CHAPTER 11
Air quality

BRISBANE METRO
Draft Design Report

Contents

11. Air quality

This chapter assesses potential air quality impacts associated with the construction and operational phases of Brisbane Metro. It provides an overview of existing ambient air quality, changes to air quality as a result of Brisbane Metro and identifies mitigation and management measures to manage potential impacts.

11.1 Assessment methodology

The study area for this assessment is as described in Chapter 1. The majority of the Brisbane Metro alignment utilises existing busway infrastructure. As such, the assessment of potential construction impacts focuses mainly on those areas of new or modified infrastructure. The methodology for this air quality assessment involved:

- reviewing the policy setting and developing appropriate objective concentrations for assessing potential air quality impacts in accordance with relevant policies and guidelines
- describing key features and conditions within the study area including:
  - sensitive receivers and surrounding land uses near to the Brisbane Metro alignment from the review of aerial imagery
  - prevailing climate and meteorological conditions including wind speed and direction, temperatures and rainfall, based on data from automatic weather stations operated by the Bureau of Meteorology
  - existing background air quality data from nearby DES monitoring stations
- identifying and assessing potential changes to local air quality conditions from the construction of Brisbane Metro, with a particular focus on those areas near to major construction works
- assessing potential changes to air quality from the operation of Brisbane Metro, based on the consideration of changes with and without Brisbane Metro
- identifying mitigation measures to manage potential air quality impacts
- evaluating the significance of any adverse air quality risks, including any residual risks following the application of the recommended control measures.

11.1.1 Construction air quality

Potential air quality risks mainly relate to major construction works such as Buranda station, Cultural Centre precinct and North Quay/Adelaide Street. Dust arising from demolition, excavation and bulk material handling activities is expected to be the primary air quality risk from the construction of Brisbane Metro.

This assessment has adopted the United Kingdom Institute of Air Quality Management[1] (UK IAQM) method for evaluating impacts from construction dust (i.e. particulate matter). This considers potential dust impacts arising from four primary construction activities being demolition; earthworks; construction; and transport and transport-related handling of materials ('trackout') and the management of these impacts through following steps:

- screening assessment to determine whether a more detailed assessment is necessary (Step 1)
- evaluating the potential magnitude (Step 2A) and sensitivity of the surrounding receiving environment to dust impacts (Step 2B) to evaluate the risk of dust impacts (Step 2C) with no mitigation measures to be applied
- developing mitigation for each work location, commensurate to the level of identified risk (Step 3)
- evaluating residual dust-related risks following the application of the mitigation measures (Step 4).

[1] UK IAQM (2014) *Guidance on the assessment of dust from demolition and construction Version 1.1*

11.1.2 Operational air quality

As indicated in Chapter 5, Council are currently assessing a range of metro vehicles from providers in Australia and around the world to determine their suitability for Brisbane Metro. This includes consideration of potential power source options. For the purposes of this assessment, it is assumed that the fuel type would be diesel. This provides a conservative assessment of potential air quality changes.

During operation, the key air pollutants are anticipated to be from the combustion of diesel in metro vehicles. They include:

- particulate matter including PM_{10} (i.e. particles with aerodynamic diameter of 10 micrometres or less) and $PM_{2.5}$
- oxides of nitrogen including nitrogen dioxide (NO_2)
- volatile organic compounds (VOCs) such as benzene.

Carbon monoxide (CO) and sulphur dioxide (SO_2) have been excluded from this assessment as the production of these by metro vehicles is expected to be in small quantities only, due to more efficient combustion and changes in Australian emissions and fuel quality standards (e.g. to exclude sulphur). Ambient levels of these pollutants are also well below the relevant air quality objectives.

Minor sources of emissions from the operation of Brisbane Metro (e.g. particulate matter generated from braking and the wearing of the rubber tyres over time, and exhaust emissions from maintenance activities) currently occur with the operation of the existing busway and have been excluded from this assessment.

A first-pass screening of operational impacts was undertaken using the NSW Roads and Maritime Services Tool for Roadside Air Quality prediction model. This CALINE algorithm model predicts air pollutant concentrations near roadways using default vehicle emission factors. Emission factors were updated based on guidance presented in the *Composite Vehicle Emission Factors for Brisbane* database[2].

Consistent with guidance presented in TMR's *Road Traffic Air Quality Management Manual*[3] (RTAQM) changes to roadside air quality concentration were predicted over two design horizons, being the year of opening and the year of opening plus 10 years ('design year'). These were compared with existing conditions to determine changes to air quality associated with Brisbane Metro.

11.2 Legislative and policy context

Legislation and policy relating to air quality include:

- *National Environment Protection (Ambient Air Quality) Measure 1998* (NEPM AAQ)
- EP Act and associated regulation
- *Environmental Protection (Air) Policy 2008* (Air EPP)
- RTAQM
- *ShapingSEQ*
- City Plan – Air quality planning scheme policy.

11.2.1 Air quality objectives

The air quality objectives proposed for Brisbane Metro operations are presented in Table 11.1. These have been identified based on the review of relevant legislation and policies and relate to the protection of human health and wellbeing, and natural ecosystems.

