VOLUME 3

Draft : Environmental Impact Statement

Chapter B11 Air Quality

B11.1 Introduction

The purpose of this chapter is to document the existing air quality within Cairns Shipping Development Project (the project) area and then identify the potential impact of the project on these areas. The aim of this air quality assessment is to identify this potential impact so that mitigation measures can be incorporated into the design and management of the project to prevent or minimise impacts.

Air quality in the Cairns region is considered to be good. Regional air quality monitoring is not required as pollutant levels are reasonably expected to be consistently below the relevant National Environment Pollution Measure (NEPM) standards. This air quality assessment considers, through a qualitative assessment as well as modelling of cruise ship vessels at the Cairns Cruise Liner Terminal (CCLT), the potential air quality impacts as a result of the the project.

Information on potential greenhouse gas emissions generated by the project is addressed in **Chapter B16, Climate Change and GHG's**.

The chapter provides information on the following:

- The relevant air quality criteria set out in the ***Environmental Protection (Air) Policy 2008*** (EPP (Air)), to be achieved at sensitive receptors
- The location of the nearest sensitive receptors
- The existing climatic and meteorological and topographical conditions to identify the air dispersion characteristics for the project area
- The air quality and background concentrations recorded at the site over time
- Existing and past air emission sources, including road traffic, dredging equipment, fuel storage and cruise ship movement
- An assessment of the potential impacts of the project on air quality
- Mitigation measures that are to be applied to reduce any identified negative impacts
- Identification of any residual impacts, if any, after implementation of proposed mitigation measures.

B11.2 Methodology and Assumptions

B11.2.1 Methodology

The air quality assessment has been undertaken as a qualitative desktop level only, with modelling undertaken to identify operational impacts in relation to cruise ships docking at CCLT.

It was deemed appropriate to complete a qualitative assessment for construction impacts and other operational elements, due to the nature of the proposed development, where the increase in port and construction activity above the existing scenario is low. This qualitative assessment involved review of reports and literature relevant to air quality in the project area. This included the following sources:

- Bureau of Meteorology information specific to the Cairns Region
- Cairns Regional Council, ***CairnsPlan*** - Consolidated Planning Scheme, March 2009
- QLD Environmental Protection Agency, ***Ambient Air Quality Monitoring in Queensland***, 1999 Annual Summary and Trends Report, March 2001
- QLD Environmental Protection Agency, ***Ambient Air Quality Monitoring in Queensland***, 1996 Annual Summary and Trends Report, August 1997
- QLD Government Environmental Protection Agency, ***National Environmental Protection Measure for Ambient Air Quality- Monitoring Plan for Queensland,*** June 2001
- QLD Department of Environment and Resource Management, ***Queensland 2010 Air Monitoring Report***, June 2011
- ASK Consulting Engineers, ***Cityport Development, Noise and Air Quality Study***, prepared for Cairns Port Authority, June 2008
- NSW Office of Environment and Heritage, ***Potential Measures for Air Emissions from NSW Ports- Preliminary Study***, June 2011
- National Pollution Inventory, ***Emissions estimation technique manual for Maritime operations***, July 2012
- BMT WBM, ***Cairns Cruise Shipping Development –Demand Study Update 2014***, March 2014.

Operational impacts relating to cruise ships as a result of the CSDP were modelled using AUSPLUME 6.0: Air Dispersion Model, with a worst-case meteorological file and generic topographical conditions (as opposed to site-specific terrain) to determine if the air quality exceeds the Air Quality Criteria (refer to **Table B11.4.1a**) at the nearest sensitive receivers.

Pollutant and cruise ship modelling inputs were identified for the CCLT from the Cityport Development Study (ASK, 2008) as outlined in **Section B11.4.4**. The model assumed one cruise ship was docked at the port at any one time with the emission source (the stack) an average height of 47 m above sea level, a stack exit velocity of 20.0m/s and average stack diameter of 1.0m. AUSPLUME modelled four of the largest pollutants (NO_X, CO, SO_2, PM_{10}).

B11.2.2 Assumptions and Technical Limitations

Assumptions have been based on previous studies to undertake AUSPLUME modelling of the cruise ship emissions as outlined in **Section B11.5.2.2**.

B11.3 Policy Context and Legislative Framework

The following sections outline the air quality criteria stipulated at various government levels with the project specific air quality goals for pollutants summarised in **Table B11.3.3a**.

B11.3.1 Commonwealth Legislation

The National Environmental Protection Council of Australia (NEPC) determined a set of national air quality goals, which are part of the *National Environmental Protection (Ambient Air Quality) Measure 2003* (NEPM). These were designed to represent an 'average' of general air quality. The NEPM monitoring protocol therefore was not designed to apply to the monitoring of peak concentrations from major emissions sources.

Air quality goals for air toxics have been developed by NEPC as a part of the National Environmental Protection (Air Toxics, 2004) Measure. Air toxics, at this stage, are termed 'investigation levels' rather than goals which are applied on a project basis.

B11.3.2 Queensland Legislation

The Department of Environment and Heritage Protection (DEHP) has set air quality goals as a part of the EPP (Air). The policy was developed to meet air quality objectives for Queensland's air environment as outlined in the *Environmental Protection Act 1994*. The air quality data collected by DEHP refers to Schedule 1 of the EPP (Air) which contains air quality indicators and goals that have been adopted in Queensland (Refer to **Table B11.3.3a**).

