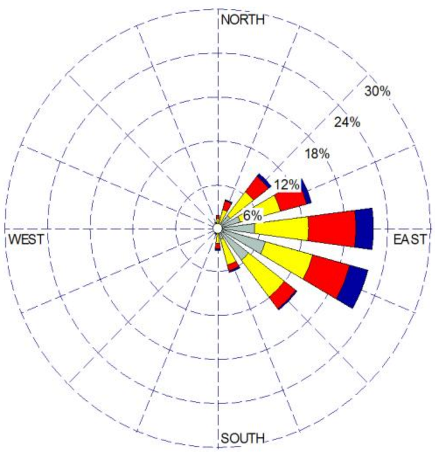
Annual wind roses for each of the five meteorological regions are depicted in Figure 10-3. The wind roses are dominated by south-easterly trade winds, with greatest exposure to these winds in the Coastal region. The four inland regions, on the leeward side of the Clarke Ranges, have lower average wind speeds.

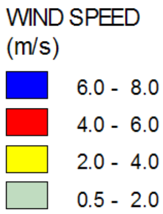
Figure 10-3 Wind speed and direction

Coastal region

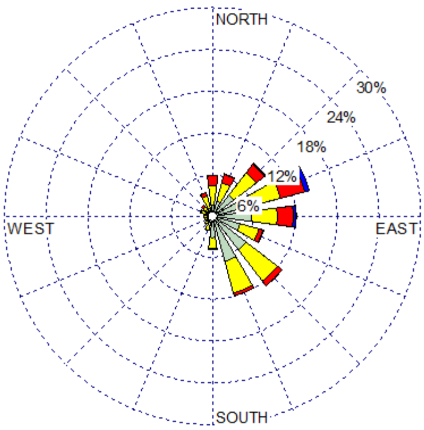


Bogie River region

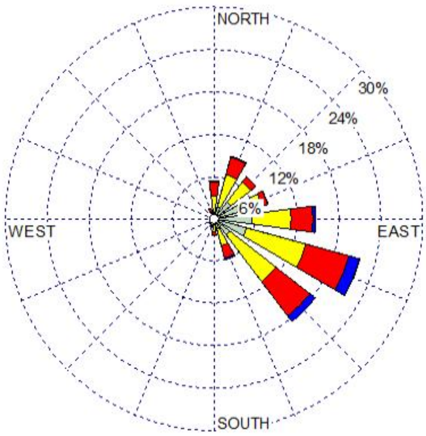




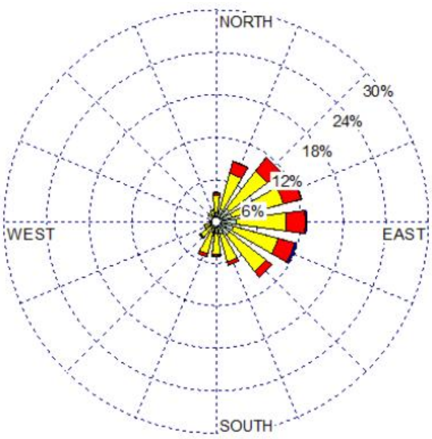
Bowen River region



Newlands region



Isaac region



10.3.4 Atmospheric stability

Atmospheric stability describes the tendency of the atmosphere to enhance or resist vertical dilution, which strongly influences emissions dispersal. The Pasquill-Gifford stability scheme (Pasquill 1961), defines the following atmospheric stability classes.

- Class A – very unstable
- Class B – unstable
- Class C – slightly unstable
- Class D – neutral
- Class E – slightly stable
- Class F – stable
- Class G – very stable.

Classes A, B and C are characteristic of day time conditions; Class D is characteristic of overcast days or nights; Class E, F and G are characteristic of night time conditions. Class G stability is rarely used in isolation, and usually refers to a combination of Class F and G.

Under stable conditions, near-ground level emission plumes are less likely to disperse as any turbulence caused by the wind blowing over the ground surface is dampened by buoyancy forces. Therefore the emission plumes in stable conditions can remain relatively concentrated at ground level as they travel downwind.

Under unstable conditions turbulence is amplified by buoyancy forces to provide strong vertical mixing. In these circumstances the plume will disperse and ground level concentrations will be lower. Therefore unstable conditions enhance downwind emissions dispersal, where stable conditions resist downwind dispersal and will generate higher ground level concentrations than would occur for unstable conditions. Under neutral conditions buoyancy forces neither enhance nor amplify turbulence.

Modelled stability class distributions for the five meteorological regions are depicted in Figure 10-4 to Figure 10-8. Results are expressed in terms of the per cent frequency that each class condition is likely to occur across an average year.

Neutral conditions are most common, however a high proportion of Class F conditions occur, particularly at in the Bogie River, Newlands and Isaac regions. The high frequency of stable conditions at the Bogie River, Newlands and Isaac regions represents a worst case scenario where dispersion of deposited dust, particles and locomotive emissions is likely to be low and ground level concentrations relatively high. However the predominance of neutral conditions over all sites indicates that near-ground level emission plumes associated with the NGBR Project generally will be more dispersed and less concentrated than the worst case scenario.