[2] Brisbane City Council and DSITI (2016) Composite Vehicle Emission Factors for Brisbane database
[3] TMR (2014) *Manual: Road Traffic Air Quality Management*, June 2014

Table 11.1: Brisbane Metro air quality objectives

Pollutant	Averaging period	Maximum concentration in µg/m^3 at 0°C	Maximum allowable exceedances	Reference
PM_{10}	24 hours	50	Five days each year	Air EPP, RTAQM
	Annual	25	-	NEPM AAQ
$PM_{2.5}$	24 hours	25	-	NEPM AAQ, Air EPP, RTAQM
	Annual	8	-	
Deposited dust	Monthly	4 g/m^2/month	-	RTAQM
NO_2	1 hour	246	One day each year	NEPM AAQ, Air EPP, RTAQM
	Annual	62	-	
	Annual (natural ecosystems)	33	-	
Benzene	Annual	10	-	Air EPP, RTAQM

Table 11.2 presents the criteria used for the sections of Brisbane Metro that are in-tunnel. These are based on the RTAQM in-tunnel air quality criteria.

Table 11.2: RTAQM in-tunnel air quality criteria

Air quality indicator	Units (µg/m^3 unless specified)	Units (ppm unless specified)	Averaging time
CO	112,500	100	15 minutes
NO_2	2,054	1	15 minutes
Visibility – extinction coefficient K^c	7 x 10^{-3} (m^{-1})	N/A	One minute

11.3 Existing environment

This section describes key features of the environment around the study area, including nearby sensitive receivers, local climate and meteorological trends and background air quality characteristics.

11.3.1 Sensitive receivers

A variety of sensitive receivers are located within the study area. Table 11.3 lists those located within approximately 50 metres of the open sections of the alignment (i.e. non-tunnel section) or major construction works (i.e. metro depot, bus layover and turnaround facility at Griffith University station, Buranda station, Cultural Centre precinct and Adelaide Street). Existing air quality at many of these sensitive receivers are influenced by traffic on adjacent transport corridors.

It is recognised that much of Brisbane Metro uses existing sections of the busway network and that construction activities are not proposed within the vicinity of most of these receivers. However, the nature of operations at these locations will vary as metro vehicles are introduced. Land uses in the vicinity of Brisbane Metro are described in Chapter 13.

Table 11.3: Nearest sensitive receivers to Brisbane Metro

Section	Suburb	Sensitive receiver	Type	Distance (metres)
Rochedale to Upper Mt Gravatt	Rochedale	Dwellings at School Road	Residential	50*
	Eight Mile Plains	Dwellings along Timaru Crescent and the Holmead Road Caravan Park	Residential	20
	Upper Mt Gravatt	Dwellings off Pickworth Street, Nagle Street and Meckiff Street	Residential	30

Section	Suburb	Sensitive receiver	Type	Distance (metres)
Mt Gravatt to Greenslopes	Mt Gravatt	Griffith University Tennis Centre (tennis courts)	Recreational	50
	Holland Park West	Dwellings off Messines Ridge Road	Residential	50
		Holland Park State High School	Educational	40
		Dwellings along Bapaume Road and along Cannes Street and Oatland Crescent	Residential	30
		Gibson Place Park	Recreational	50
		Dwellings along Birdwood Road, Edric Street, Mananda Street and Merrell Street	Residential	20
	Greenslopes	Dwellings along Marquis Street	Residential	30
	Stones Corner	Dwellings along Cornwall Street and Myrtle Street	Residential	20
Woolloongabba to St Lucia	Buranda	Dwellings along Oxford Street and Fern Street, and O'Keefe Street	Residential	20
		Dwellings at O'Keefe Street within Buranda TOD	Residential	<10*
	Dutton Park	Harmony Gardens	Recreational	20
		South Brisbane Cemetery	Community	20
	Woolloongabba	Dwellings along Reid Street, Hawthorne Street, Wilton Street, Henry Street, Mossgrove Street, Grattan Street, Guy Street, Link Street, Bourne Street, Queen Bess Street, Church Avenue, Arrow Street and Bank Lane	Residential	20
South Brisbane	South Brisbane	Mater Private Hospital and Mater Medical Centre	Health	20
		Mater Children's Hospital	Health	30
		South Brisbane Memorial Park	Recreational	30
		Lady Cilento Children's Hospital	Health	20
		Southbank TAFE	Educational	40
		BCEC	Community	20
		QPAC	Community	<10*
		Queensland Museum and Art Gallery	Community	20*
Brisbane CBD	CBD	Brisbane City Council (Brisbane Square building, including library)	Community	20*
		City Hall	Community	<10*
		Emma Miller Place	Recreational	20
	Petrie Terrace	Dwellings along St James Street, Terrace Street and Mountjoy Street	Residential	50
		Hardgrave Park	Recreational	50
	Spring Hill	Brisbane Grammar School	Educational	20
Kelvin Grove to Herston	Kelvin Grove	QUT Kelvin Grove campus	Residential	20*
	Herston	Dwellings along Herston Road and Wyndham Street	Residential	40
		Victoria Park Golf Course	Recreational	20*
		UQ School of Public Health	Health	50
		Old Royal Children's Hospital	Health	30
		RBWH	Health	20