B11.3.3 Relevant Air Quality Standards

The relevant air quality standards and goals that apply in Australia and in Queensland for relevant pollutants are summarised in **Table B11.3.3a**. The Australian air quality standards are the NEPM standards and the Queensland standards are the DEHP standards. The standards in bold font have been chosen as the most conservative measures of air quality and have been used as the standard in this air quality assessment.

Table B11.3.3a Air Quality Goals Relevant to this project

Pollutant	Goal	Averaging Period	Agency
Carbon monoxide (CO)	eight ppm or 10 mg/m^3 nine ppm or 10 mg/m^3	eight hour maximum eight hour maximum	DEHP NEPM[1]
Nitrogen dioxide (NO_2)	0.16 ppm or 320 µg/m^3 0.12 ppm or 246 µg/m^3 0.03 ppm or 60 µg/m^3	one hour maximum one hour maximum[1] Annual mean	DEHP NEPM NEPM
Particulate matter less than 10µm (PM_{10})	150 µg/m^3 50 µg/m^3 50 µg/m^3	24 hour maximum 24 hour maximum Annual mean	DEHP NEPM[2] DEHP
Particulate matter less than 2.5µm ($PM_{2.5}$)	25 µg/m^3 eight µg/m^3	24 hour maximum Annual mean	NEPM NEPM
Total Suspended Particulate Matter (TSP)	90 µg/m^3	Annual average	DEHP
Sulphur dioxide (SO_2)	0.25 ppm or 700 µg/m^3 0.20 ppm or 570 µg/m^3 0.08 ppm or 225 µg/m^3 0.04 ppm or 113 µg/m^3 0.02 ppm or 60 µg/m^3	10 minute maximum one hour maximum 24 hour maximum 24 hour maximum Annual average	DEHP NEPM[1], DEHP NEPM[1] DEHP NEPM, DEHP
Air Toxics (investigation levels only)			
Benzene	0.003 ppm	Annual Average	NEPM (Air Toxics)
Benzo(a)pyrene	0.3 µg/m^3	Annual Average	NEPM (Air Toxics)
Formaldehyde	0.2 ppm 0.04 ppm	30 minute maximum 24 hour maximum	DEHP NEPM (Air Toxics)
Toluene	2 ppm or 8mg/m^3 one ppm 0.1 ppm	24 hour maximum 24 hour maximum Annual average	DEHP NEPM (Air Toxics) NEPM (Air Toxics)
Xylene	0.25 ppm 0.2 ppm	24 hour maximum Annual average	NEPM (Air Toxics) NEPM (Air Toxics)

1 One day per year maximum allowable exceedance.

2 Five days per year maximum allowable exceedance

The most stringent air quality standards and goals that have been adopted are shown in bold font.

B11.4 Existing Conditions

B11.4.1 Sensitive Receptors

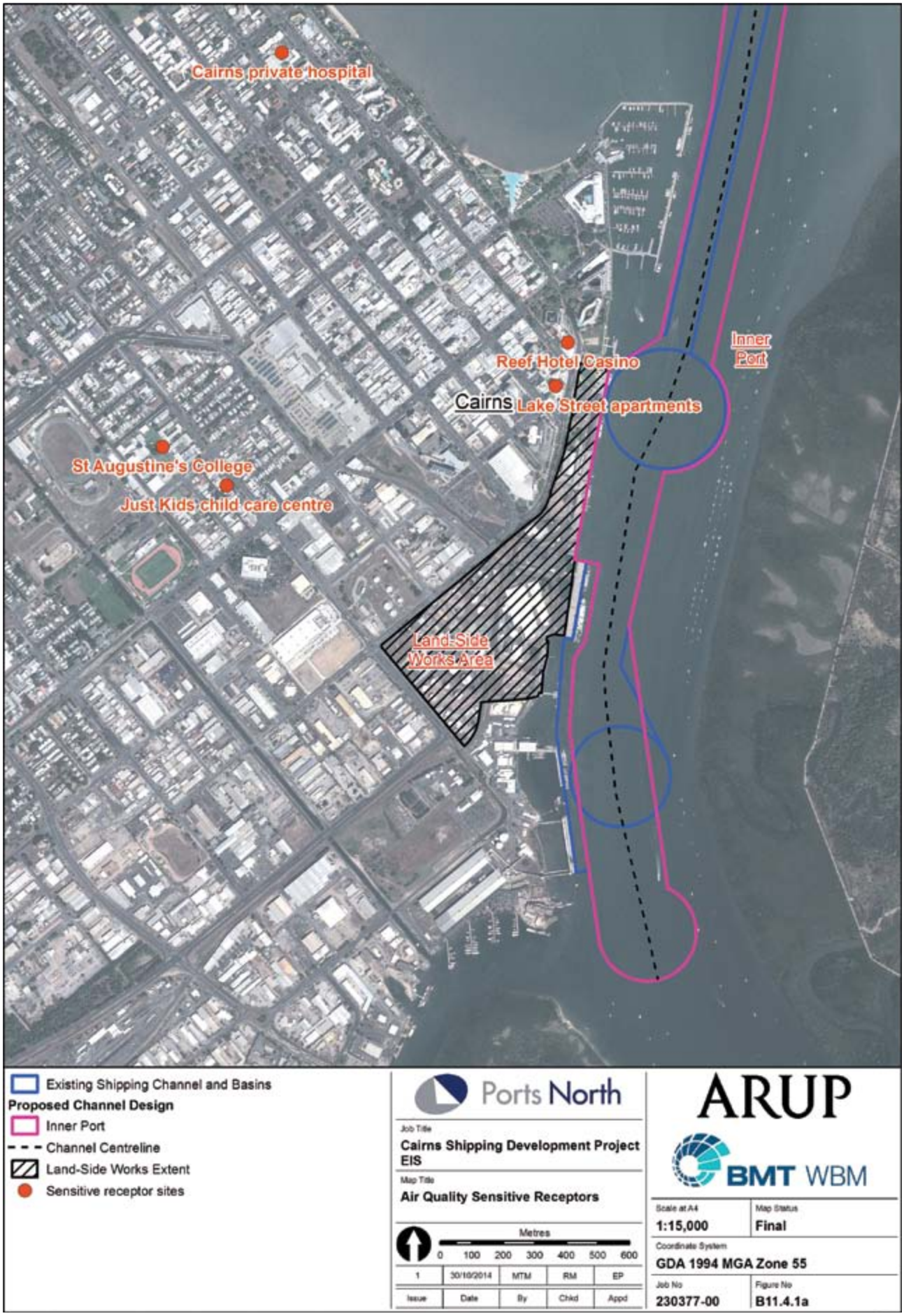
Sensitive receptors are defined under the *State Planning Policy (2013)* as 'a child care centre, community care centre, community residence, dual occupancy, dwelling house, educational establishment, health care services, hospital, hostel, multiple dwelling, relocatable home, residential care facility, retirement facility, short-term accommodation or tourist park'.