Figure 10-4 Stability class distribution (Coastal region)

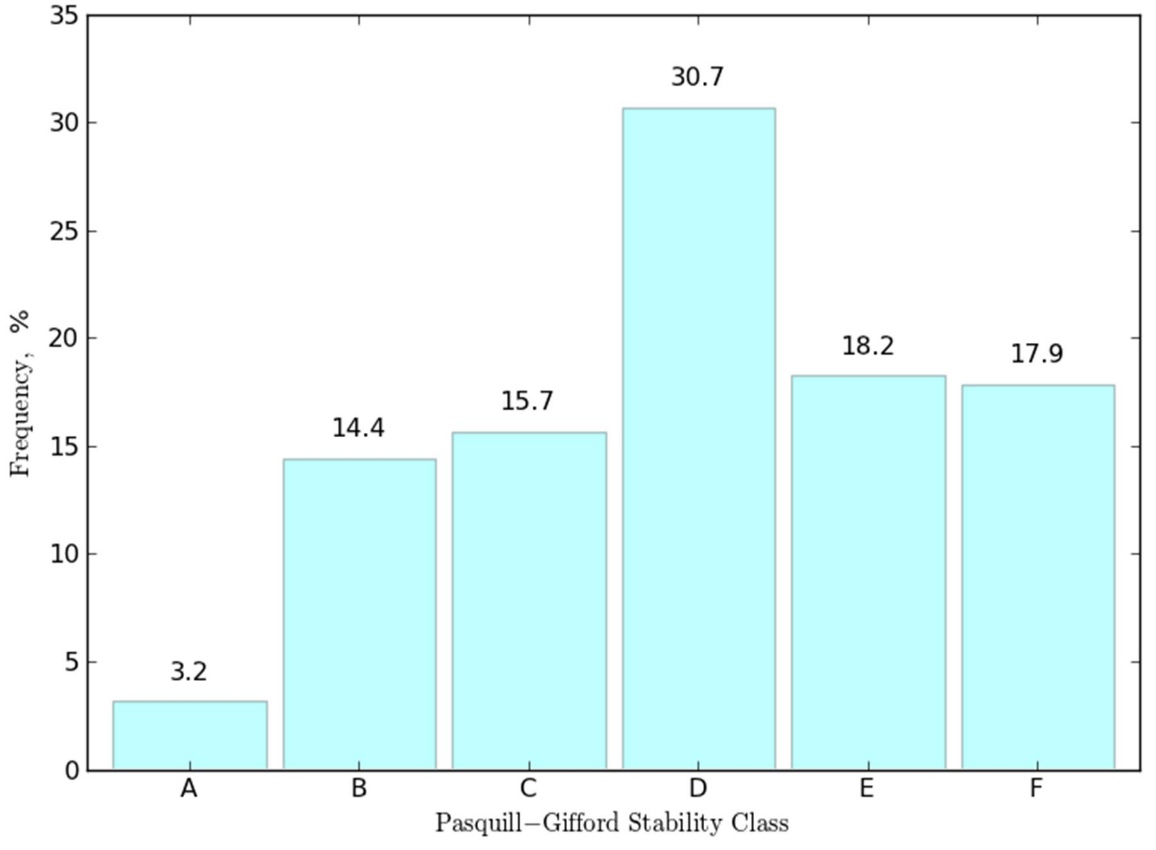


Figure 10-5 Stability class distribution (Bogie River region)