**distance from construction worksite*

11.3.2 Climate and meteorological conditions

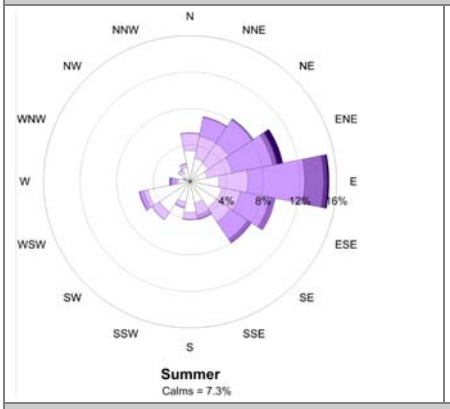
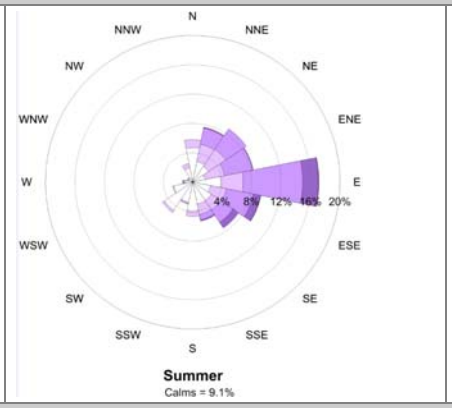
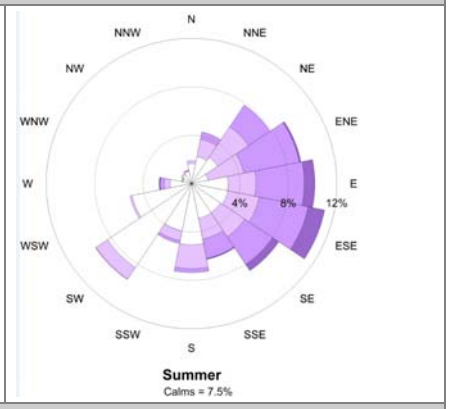
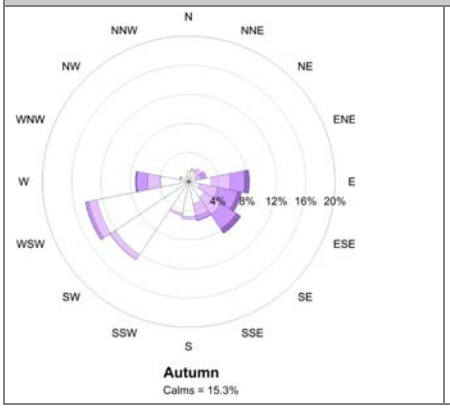
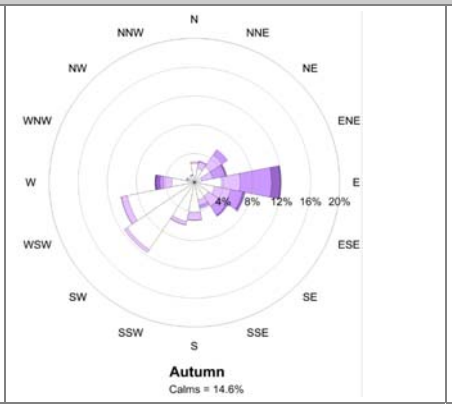
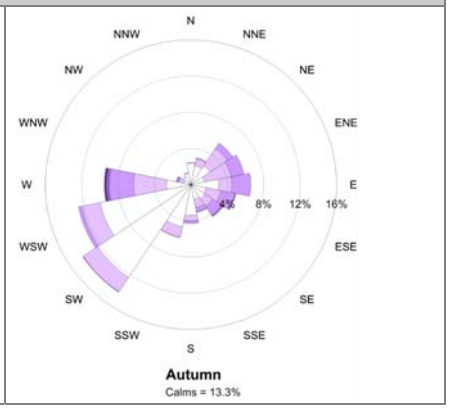
Climate and meteorological conditions are important for determining the dispersion of emissions. The key factors affecting dispersion are wind speed and direction and to a lesser extent, air temperature and precipitation. The Bureau of Meteorology operates an automatic weather station at Kangaroo Point, approximately two kilometres from the CBD. The station collects a variety of meteorological data and has been in operation since 1999. Data from this station has been used to characterise meteorological conditions near the study area.

Long-term temperature and rainfall data near the study area indicates that maximum average air temperatures are around 30°C during summer months, with mean minimum temperatures decreasing to around 10°C in winter. The highest proportion of annual rainfall generally falls from November to March with the period from July to September historically the driest period with the lowest mean rainfall and number of rain days.