The nearest sensitive receptors in proximity to the project are within 150m of the CCLT. These are hotels and residential apartments adjacent to the Terminal. The nearest major residential area (noting that some inner city high rise buildings do have a residential component) is located approximately 1.5km west (refer to **Figure B11.4.1a** and **Table B11.4.1a** for Sensitive Receptors).

Table B11.4.1a Nearest Sensitive Receptors

Noise Sensitive Receptor Catchment	Representative Receptor	Direction from Project to Receptor	Approximate Minimum Distance to Project Study Area
1. Hotels and residences along Wharf St	31 Wharf Street, Cairns	West	125m
2. Hotels along the Marina, including the Cairns Hilton	Hilton Hotel, 34 Esplanade, Cairns	North-west	250m
3. Residences along the coastline at East Trinity (South)	2 Esplanade, East Trinity	East	2300m
4. Residences along the coastline at East Trinity (North)	2427 Pine Creek Road, East Trinity	East	2500m
5. Residential receptors on boats moored on Trinity Inlet	Closest receptor to shipping channel	East	Varies. Closest receptor approximately 100m from shipping channel (for specific locations refer to **Chapter B.9, Socio-economic Assessment**)
6. Cityport planned development sensitive receptors (approved only, not built)	Closest receptor to CCLT	North-west	125m

Figure B11.4.1a Sensitive Receptors



B11.4.2 Meteorology

The nearest available meteorological monitoring data is collected by the Bureau of Meteorology (BoM) at the Cairns Airport which is located approximately seven kilometres northwest of the CCLT. Climatic information has been recorded at Cairns Airport since 1941 for a range of meteorological data including temperature, humidity, wind and rainfall.

Temperature and humidity data consists of monthly averages of daily 9am and 3pm readings and monthly averages of daily minimum and maximum temperatures. Rainfall data consists of monthly mean and median rainfall based on daily measurements, and the average number of rain days per month. The long-term averages have been based on up to 71 years of data, as noted in **Table B11.4.2a**.

Table B11.4.2a Long Term Average Climate Information for Cairns

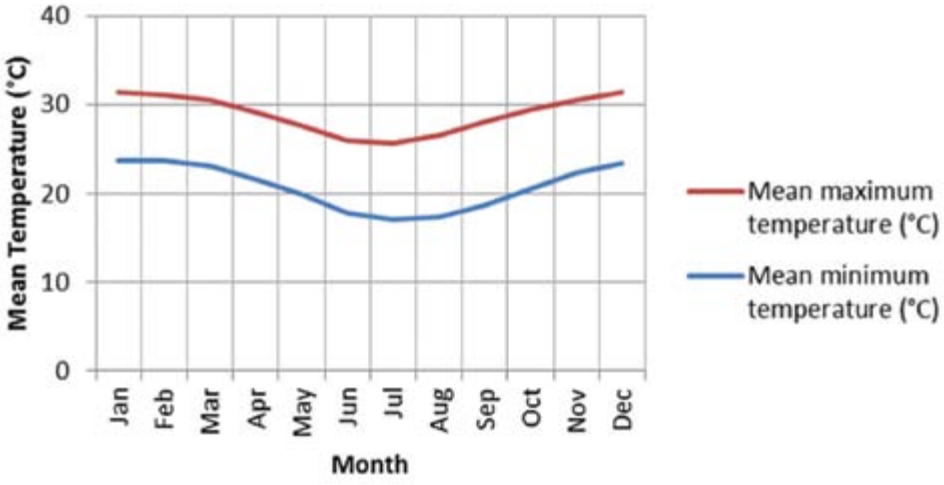
Cairns Airport	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years averaged over
Mean maximum temperature (°C)	31.4	31.2	30.6	29.2	27.6	26.0	25.7	26.6	28.1	29.5	30.6	31.4	29.0	70
Mean minimum temperature (°C)	23.7	23.8	23.1	21.6	19.9	17.8	17.1	17.4	18.7	20.6	22.3	23.4	20.8	70
Mean monthly rainfall (mm)	395.3	450.6	424.2	195.1	91.4	45.3	29.3	27.0	33.7	46.6	93.8	178.8	2014.8	71
Mean no. of rain days	15.6	16.4	16.1	14.8	10.4	6.8	5.6	4.9	4.9	5.6	8.0	10.7	119.8	71
Mean no. of clear days	3.7	2.5	3.9	5.0	6.7	8.7	9.8	11.7	12.4	11.8	7.9	5.6	89.7	69
Mean no. of cloudy days	16.5	17.4	16.4	14.0	12.6	10.2	9.9	7.5	5.7	5.4	7.6	11.7	134.9	69
Mean 9am air temperature (°C)	27.6	27.2	26.5	25.1	23.3	21.3	20.6	21.6	23.7	25.9	27.3	28.0	24.8	69
Mean 9am relative humidity (%)	75	78	78	78	76	74	72	70	66	65	68	70	72	60
Mean 9am wind speed (km/h)	8.8	8.9	12.2	14.5	14.7	15.9	15.7	14.8	13.9	11.3	10.0	9.2	12.5	69
Mean 3pm air temperature (°C)	29.9	29.6	29.2	27.9	26.4	24.9	24.6	25.3	26.7	28.1	29.2	29.9	27.6	69
Mean 3pm relative humidity (%)	66	69	67	65	64	61	58	56	55	57	60	62	62	60
Mean 3pm wind speed (km/h)	15.6	14.6	17.3	19.0	17.9	18.1	18.7	19.6	20.5	19.1	18.0	17.0	18.0	69