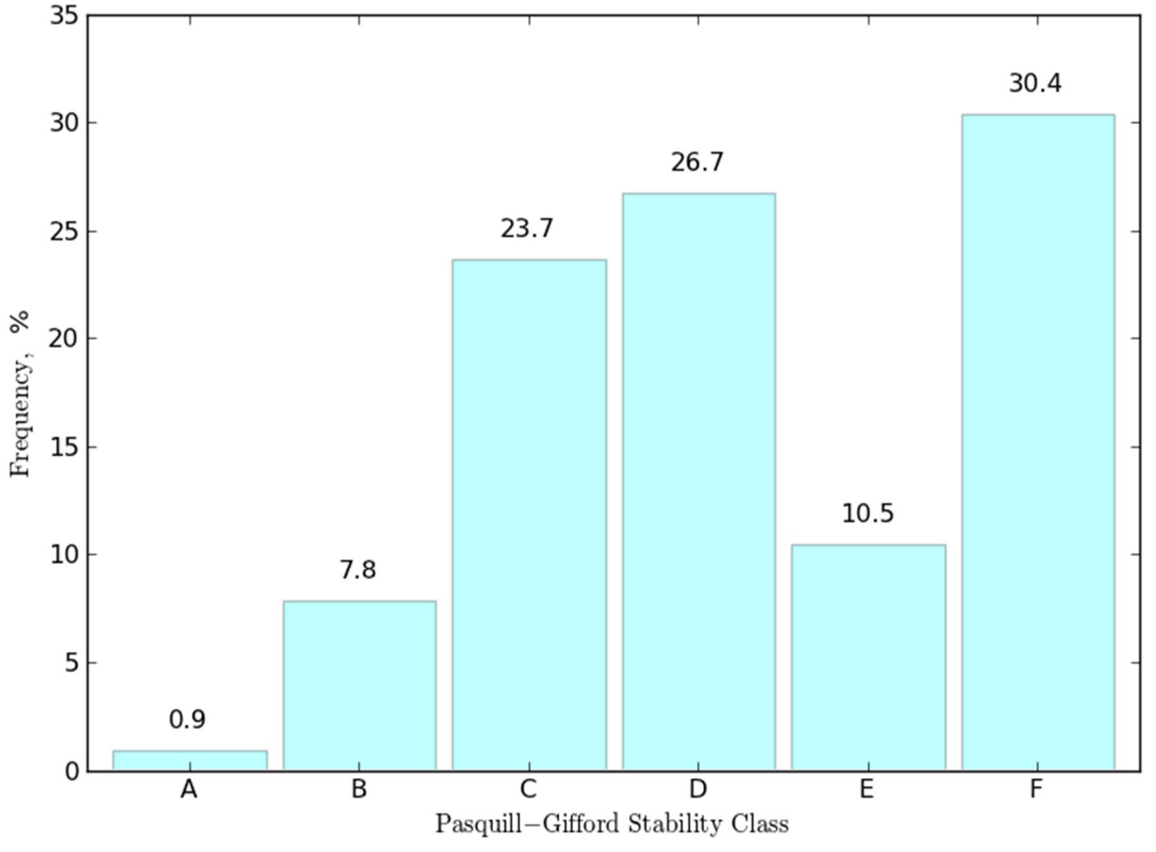


Figure 10-6 Stability class distribution (Bowen River region)

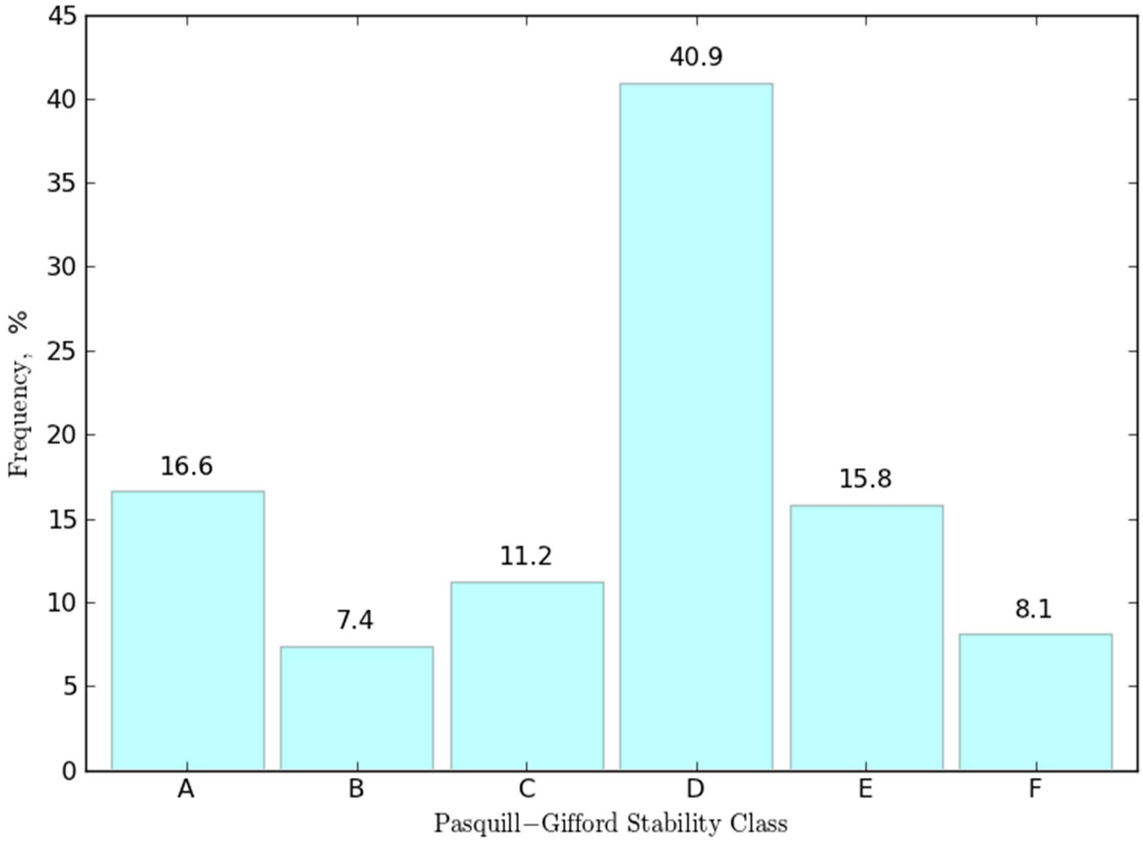


Figure 10-7 Stability class distribution (Newlands region)