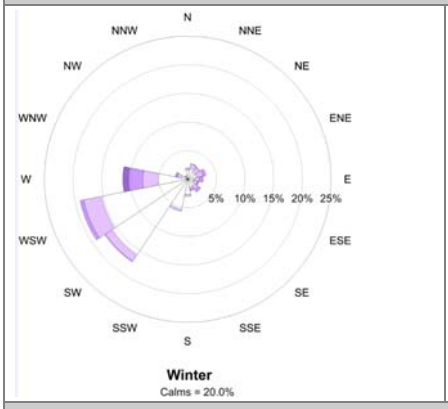
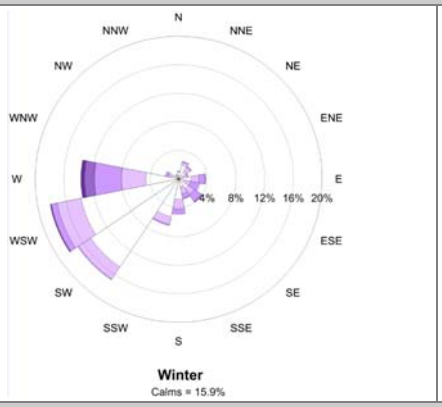
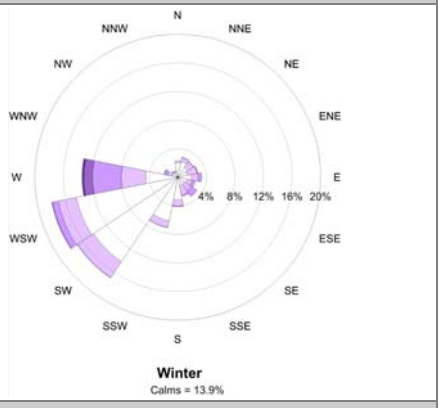
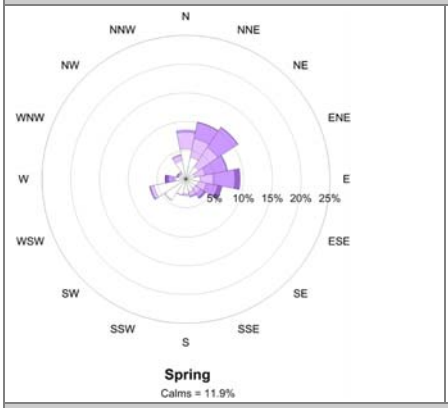
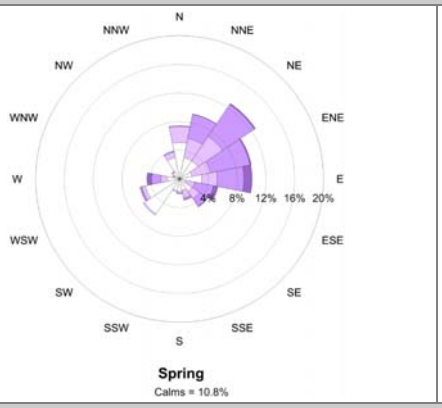
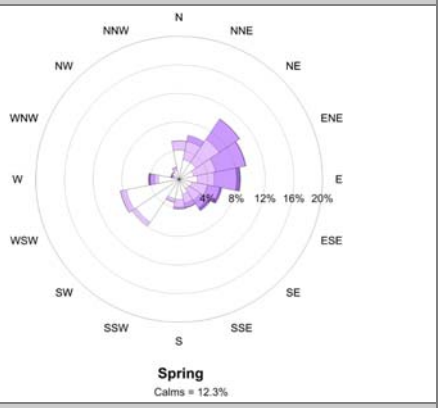
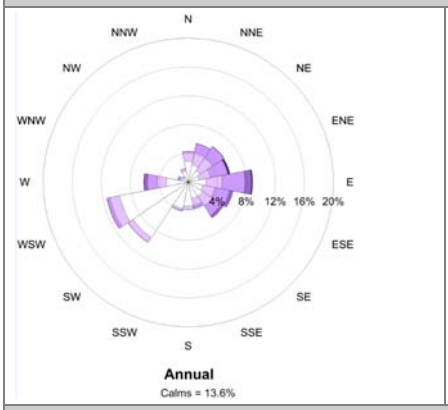
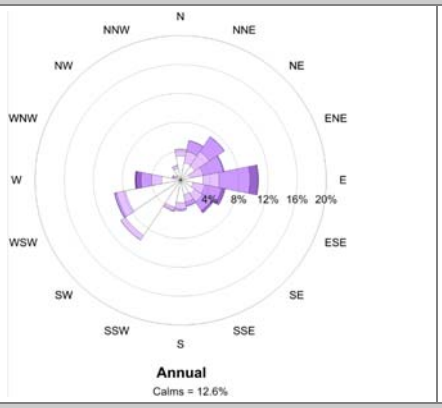
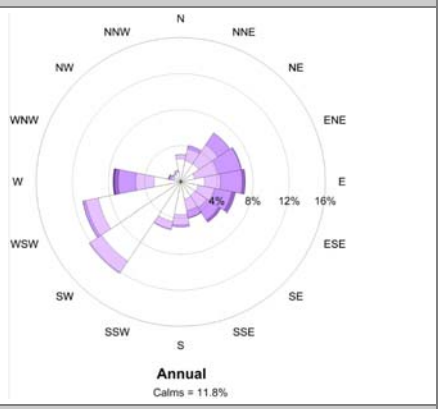
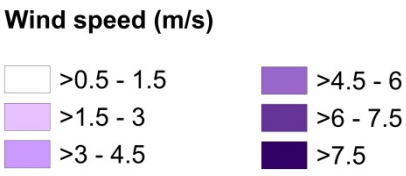
Annual and seasonal wind roses were developed from data collected for the years 2013-15 to determine prevailing wind conditions near the study area (refer to Table 11.4). The prevailing wind conditions are generally similar with typical trends demonstrating:

- annual – light winds blowing from all clockwise directions between the western and south-western sector, with some moderate winds blowing from the north-east clockwise to the south-east
- summer – moderate winds blowing from the north-east clockwise to the south-east
- autumn and winter – light to moderate winds blowing from the west anti-clockwise to the south-west
- spring – moderate winds blowing from the north-northeast clockwise to the south-southeast.

Table 11.4: Annual and seasonal wind roses, 2013-2015[4]

2013	2014	2015
Summer		
		
Autumn		
		

[4] Bureau of Meteorology (2017) Summary statistics Kangaroo Point (Station no. 040913), accessed August 2017 at http://www.bom.gov.au/climate/averages/tables/cw_040913.shtml

2013	2014	2015
Winter		
		
Spring		
		
Annual		
		
Legend		
		

11.3.3 Ambient air quality

DES operates an ambient air quality monitoring network, comprising 33 monitoring stations across Queensland. Data collected from six monitoring stations within or close to the study area is presented in Table 11.5 by monitoring station and pollutant for each relevant averaging period. The number of exceedances of the applicable criterion for that year is presented in brackets.

Table 11.5: Summary of measured background air quality conditions measured around Brisbane Metro alignment[5]

Year	Concentrations at air monitoring stations (µg/m^3)						Air quality objective
	Springwood	Rocklea	Woolloongabba	South Brisbane	CBD	Cannon Hill	
Maximum 24 hour averaged PM_{10}							
2013	35	32	40	39	36	-	50
2014	33	32	96 (7)	47	39	43	
2015	56 (1)	44	49	43	50	62 (1)	
2016	31	31	-	33	42	34	
Annually averaged PM_{10}							
2013	14	14	17	18	16	-	25
2014	13	14	19	16	14	17	
2015	13	15	18	15	14	15	
2016	12	15	-	16	15	15	
Maximum 24 hour averaged $PM_{2.5}$							
2013	14	17	22	23	-	-	25
2014	18	22	26 (1)	29 (1)	-	26 (1)	
2015	13	20	15	26 (1)	-	16	
2016	20	20	-	22	-	27 (1)	
Annually averaged $PM_{2.5}$							
2013	5.2	6.6	8.0	7.8	-	-	8
2014	4.9	5.8	7.4	7.0	-	9.1	
2015	4.5	7.3	6.2	7.4	-	6.9	
2016	5.7	6.5	-	8.3	-	7.7	
Maximum 1 hour averaged NO_2							
2013	68	74	121	99	-	-	246
2014	72	97	123	113	-	-	
2015	66	84	156	129	-	-	
2016	70	117	-	121	-	-	
Annually averaged NO_2							
2013	11	12	34	28	-	-	62
2014	11	14	32	28	-	-	
2015	10	12	31	34	-	-	
2016	12	14	-	30	-	-	
Annually averaged VOCs (as benzene)							
2013	2.5	-	-	-	-	-	10
2014	2.4	-	-	-	-	-	
2015	3.0	-	-	-	-	-	
2016	3.3	-	-	-	-	-	

Note: (-) indicates that data is not measured at the monitoring station. Data only available at Woolloongabba from 2013 to 2015, with no PM_{10} and $PM_{2.5}$ data collected and only a partial dataset available for NO_2. Data only available from Cannon Hill since midway through the first quarter of 2014

[5] DEHP (2017) Background air quality datasets, accessed August 2017 at https://data.qld.gov.au/dataset?q=air+quality, Queensland Government

The background concentrations for each key pollutant against the air quality objectives for Brisbane Metro is summarised as follows.

- The maximum 24-hour averaged PM_{10} background concentrations were generally measured below the 50 microgram per cubic metre (µg/m^3) objective value or the number of exceedances recorded were less than the allowable limit of five per year. The exception was at the Woolloongabba monitoring station, which recorded seven exceedances in 2014 due to dust from building construction works immediately adjacent to the Woolloongabba monitoring site[6]. The annually averaged concentrations were below the objective.
- The maximum 24-hour averaged $PM_{2.5}$ background concentrations were measured from 14 to 29 µg/m^3, relative to the objective value of 25 µg/m^3 at South Brisbane, Woolloongabba and Cannon Hill from 2014 to 2016. Exceedances in the $PM_{2.5}$ objective were mainly due to local motor vehicle emissions coupled with such things as smoke from regional bushfires[7]
- Annually averaged $PM_{2.5}$ background concentration values ranged from 4.5 to 9.1 µg/m^3, against the assessment criterion of 8 µg/m^3.
- Measured concentrations of NO_2 and VOC (benzene) complied with the relevant human health objective for each pollutant and averaging time at all of the monitoring locations reviewed. The annually averaged ecological health objective for NO_2 was exceeded at Woolloongabba in 2013 and South Brisbane in 2015.