B11.4.2.1 Temperature, Humidity and Rainfall

In summer, the average maximum temperature ranges from 31.2°C to 31.4°C and the minimum temperature ranges from 23.4°C to 23.8°C.

In winter, the average maximum temperature ranges from 25.7°C to 26.6°C and the minimum temperature ranges from 17.1°C to 17.8°C (Refer to Figure B11.4.2.1a).

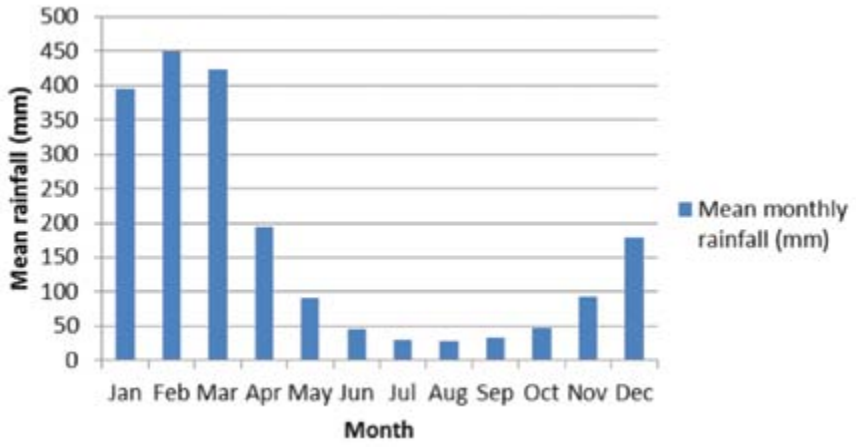
Figure B11.4.2.1a Cairns Average Monthly Maximum and Minimum Temperature (BOM, 2013)



The annual average humidity reading for Cairns at 9am is 72 percentand at 3pm is 62 percent. The months with the highest humidity on average are February, March and April with 9am averages of 78 percent and the lowest is September with a 3pm average of 55 per cent.

Rainfall data shows that the wettest month is February with an average rainfall of 450.6mm over 16.4 days. The lowest rainfall on average is August with 27.0mm over 4.9 days. The average annual rainfall is 2014.8mm over an average of 119.8 rain days (Refer to **Figure B11.4.2.1b**).

Figure B11.4.2.1b Cairns Average Monthly Rainfall (BOM, 2013)



The number of clear and cloudy days per month were also recorded by BoM at Cairns Airport. Typically the warmer months have a greater number of cloudy days while the cooler months have more clear days.