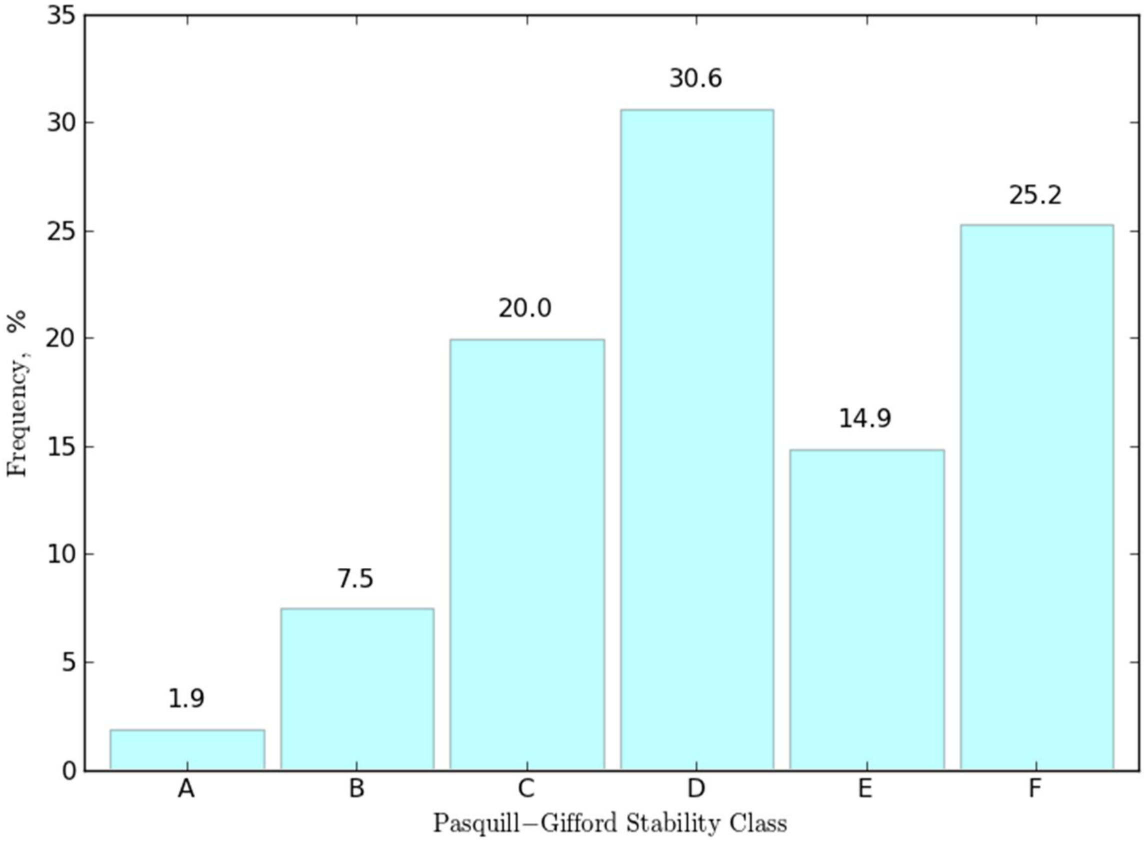
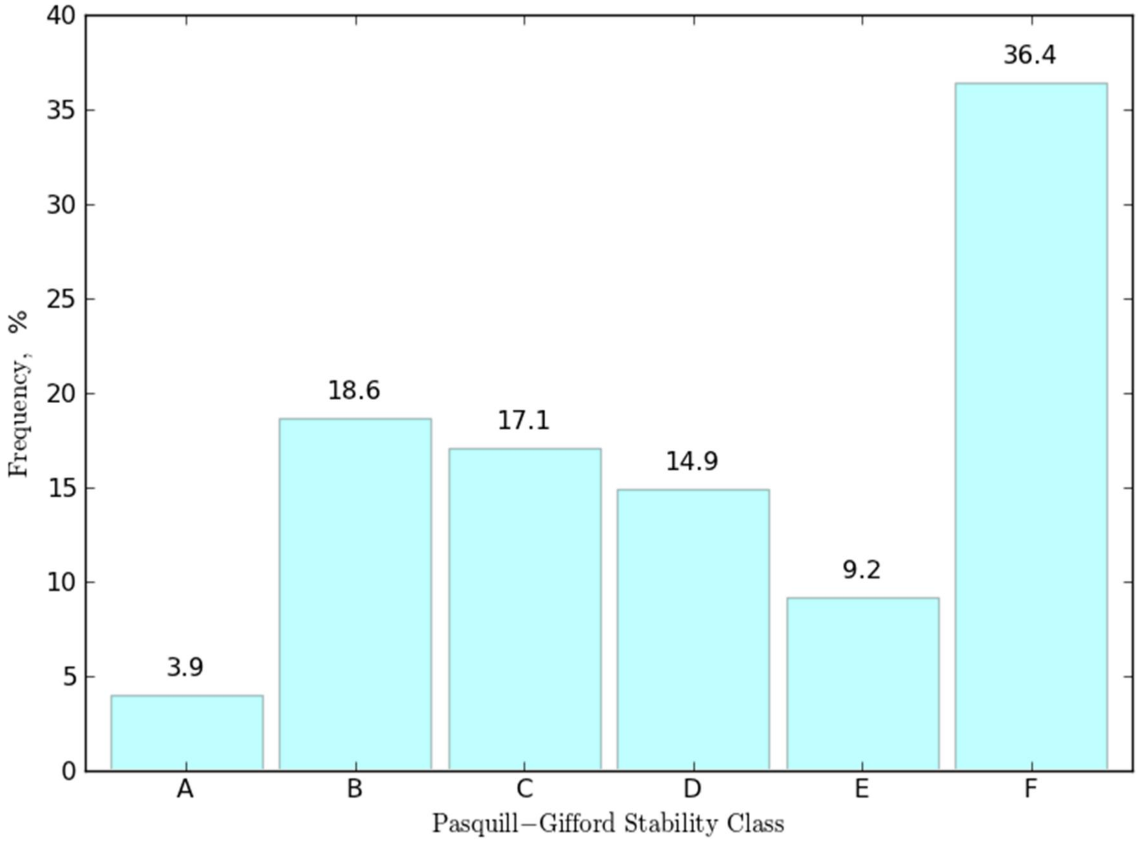