Exceedances were generally associated with short-term localised influences (e.g. building construction works near to the monitoring sites) or medium-scale natural effects (e.g. fires, dust storms) coupled with meteorological conditions.

11.4 Construction impacts

This section describes the outcomes of the risk assessment of potential construction impacts, particularly the generation of dust.

Potential air quality risks mainly relate to major construction works such as the metro depot site, Buranda station, Cultural Centre precinct and North Quay/Adelaide Street. Dust emissions from busway station modifications at Holland Park West, Greenslopes, UQ Lakes, Woolloongabba, South Bank, King George Square (within existing tunnel) and Normanby to RBWH are expected to be negligible and are not expected to result in any risk of dust impacts at these locations.

The risk assessment found that the highest potential for dust-related risks are expected to generally be associated with:

- earthworks for the new bus layover and turnaround facility at Griffith University station, impacting on ecological values
- earthworks, construction and construction transport (‘trackout’) for the new underground Cultural Centre station, resulting in dust deposition
- earthworks, construction and construction transport (‘trackout’) for the Adelaide Street tunnel, resulting in dust deposition.

Medium-level dust-related risks are expected to generally be associated with:

- construction activities for the metro depot at Rochedale, impacting ecological values
- modification of the Buranda station, resulting in dust deposition
- works associated with Victoria Bridge and North Quay, resulting in dust deposition.

[6] DSITI (2014) Air quality bulletin – South East Queensland, October 2014 and November 2014, Queensland Government
[7] DSITI (2015) Air quality bulletin – South East Queensland, March 2015, February 2014 and October 2014, and November 2014, Queensland Government

These risks are expected to be appropriately managed with the implementation of specific management and control measures. Standard air quality management measures such as notification of sensitive receivers, site management measures, and regular air quality monitoring and inspections, will also be implemented as required, helping to minimise potential construction air quality impacts.

A summary of potential construction air quality risks at each construction location is provided in Table 11.6.

Table 11.6: Potential construction air quality risks

Construction area	Potential air quality risks
Metro depot	• Negligible to low risk for dust deposition and human health impacts associated with all construction activities (i.e. demolition, earthworks, construction and construction transport) • Medium risk for ecological effects associated with earthworks, construction and construction transport activities, although potential risks are expected to be appropriately managed through specific management and control measures (e.g. water sprays, soft stripping of buildings to be demolished)
Bus layover and turnaround facility at Griffith University station	• Negligible to low risk for dust deposition and human health impacts relating to all construction activities • High risk for ecological effects associated with earthworks, medium risk for ecological effects from construction transport activities. These risks are expected to be appropriately managed with the implementation of specific management and control measures (e.g. covering of trucks transporting excavated material, wheel washing and/or rumble bars) • Negligible to low risks for ecological effects from demolition and construction activities
Buranda station	• Medium risk for dust deposition impacts associated with all construction activities (i.e. demolition, earthworks, construction and construction transport). These risks are expected to be appropriately managed through the implementation of specific management and control measures (e.g. water sprays, covering of trucks transporting excavated material, locating site access away from sensitive receivers where possible) • Low risks for human health impacts and negligible risks for ecological effects from all construction activities
Mater Hill station	• Medium risk for dust deposition impacts from demolition and low risk for dust deposition impacts from other construction activities (i.e. earthworks, construction and construction transport), although these risks are expected to be appropriately managed through specific mitigation measures (e.g. water sprays) • Negligible risk for human health and ecological impacts from all construction activities
Cultural Centre precinct	• Medium risk for dust deposition impacts from demolition and high risk for dust deposition impacts from other construction activities (i.e. earthworks, construction and construction transport). These risks are expected to be appropriately managed with the implementation of specific mitigation measures such as covering of trucks transporting excavated material, water sprays, and siting of construction site access away from sensitive receivers, where possible • Low risk for human health and negligible risk for ecological impacts from all construction activities
Victoria Bridge (backspan)	• Medium risk for dust deposition during demolition, construction and trackout activities. These risks are expected to be appropriately managed with the implementation of specific mitigation measures such as covering of trucks transporting excavated material, water sprays, and siting of construction site access away from sensitive receivers, where possible.
North Quay	• Medium risk for dust deposition impacts associated with all construction activities (i.e. demolition, earthworks, construction and construction transport), although these are expected to appropriately managed with the implementation of specific mitigation measures mitigation measures such as water sprays, covering of trucks transporting excavated material, and use of water-assisted dust sweepers on access roads • Low risk for human health impacts from earthworks, construction and construction transport activities • Negligible risk for ecological effects associated with all construction activities