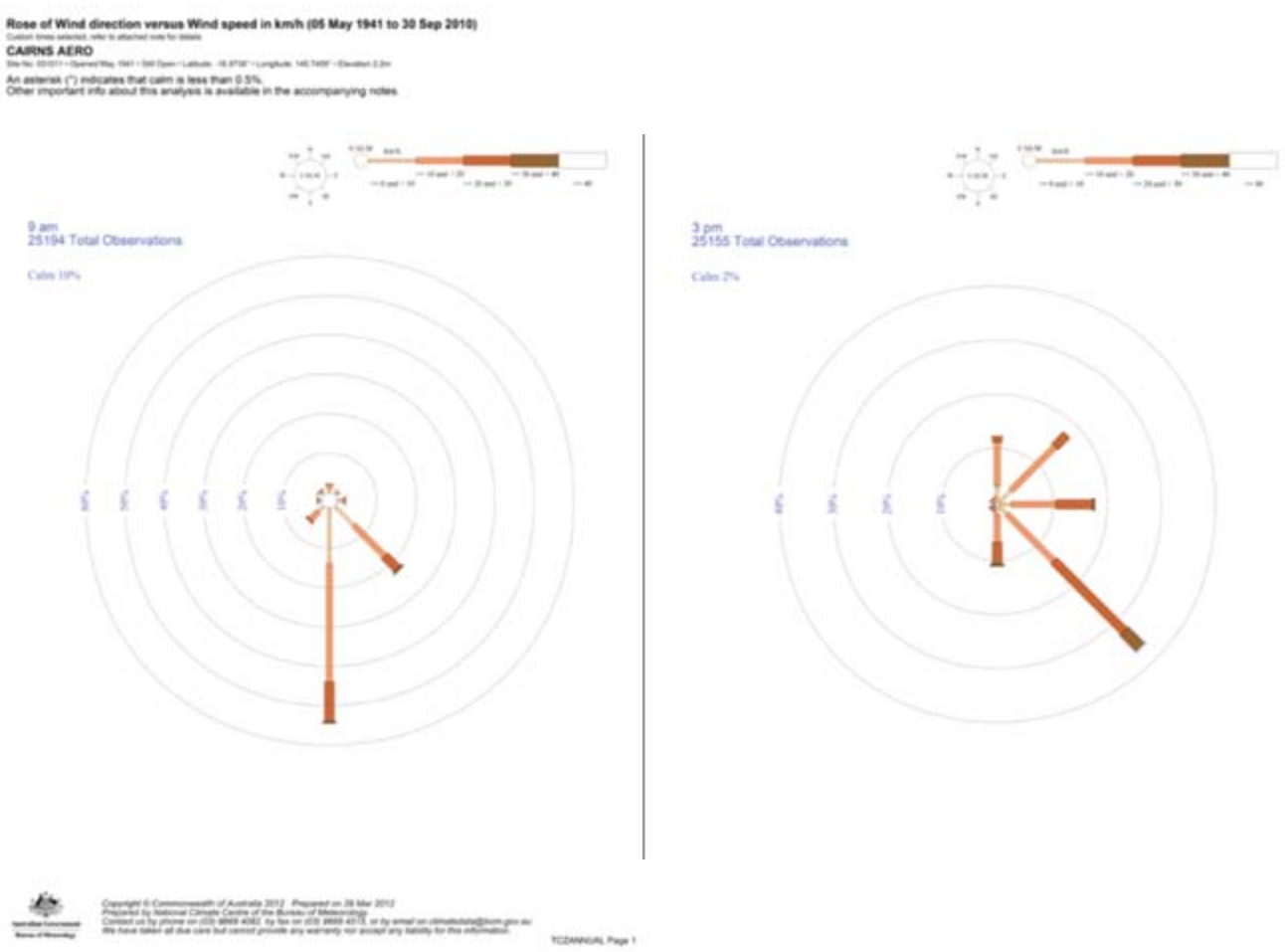
B11.4.2.2 Wind

The BoM monitoring at Cairns Airport recorded the 9am and 3pm wind speed and direction, presented as a wind rose in **Figure B11.4.2.2a**. A wind rose is a graphical tool used to display wind speed and direction from a particular location, with the direction of the bars corresponding to the direction of wind; the length of the bar representing the frequency of winds from that direction; and the width of the bar representing the strength of the wind in that direction. A wind rose enables a visual representation of the direction and strength of the wind over a long period of time and in the case of Cairns Airport, the wind roses in **Figure B11.4.2.2a** represents over 72 years of wind activity in the area.

The Cairns Airport annual wind roses (**Figure B11.4.2.2a**) indicate that winds experienced in Cairns are predominately moderate south/south easterly winds. Conditions are calmer in the morning at 9am with speeds of 8.8km/hr up to15.9km/hrr whereas in the afternoon at 3pm wind speeds are generally higher ranging from14.6km/hour to 20.5km/hr.

The predominately south/south easterly wind could potentially move particulates and emissions generated from the existing operations in the project area north/northwest of the Port of Cairns. The Cairns Central Business District (CBD), which is situated northwest of the CCLT may be slightly affected by some south easterly winds predominately in the afternoon (3pm average), which could carry potential pollution generated in the vicinity of the CCLT in the direction of the CBD, however, moderate wind speed and the 9am southerly wind direction indicates that potential pollutants would be unlikely to settle over the CBD and would more likely continue away from the coast.

Figure B11.4.2.2a Cairns Annual Wind Rose at 9am and at 3pm



B11.4.2.3 Topography

The structure and orientation of terrain features will often influence and even control air motion and mechanical turbulence in the lower atmosphere. The topography of the area immediately surrounding the Port of Cairns is relatively flat terrain with an increase of the landform towards the east and west. These landforms would not be likely to cause any containment of pollutants in the area as any air pollutants would be dispersed adequately by wind direction and speed and other meteorological conditions.

B11.4.2.4 Summary of Meteorology

The Cairns region is based around the City of Cairns, and bounded by the coast to the east and mountainous inland areas to the west. The climate is tropical with humid, rainy summers and warm, sunny winters.

From November to April the weather in Cairns is hot and humid with high rainfall. Under these conditions, rain is likely to absorb pollutant gases and particulate matter, removing them from the air. In the cooler months from May to October, there is less rain and more wind. Therefore pollutants are dispersed in the air.

The predominant south/south easterly winds would tend to move air pollutants generated within the vicinity of the CCLT to the north/northwest, often over the Pacific Ocean to the north or over the nearest sensitive receptor (Cairns CBD) to the northwest, most likely in the late afternoon (3pm average).