Figure 10-8 Stability class distribution (Isaac region)



10.3.5 Mixing height

Mixing height indicates the potential for vertical dispersion to occur. Generally speaking, lower mixing height enables downwind emissions dispersal, whereas greater mixing height creates potential for vertical dilution locally, which prevents downwind dispersal. Minimum, median and mean mixing heights for the five meteorological regions are listed in Table 10-3.

Table 10-3 Mixing height

Region	Minimum (m)	Median (m)	Mean (m)	Maximum (m)
Coastal	25	228	338	1,748
Bogie River	49	280	518	5,000
Bowen River	50	1,081	1,300	5,000
Newlands	91	889	1,237	5,000
Isaac	50	235	532	2,444

10.3.6 Background air quality

Due to similarities between meteorological regions, for the purpose of describing background air quality, the Coastal region was considered separately while the inland regions (Bogie River, Bowen River, Newlands and Isaac) were described collectively (refer Table 10-4). The Coastal region showed a low background dust concentration, yet higher gaseous emissions, due to industrial and motor vehicle sources associated with regional population centres. Background dust concentration in the drier, inland regions was higher, whereas the aforementioned gaseous emissions were low.

Inland regions were characterised from representative published material on background particulate matter in the Bowen Basin. Gaseous emissions were assumed to be negligible, based on the lack of any concentrated sources in the region. The Coastal region was characterised from representative published material on background particulate matter and gaseous emissions in Townsville. PM_{10} to $PM_{2.5}$ ratios were determined at the Toowoomba North monitoring site, for the purpose of applying these ratios to the Townsville data. Refer to Section 10.2.2 for a list of the particular publications that were referenced.

$PM_{2.5}$ is rarely measured and only tends to be monitored by DEHP in large, heavily industrialised urban centres. Data from the Toowoomba North monitoring site is a reliable source as it is the smallest and least urbanised of the available DEHP locations and therefore provides the most suitable location to characterise the Abbot Point $PM_{2.5}$ to PM_{10} ratio.

Table 10-4 Background air quality

Component	Period	Background concentration	
		Inland	Coastal
Total suspended particles (µg/m^3)	1 year	30.0	26.4
PM_{10} (µg/m^3)	24 hours	15.0	18.1
$PM_{2.5}$ (µg/m^3)	24 hours	6.6	5.1
	1 year	5.8	3.7
Deposited dust (g/m^2/month)	1 year	1.6	0.5
Benzene (µg/m^3)	1 year	0.0	0.0
Carbon monoxide (µg/m^3)	8 hours	0.0	0.0
Formaldehyde (µg/m^3)	30 minutes	0.0	0.0
	24 hours	0.0	0.0
Nitrogen dioxide (µg/m^3)	1 hour	0.0	55
	1 year	0.0	9
Sulphur dioxide (µg/m^3)	1 hour	0.0	11
	24 hours	0.0	6
	1 year	0.0	3
Toluene (µg/m^3)	30 minutes	0.0	0.0
	24 hours	0.0	0.0
	1 year	0.0	0.0
Xylenes (µg/m^3)	24 hours	0.0	0.0
	1 year	0.0	0.0

10.4 Potential impacts and mitigation measures

The construction and operation of the NGBR Project will generate emissions to air. The potential of these emissions to have an impact at identified sensitive receptors is assessed in the following sections in relation to the relevant assessment criteria (refer Section 10.2.5).

10.4.1 Construction

Impact of particulate emissions during construction

Primary particulate sources during the construction of the NGBR Project include:

- Mechanical disturbance by vehicles and equipment
- Erosion of exposed soil surfaces under high wind speeds
- Exhaust emissions from vehicles and stationary and mobile plant.

A PM_{10} emission factor of 0.11 tonne/acre-month (Countess Environmental, 2006) was applied to an indicative one kilometre segment of the final rail corridor. AUSPLUME modelling of the segment, with the above emission factor applied, indicated that PM_{10} levels would lower to the 50 µg/m^3 criterion at 200 – 230 m. Based on this indicative result, it is considered that PM_{10} levels will be lower than the criterion within approximately 300 m of the final rail corridor. As a secondary effect of PM_{10}, dust deposition was also expected to fall within the 2 g/m^2/month criterion within this distance. This is consistent with experience on similar construction projects, in which PM_{10} above regulatory criteria is unlikely beyond the range of 500 m.

This 500 m offset distance was also considered to be applicable to quarrying operations, and is in accordance with the recommended separation distances for quarries involving blasting in the Victorian Environmental Protection Authority Recommended separation distance for industrial residual air emissions (EPA Victoria 2013).

The nearest identified sensitive receptor to the centreline of the NGBR Project final rail corridor was approximately 1.1 km distant, while the nearest sensitive receptor to a potential quarrying location was approximately two kilometres distant (refer Figure 10-2). As such, no impact is expected in either case.