Construction area	Potential air quality risks
Adelaide Street	• High risk for dust deposition impacts associated with some earthworks, construction and construction transport. These risks are expected to be appropriately managed through the implementation of specific management and control measures (e.g. water sprays, covering of trucks transporting excavated material, locating site access away from sensitive receivers where possible) • Low risk for human health impacts associated with earthworks, construction and construction transport • Negligible risks associated with demolition for dust deposition and human health, and for ecological effects associated with all construction activities
Roma Street station	• Negligible to low impacts for all construction activities
Ernie's Roundabout	• Negligible risks for dust deposition, human health and ecological effects for most construction activities
Other existing busway stations	• Negligible risk for dust deposition, human health and ecological effects associated with all construction activities

11.5 Operational impacts

This section assesses the potential changes to ambient air quality during the operation of Brisbane Metro. Pollutant contributions from a mixed fleet including Brisbane Metro are expected to be lower than continued use of the existing busway fleet, due to fewer vehicles in use and a more efficient combustion system.

Adopted background concentrations calculated based on DES monitoring data are presented in Table 11.7. Typically, the highest background concentrations recorded were adopted for the purpose of this assessment with a bias towards Woolloongabba monitoring data, which is located near the Pacific Motorway and considered to represent background levels experienced by the nearest sensitive receivers.

Table 11.7: Adopted pollutant background concentrations

Pollutant	Averaging time	Adopted background concentration in µg/m^3 unless otherwise stated
PM_{10}	24 hour (90th percentile)	26
	Annual	19
$PM_{2.5}$	24 hour (90th percentile)	14
	Annual	8
NO_2	1 hour (90th percentile)	62
	Annual	34
VOCs as benzene	Annual	3.3

11.5.1 Modelling results

Incremental pollutant concentrations at a distance of 20 metres from the alignment are presented in Table 11.8 for each of the assessment scenarios (e.g. with and without Brisbane Metro at the year of opening and 10 years after opening). Background concentrations presented in Table 11.8 are assumed to include pollutant estimations from present busway operations.

It is predicted that PM_{10}, $PM_{2.5}$, NO_2 and VOCs pollutant contributions from Brisbane Metro at the opening year (scenario 3) and 10 years after opening (scenario 5) would be lower than the present estimated emissions (scenario 1) and the without Brisbane Metro scenario for the same years (i.e. scenarios 2 and 4). This is generally due to a reduction in the number of vehicles operating on the busway with Brisbane Metro and a more efficient vehicle fleet.

Adopted background concentrations are at or below the allowable criteria for each of these pollutants and contributions from Brisbane Metro are predicted to be less than existing estimated emissions. As such, operation of Brisbane Metro is expected to be compliant with the adopted air quality objectives and is not predicted to adversely affect air quality conditions at nearby sensitive receivers.

Table 11.8: Incremental results for each assessment scenario at a distance of 20 metres from Brisbane Metro

Pollutant and averaging period	Incremental pollutant concentration at 20 metres (µg/m^3)					Background concentration µg/m^3	Objective µg/m^3 at 0 °C
	Scenario 1 (present operations)	Scenario 2 (without Brisbane Metro, day 1)	Scenario 3 (with Brisbane Metro, day 1)	Scenario 4 (without Brisbane Metro, 10 year)	Scenario 5 (with Brisbane Metro, 10 year)		
PM_{10}, 24-hour averaged	5.6	4	3.4	4	3.6	26	50
PM_{10}, annually averaged	2.2	1.6	1.4	1.6	1.4	19	25
$PM_{2.5}$, 24-hour averaged	5.6	4	3.4	4	4	14	25
$PM_{2.5}$, annually averaged	2.2	1.6	1.4	1.6	1.6	8	8
NO_2, 1-hour averaged	44.9	32.5	23.3	32.4	24.8	62	246
NO_2, annually averaged	9	6.5	4.7	6.5	5	34	62
VOCs as benzene, 1-hour averaged	0.6	0.4	0	0.4	0.4	3.3	10

11.5.2 Air quality changes in the CBD

Reconfiguration of traffic flows for Brisbane Metro is likely to result in reductions in bus emissions in some areas of the CBD, such as Adelaide Street and Elizabeth Street at both the year of opening and 10 years following operations (refer to Table 11.9).