Tropical cyclones have the potential to occur each year bringing strong winds and driving rain during the cyclone season (December to April). Even when there is no direct threat from cyclones striking the region, the influence of cyclonic weather in the Coral Sea often causes strong south-easterly winds on the coast during the season.

B11.4.3 Existing Air Quality

DEHP have no ongoing air quality monitoring station in the Cairns region (with limited monitoring undertaken in the late 1990s). DEHP state that on the basis of the results of monitoring conducted in larger population centres, monitoring of air pollutants is not required for the Cairns region.

Sugar milling is the main industry facility type and potential pollutant source in the Cairns region. North Queensland is estimated to green cane harvest (no burning of the crop) around 90 percent of the harvest specifically to reduce particle emissions.

B11.4.3.1 Monitoring data

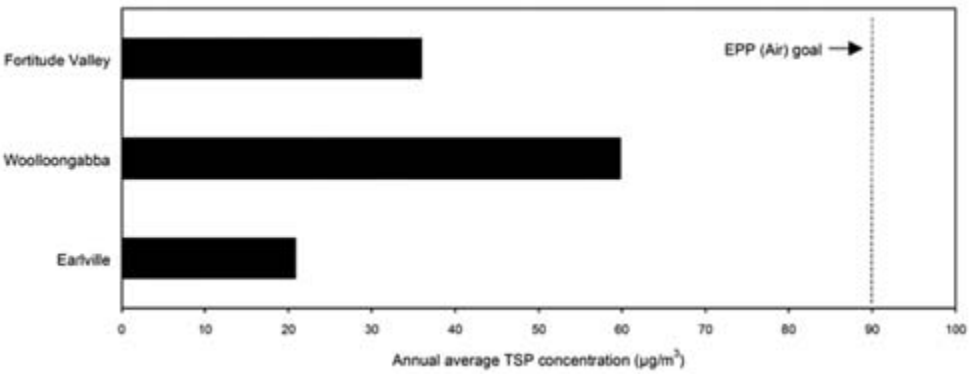
Available air quality monitoring data has been used to estimate background air pollution for Cairns.

One main air quality monitoring station was installed in Earlville (Mulgrave Road, Channel Ten Television Station grounds), 5km west of the Port of Cairns in 1995. This monitoring station measured Total Suspended Particulates (TSP) (and lead between 1995 and 1996 only). This site was decommissioned in October 1999.

B11.4.3.2 Total Suspended Particulates

TSP refers to particles typically less than 50 micrometres (µm) in equivalent aerodynamic diameter. Although the Earlville monitoring station was close to a main road, the site monitored relatively low TSP levels, due in part to a high rainfall environment. **Figure B11.4.3.2a** illustrates the annual average TSP levels in south-east Queensland and Cairns for the last recorded year (1999). According to monitoring reports from 1995 to 1999, the Cairns monitoring site did not exceed the EPP (Air) annual goal of 90µg/m3 in the five years of monitoring.

Figure B11.4.3.2a Cairns (Earlville) Annual Average TSP concentration 1999 - last record (QLD EPA, 2001), compared to urban areas of Brisbane



B11.4.3.3 Lead

Lead was monitored in south-east Queensland and Cairns from 1994 to 1996. The former Department of Environment and Resource Management (now DEHP) measured lead concentrations in the TSP fraction. Airborne lead levels at the Cairns monitoring site were well below the National Health and Medical Research Council air quality goal of 1.5µg/m3 during the last recorded year (1996). It is likely that airborne lead levels in Cairns are now even lower, mirroring results in other Australian cities as a result of fuel lead reduction programs.

B11.4.3.4 All other particles

The *Ambient Air Quality Monitoring Plan for Queensland 2001* (EPA, 2001) identified that campaign monitoring for PM10 would be performed in the Cairns region and the need for ozone and nitrogen dioxide monitoring would be assessed before campaign monitoring proceeded in the region. No carbon monoxide, sulphur dioxide or lead monitoring was found to be required as pollutant levels are reasonably expected to be consistently lower than the standards in the NEPM (DERM, 2011).

The *Queensland Air Monitoring Report 2010* (DERM, 2011) stated that 'other air monitoring priorities have meant that it has not been possible to undertake campaign monitoring of PM10 in the Cairns region to date according to the timeframes set out in the monitoring plan for Queensland'.

The *Queensland Air Monitoring Report 2011* (DERM, 2012) also stated that 'on the basis of the results of monitoring conducted in larger population centres, it has been concluded that campaign monitoring of nitrogen dioxide and ozone is not required for the Cairns region'.

B11.4.4 Previous Study

In June 2008, ASK Consulting Engineers was commissioned by Cairns Port Authority (CPA) to undertake a Noise and Air Quality Study at the Port of Cairns to inform strategic planning.

For the purposes of the air quality study (ASK, 2008), sensitive receptors were determined to be nearby residential apartments. Sensitive receptors would therefore be located at ground level as well as at elevated levels.

In order to assess the air quality impacts of port operations, background pollutant levels are determined, without the addition of cruise ship emissions. However, due to the lack of local monitoring data, the study incorporated background pollutant levels from southeast Queensland. These background pollutant levels were considered by ASK (2008) to be a conservative estimate of the background air quality in the Port of Cairns study area. A summary of the background concentrations assumed for these pollutants is presented in **Table B11.4.4a**.