Five temporary construction camps will be established on sites adjacent to the final rail corridor and are likely to be partially or wholly constructed within 500 m of emission sources. The construction camp facilities will be positioned to minimise external impacts from the final rail corridor construction or associated laydown or turning areas, as well as any internal emission sources from vehicle parking or waste management. Construction camp designs will meet the Air EPP criteria, by incorporating enclosed meals, living and sleeping quarters, which will be mechanically ventilated and insulated to protect residents. Given that the construction camps will predominantly be occupied outside of daytime construction hours, when emission sources will be minimal, in addition to the transient or fleeting nature of construction activities in sections of the final rail corridor adjacent to the construction camps, the potential impacts to occupants can be fully mitigated to avoid any potential health risks.

Impact of exhaust emissions during construction

Engine exhausts during construction would include carbon monoxide, oxides of nitrogen, sulphur dioxide and volatile organic compounds. Sources of construction exhaust emissions will include those from vehicles travelling to and from construction areas along public roads, heavy vehicles using haulage routes, and operation of plant and equipment within and adjacent the final rail corridor and ancillary infrastructure footprints. The relatively small-scale, temporary and mobile nature of emissions sources during construction are considered relatively minor in comparison to total engine exhaust emissions across the region.

As the nearest identified sensitive receptor to the NGBR Project was approximately 1.1 km distant, the potential for exhaust emissions to impact a sensitive receptor was considered negligible. Separation distances between the exhaust emissions generated from construction machinery and the position of living areas within construction camps are likely to exceed 100 m and therefore will sufficiently mitigate any impacts on residents during construction.

10.4.2 Operation

Impact of particulate emissions during operation

The primary particulate emissions during operation of the NGBR Project are considered to be TSP, PM_{10} and $PM_{2.5}$. Primary emission sources during the operation of the NGBR Project include:

- Particulate exhaust emissions from loaded and unloaded locomotives
- Coal dust wind erosion from loaded wagons in transit
- Coal dust leakage from loaded wagons (bottom-dump unloading doors)
- Coal dust wind erosion from spilled coal in the final rail corridor.

Hourly emissions were modelled in AUSROADS at up to 200 m from the centreline of the final rail corridor. Predicted peak daily mean PM_{10} is depicted in Figure 10-9. The maximum distance to compliance with the relevant assessment criteria for each of the above particulate emissions within each of the five meteorological regions of the study area is provided in Table 10-5.

As the nearest identified sensitive receptor to the NGBR Project was approximately 1.1 km distant, the potential for particulate emissions to impact a sensitive receptor was considered negligible.

Table 10-5 Particulate emissions during operation

Criterion	Distance to compliance from centreline of final rail corridor (m)				
	Coastal	Bogie River	Bowen River	Newlands	Isaac
TSP	27	46	61	39	43
PM_{10}	90	102	147	121	228
$PM_{2.5}$ [(a)]	71	99	143	115	223
$PM_{2.5}$ [(b)]	144	315	279	288	273

[(a)] Daily criterion

[(b)] Annual criterion

Impact of dust deposition during operation

Dust deposition during operation was modelled in AUSPLUME from an indicative one kilometre segment of the final rail corridor, at up to 200 m from the centreline (refer Figure 10-10). The maximum predicted values for dust deposition were below the 2 g/m^2/month criterion for increase of deposited dust (refer Section 10.2.5) at all locations within the 200 m wide model area. The maximum predicted dust deposition value was 0.35 g/m^2/month (approximately 18 per cent of the criterion). Given the low background deposited dust levels (refer Section 10.3.6), the four g/m^2/month criterion for total deposited dust was also predicted to be met at all locations.