Table 11.9: Changes in roadside pollutant concentrations (at 20 metres) within the CBD

Pollutant and averaging period	Scenario 1 (present operations)	Scenario 2 (without Brisbane Metro, day 1)	Scenario 3 (with Brisbane Metro, day 1)	Scenario 4 (without Brisbane Metro, 10 year)	Scenario 5 (with Brisbane Metro, 10 year)
Adelaide Street between George Street and Edward Street					
PM_{10}, 24-hour averaged	4.8	4	3.3	4	3.3
PM_{10}, annually averaged	1.9	1.6	1.3	1.6	1.3
$PM_{2.5}$, 24-hour averaged	4.8	4	3.3	4	3.3
$PM_{2.5}$, annually averaged	1.9	1.6	1.3	1.6	1.3

Pollutant and averaging period	Scenario 1 (present operations)	Scenario 2 (without Brisbane Metro, day 1)	Scenario 3 (with Brisbane Metro, day 1)	Scenario 4 (without Brisbane Metro, 10 year)	Scenario 5 (with Brisbane Metro, 10 year)
NO_2, 1-hour averaged	38.4	28.7	23.4	29.1	23.6
NO_2, annually averaged	7.7	5.7	4.7	5.8	4.7
VOCs as benzene, 1-hour averaged	0.5	0.2	0.3	0.4	0.3
Elizabeth Street between George Street and Edward Street					
PM_{10}, 24-hour averaged	1.9	1.6	1.1	1.6	1.6
PM_{10}, annually averaged	0.7	0.7	0.4	0.7	0.7
$PM_{2.5}$, 24-hour averaged	1.9	1.6	1.1	1.6	1.6
$PM_{2.5}$, annually averaged	0.7	0.7	0.4	0.7	0.7
NO_2, 1-hour averaged	10.4	7.4	3.5	7.8	7.8
NO_2, annually averaged	2.1	1.5	0.7	1.6	1.6
VOCs as benzene, 1 hour averaged	0.2	0.2	0.1	0.2	0.2

11.5.3 Emissions arising from tunnel emission control systems

Vehicle emissions from day-to-day operations of buses and metro vehicles in the tunnelled section (including underground station) at the Cultural Centre precinct are proposed to be passively ventilated via the portals. During emergencies within the tunnel, an exhaust release point is proposed to be used to remove smoke from within the tunnel and underground station. Vehicle emissions from day-to-day operation of the Adelaide Street tunnel are proposed to be passively ventilated via the tunnel portal. Detailed assessment of emissions within the tunnelled sections of Brisbane Metro will be undertaken as part of the detailed design phase. This will include consideration of the ventilation control systems to ensure that the concentrations released meet the relevant air quality objectives.

Air quality at platforms at underground stations are proposed to be managed through the use of platform screen doors and air-conditioning.

11.6 Mitigation and management measures

Mitigation and management measures will be incorporated into the CEMP and associated sub-plans to minimise or avoid potential construction air quality impacts. These include measures such as:

- plan construction worksite layout so that machinery and dust causing activities are located away from receptors, as far as practicable
- remove materials that have a potential to produce dust from site as soon as practicable, unless being re-used on site
- cover stockpiles, skips and loads, where practicable
- water exposed and disturbed areas including stockpiles, especially during inclement weather conditions

- bag and remove any biological debris or damp down such material before demolition
- revegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces or consider use of hessian, mulches or tackifiers, as soon as practicable
- use water-assisted dust sweepers on the access and local roads, to remove as necessary, any material tracked out of the work areas
- operate vehicles, plant, and equipment in a proper and efficient manner, including switching off when not in-use and use mains electricity or battery-powered equipment, where practicable
- develop and implement a stakeholder communications plan that includes community engagement prior to construction works
- develop and implement a complaint record and management system
- consider installation of dust monitoring devices where complaints are received or there is excessive dust.

Additional measures will also be implemented at areas with a higher potential to generate dust emissions including Rochedale (metro depot), new bus layover and turnaround facility at Griffith University station, Buranda station, Cultural Centre precinct, North Quay and Adelaide Street.

No specific mitigation measures are determined to be necessary for the operation of Brisbane Metro as predicted operational air quality concentrations at surrounding receivers are predicted to be below the adopted air quality objectives. However, this will be confirmed as part of the detailed design phase through:

- the review of emissions generated within the tunnelled sections at the Cultural Centre and Adelaide Street as a result of Brisbane Metro, including the ventilation control systems, to ensure that the concentrations released meet the relevant legislative objectives
- confirmation of post-construction traffic to verify that volumes and characteristics are not materially different from the forecast numbers considered in this assessment.

It is expected that the management of air quality for the Brisbane Metro operations will be in accordance with the existing environmental processes and procedures for the busway and Council bus depots. However, it is recognised that updates to some existing processes and operating procedures will be required to incorporate the new metro vehicles and new infrastructure.

11.7 Summary

Brisbane Metro will utilise existing operational busway infrastructure for the majority of its alignment.

Construction activities will be limited to localised areas where the major construction works are proposed and most sensitive receivers along the alignment would be unaffected during construction. Dust impacts at these locations are expected to be managed through standard mitigation measures.

The screening level operational assessment determined a low potential for adverse impacts at surrounding receiver locations as a result of Brisbane Metro operations. Impacts arising from the intended traffic along the bus route were predicted to be lower than from present operations as a result of expected vehicle operational efficiencies. Further, a conservative assessment for operational air quality predicted some reductions in bus emissions on a few streets of the CBD where traffic would change as a result of Brisbane Metro.

Detailed assessment of potential in-tunnel air quality impacts will be undertaken as part of the detailed design phase.