Table B11.4.4a EPA Air Quality Concentrations (background pollutant concentrations)

Pollutant	EPA Monitoring Station	Background Concentrations (based on 95th percentile)	Units	Averaging Period	Air Quality Criteria (NEMP)
Particulates (PM_{10})	Mountain Creek	24.3	µg/m^3	24-hour	50 µg/m^3
Nitrogen dioxide	Pinkenba	0.024 (45)	ppm (µg/m^3)	1-hour	0.12 ppm or 246 µg/m^3
Carbon monoxide	Pinkenba	0.1 (115)	ppm (µg/m^3)	8-hour	9 ppm or 10 mg/m^3
Sulphur dioxide	Eagle Farm	0.007 (18) 0.010 (26)	ppm (µg/m^3)	24-hour 1-hour	0.04 ppm or 113 µg/m^3 0.20 ppm or 570 µg/m^3

Potential sources of pollutants were identified for the Port of Cairns as part of the air quality study. The pollutant emission estimates were based on data provided by cruise ship companies utilising the port (ASK, 2008). The estimation of the emissions from cruise ships at the Port of Cairns can be found in **Table B11.4.4a**.

Table B11.4.4b Estimated Pollutant emissions (ASK, 2008)

Source	Location	Emission Type	Pollutant	Emission Rate (g/s)
Cruise Ships	Seven Seas Mariner (Large)	Stack	NOx	89.3
			CO	7.07
			SO2	27.6
			PM10	1.93
			Benzene	0.05
	Silver Cloud (Small)	Stack	NOx	33.0
			CO	2.61
			SO2	10.2
			PM10	0.71
			Benzene	0.02

Estimated background concentrations (refer to **Table 11.4.4a**) and the estimated pollutant emissions (refer to **Table B11.4.4b**) for each pollutant were modelled using TAPM and CALMET/CALPUFF models. No detailed meteorological observations were available for the site and surrounds. As a result the meteorology for the subject site was obtained by means of simulation. Ground and upper level meteorological data was generated by TAPM and was inputted into CALMET, a meteorological pre-processor, in order to generate the three-dimensional meteorological data input in CALPUFF.

The modelling scenario included ship berthing for a continuous period of time. A large ship (***Seven Seas Mariner***) and a small ship (***Silver Cloud***) were modelled. The pollutant concentrations were measured in relation to sensitive receptors (nearby residential apartments) against air quality criteria as outlined in **Table B11.4.4a**.

The results of the air quality study at the Port of Cairns (Ask, 2008) were as follows:

NO_2: Nitrogen dioxide concentrations were predicted to exceed the criterion for small cruise ships. Exceedances were obtained for 20m, 30m and 40m high receivers.

PM_{10}: No exceedances of the criterion were predicted for 24-hour PM10 concentrations.

CO: No exceedances of the criterion were predicted for 8-hour CO concentrations.

SO_2: Sulphur dioxide concentrations were predicted to exceed the criterion for small cruise ships. Exceedances were obtained for 30m and 40m high receivers.

Benzene: No exceedances of the criterion were predicted for three-minute benzene concentrations.

These results were considered highly conservative given the model was based on simulated meteorological data and the background concentrations were taken from Southeast Queensland monitoring data which are substantially higher than Cairns background air quality.

B11.4.5 Existing Emission Source Characterisation

The current sources of pollutant emissions within the air quality study area are port operations including vessel emissions, vehicle emissions and other diesel equipment emissions.

According to the NPI *Emissions Estimation Technique Manual for Maritime Operations* (July 2012) air emissions may be categorised as fugitive emissions or point source emissions.

B11.4.5.1 Vessel Emissions

Cruise ships are generally powered by large diesel engines operating on Intermediate Fuel Oil (IFO). In 2008, the Marine Environment Protection Committee of the International Maritime Organisation (IMO) adopted the revised ***Annex VI, Prevention of Air Pollution from Ships***, to the MARPOL 73/78 Convention. The Annex sets limits on nitrogen oxide and sulphur oxide emissions from ship exhausts. Low sulphur fuel also reduces particulate emissions from ships. The Annex entered into force on 1 July 2010. The highest sulphur content allowed in ship fuel reduced globally on 1 January 2012 from 4.5 percent to 3.5 percent and will, as of 1 January 2020, reduce further to 0.5 percent. The use of exhaust gas cleaning systems will continue to be allowed, which means that vessels equipped with scrubbers may also run on types of fuel that are currently in use.

Cruise ships have relatively high electrical loads to supply the needs of passengers. Ships use on board diesel powered generators for lighting, air conditioning, control systems, fuel and water systems, bow thrusters and cargo handling. Ships may also use oil-fired boilers for fuel heating, cargo heating and to produce steam to supply turbines for cargo and ballast pumping.

Main propulsion engines in cruise mode at sea and port entrances are the greatest source of vessel emissions, followed by auxiliary engines and boilers at berth.

Some vessels are used intermittently when required such as tug boats, which assist large cruise ships into port, and maintenance dredging vessels. Therefore, due to the size and intermittent use of these vessels, tugs and maintenance dredging vessels are not considered major emission sources.