Figure 10-9 Predicted peak daily mean PM_{10}

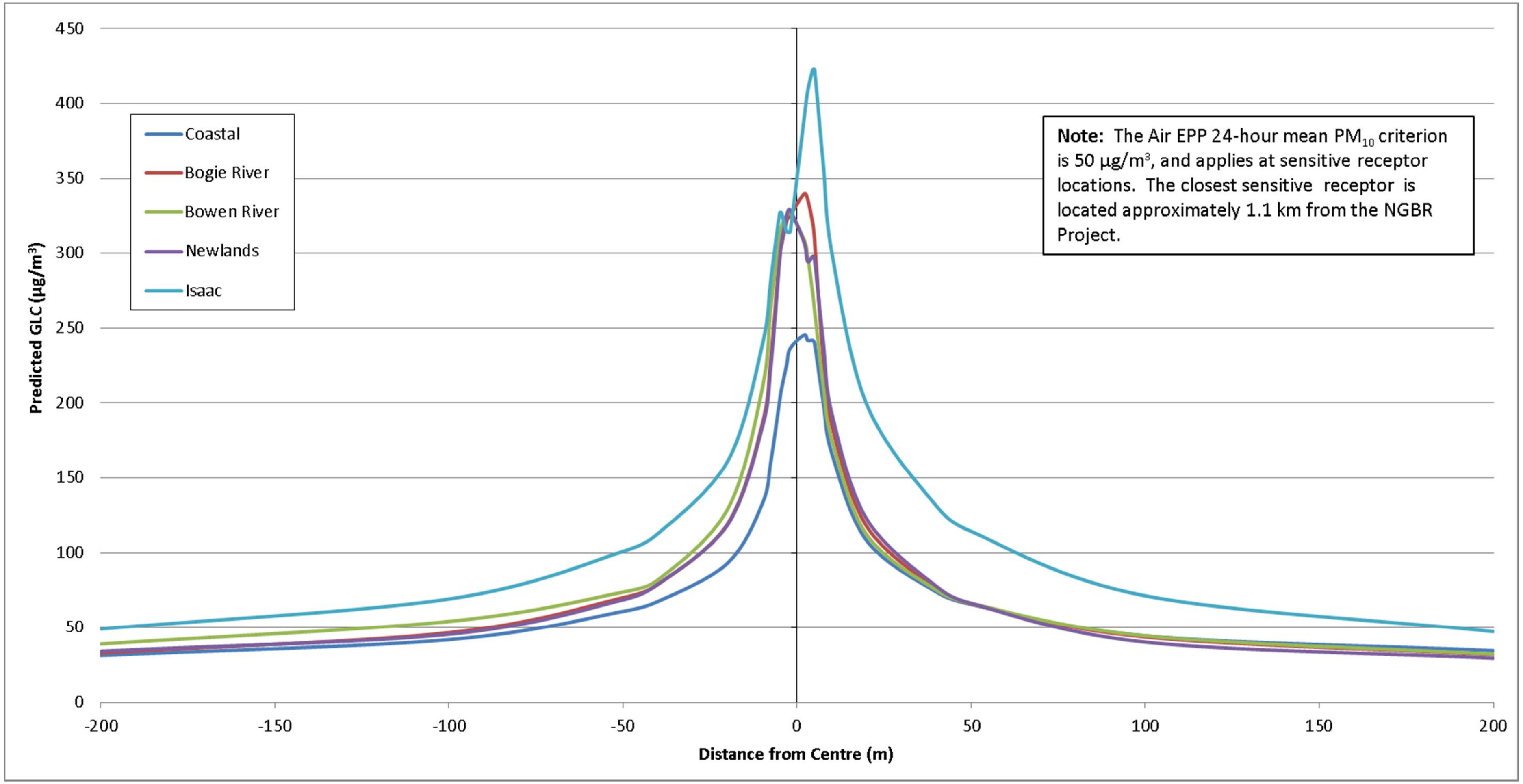
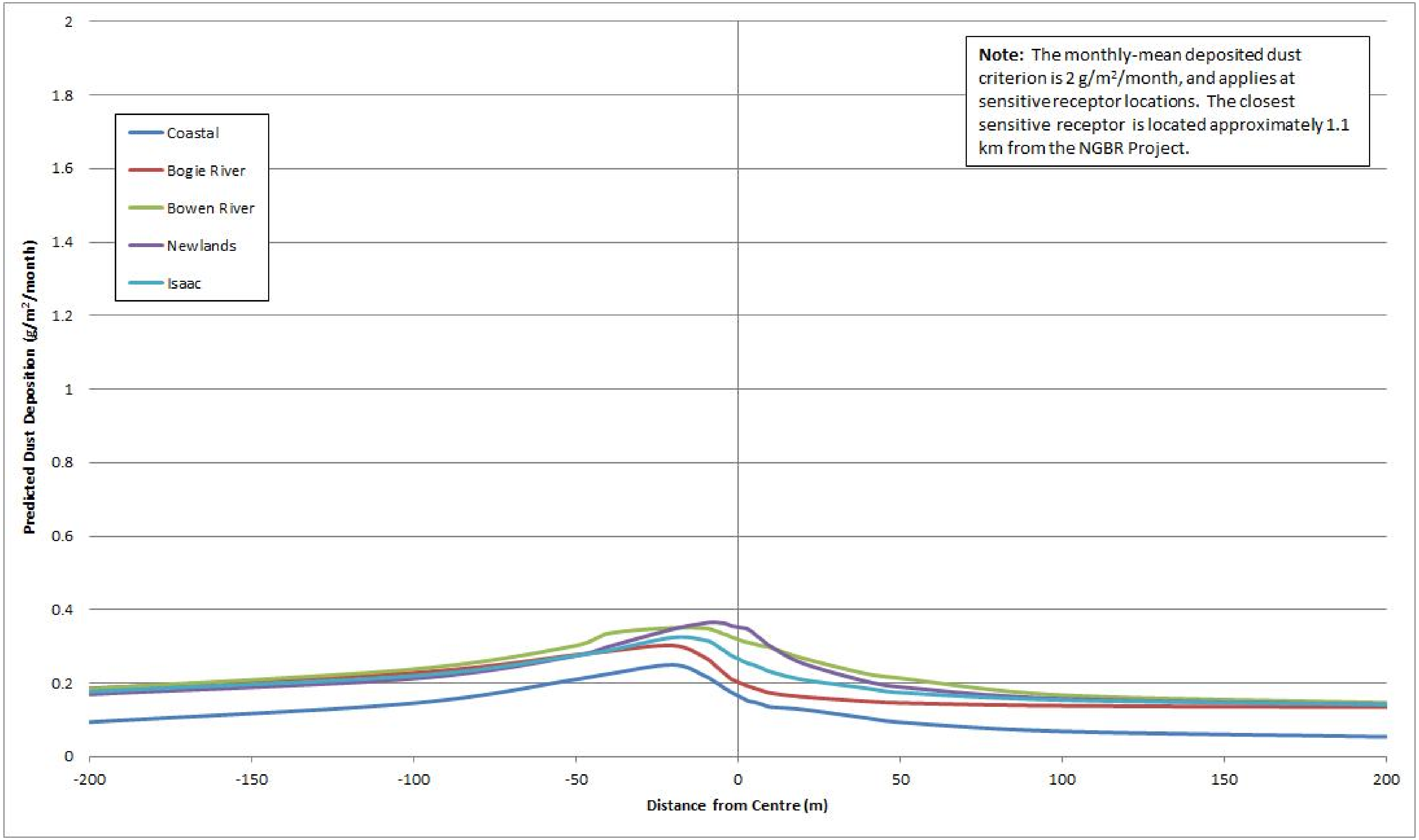


Figure 10-10 Predicted peak annual dust deposition



Impact of exhaust emissions during operation

Exhaust from locomotives will be the primary source of non-particulate emissions during the operations of the NGBR project. The following emissions from locomotives were considered:

- Carbon monoxide
- Oxides of nitrogen
- Sulphur dioxide
- Benzene
- Formaldehyde
- Toluene
- Xylene.

PM_{10} and $PM_{2.5}$ from locomotive exhausts are considered above, in combination with other particulate emissions.

Hourly emissions were modelled in AUSROADS from two metres up to 200 m from the centreline of the final rail corridor. Maximum predicted values for all exhaust emissions were below the criteria at all locations within the 200 m wide model area (refer Table 10-6).

Table 10-6 Maximum modelled concentration of exhaust emissions

Substance	Averaging time	Statistic	Criterion (µg/m³)	Maximum modelled concentration (µg/m³)	Percentage of Air EPP criterion (%)
NO_2	1 year	Mean	62	30.7	49.5
Benzene	1 year	Mean	10	6.6	66.3
CO	8 hours	Maximum	11000	391	3.6
Formaldehyde	30 minutes	Maximum	110	0.05	0.04
Formaldehyde	24 hours	Maximum	54	0.01	0.00001
SO_2	1 hour	Maximum	570	11.4	2.0
SO_2	24 hours	Maximum	230	6.2	2.7
SO_2	1 year	Mean	57	3.1	5.4
Toluene	30 minutes	Maximum	1100	0.7	0.07
Toluene	24 hours	Maximum	4100	0.18	0.004
Toluene	1 year	Mean	410	0.06	0.02
Xylene	24 hours	Maximum	1200	0.26	0.02
Xylene	1 year	Mean	950	0.10	0.01

10.4.3 Summary of mitigation

Although the separation distances between the NGBR Project and identified sensitive receptors in the region are likely to provide an adequate buffer from any potential impacts, Table 10-7 contains a number of mitigation measures that will be applied, if necessary, during construction. Instances in which the below mitigation may apply are if soil stockpiles are established away from the final rail corridor, or potential quarry locations are revised.

Mitigation measures for operation are typified in the Aurizon Coal Dust Management Plan (Aurizon 2010), and include veneering, wagon loading systems and monitoring of coal dust emissions to air. A Coal Dust Management Plan will be developed by Adani to be generally consistent with the Aurizon Coal Dust Management Plan.

Based on separation distances between the NGBR Project and identified sensitive receptors, it is not expected the monitoring of coal dust emissions to air will be required. However, the Coal Dust Management Plan for the NGBR Project will provide for monitoring in the event of a complaint.

Table 10-7 Summary of mitigation

Timing	Mitigation measures
Pre-construction Construction	Dust during construction will be managed through a Dust Management Plan, which includes the following management measures: • Watering of construction site and access roads will be undertaken as required to control dust • Avoid movement or handling, or increase wetting, of soil material on days of very high winds in close proximity to downwind sensitive receptors • Any soil that is stockpiled for longer than two weeks will be covered, stabilised and/or moistened as required to prevent generation of dust particulates
Pre-operation Operation	A Coal Dust Management Plan will be developed and implemented for the operational phase of the NGBR Project. The plan will be consistent with the aims, objectives and mitigation measures proposed in the Aurizon Coal Dust Management Plan (Aurizon 2010).
Operation	All complaints relating to air quality (including dust emissions) will be recorded and managed in accordance with the complaints management procedure. Air quality monitoring may be conducted following a complaint.

10.4.4 Conclusion

This air quality chapter describes the potential impacts of emissions to air from the NGBR Project. Emissions predicted in this chapter are based on the construction methodology and proposed operations described in the North Galilee Basin Railway Concept Design Report (Aarvee Associates 2013) in addition to conservative or 'worst case' assumptions as necessary.

The assessment concludes that, despite the inherent conservatism in the assessment, negligible change to background air quality is expected at any of the identified sensitive receptors and suitably designed construction camps were considered to be sufficiently resilient to air quality impacts. On the basis of this assessment, no residual impacts are expected to result from the NGBR Project.

A number of mitigation measures have been identified in the instance that ancillary features of the NGBR Project, e.g. soil stockpiles or quarries, are established in closer proximity to a potential sensitive receptor than assessed. A Coal Dust Management Plan will be developed by Adani to be generally consistent with the Aurizon Coal Dust Management Plan.