Port of Cairns

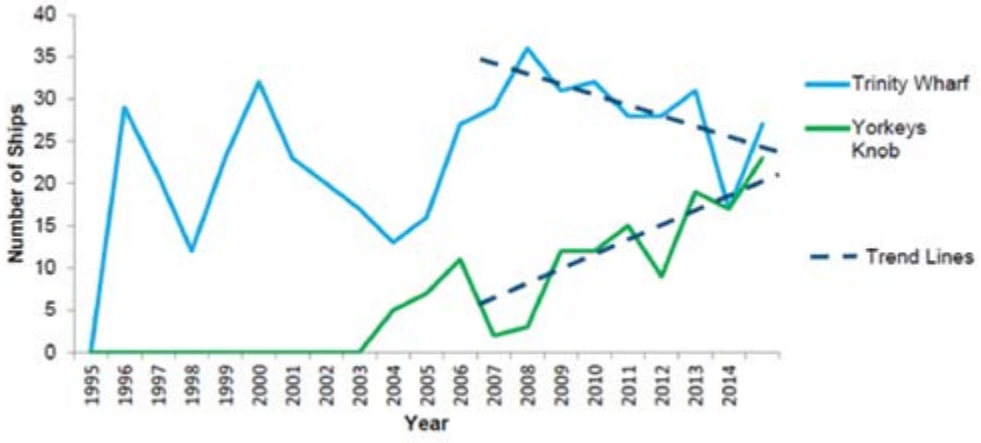
Vessels which use the Port of Cairns each year include:

- Approximately 30 cruise ships (refer to **Figure B11.4.5.1a**)
- Approximately 76 various bulk cargo ships (typically 100-200m Length Overall (LOA)
- Approximately 182 various general cargo ships (typically up to 80m LOA).

Yorkeys Knob

Current use of the Port of Cairns by cruise ships is split between those vessels that can access the entrance channel and moor at the CCLT and the larger ships that must anchor at Yorkeys Knob. Ships that cannot access the Port of Cairns will typically anchor approximately two km offshore from Yorkeys Knob and ferry their passengers ashore. Passengers are ferried ashore from the anchorage at Yorkeys Knob by either boat tenders or by catamarans from the Cairns reef fleet or hired from Townsville or Airlie Beach. These cruise ships would be expected to have increased emissions over those moored at the CCLT as some use thrusters to maintain position at sea.

Figure B11.4.5.1a shows the total number of cruise ship visits to Trinity wharves (Port of Cairns) and Yorkeys Knob between 1995 and 2013.



Road Vehicle Emissions

Vehicular access to the CCLT and wharf is provided via a port road commencing at the intersection of Lake Street and Wharf Street. Vehicles can also access the site from the south as the port road reconnects with Wharf Street approximately 400m south of the Wharf/Lake Street intersection. A car park is provided with bus and taxi access along the face of the CCLT on port land. As cruise ship passengers do not have their own means of vehicular transport, most passengers utilise tour buses and taxis to experience the Cairns region.

Port of Cairns Existing Environment

Chapter B14, Transport indicates a study area which includes one key intersection and various transport elements in the vicinity of the CCLT. The study area is shown in **Figure B11.4.5.2a** below. The study area includes:

- Major Wharf Street/Lake Street/Port Access Road signalised intersection and minor Port Access/Wharf St southern intersection
- Exiting bus and taxi provisions
- Existing pedestrian links
- Existing car parking provision
- Existing service vehicle arrangements.

Figure B11.4.5.2a Traffic Study area- Port of Cairns

The current bus and taxi set-down facility can cater for a maximum of six buses and five taxis at any one time at the CCLT. The *"Rhapsody of the Seas"* cruise ship is the largest ship that currently docks at the CCLT and represents the current worst-case scenario in terms of contribution to air emissions. Based on this vessel size, a maximum number of 26 buses and 40 taxis, (refer to **Chapter B14, Transport**) would be expected in a day.

Yorkeys Knob Existing Environment

Ships that cannot access the Port of Cairns will typically anchor offshore from Yorkeys Knob and ferry their passengers ashore by ship tender. Once onshore, approximately 15 vehicles per day (including 13 buses and two taxis – refer to **Chapter B14, Transport**) are used to transport tourists to Cairns CBD or other destinations in any 12-hour period in which a ship is berthed at Yorkeys Knob.

B11.4.5.2 Other Potential Air Pollutants

Other air quality issues due to existing port activities at Cairns that have occurred on a very rare to infrequent basis include minor events involving:

- Residual dust released during transfer activities of fine products (e.g fertiliser) depending on the type of conveyors and the efficacy of control measures
- Fumes and odour from unloading petroleum products, or venting from storage tanks at the respective fuel facilities
- Demolition, soil remediation and construction works
- Visible smoke and fine particulates from exhaust systems on older ships during start up or increased load of on-board generators
- Emissions from maintenance dredging equipment.

B 11.5 Air Quality Impact Assessment

B11.5.1 Description of Air Quality Significance Criteria

For the purpose of quantifying the likely impact and risk of the proposed project on air quality at the nearby sensitive receptors (refer **Section B11.4.1**), significance criteria have been developed to allow a ranking of impacts and risks in order of severity. This is presented in **Table B11.5.1a**.

Table B11.5.1a Air Quality Significance Criteria

Impact/ Significance/ Consequence	Description
Very High	Regional, long-term and major predicted exceedance of the nominated air quality criteria. Without mitigation, regional and local residents will have their existing amenity significantly decreased, some may suffer negative health impacts and most will make formal complaints. Regulator intervention and state-wide media attention very likely.
High	Regional, short-term and major exceedance of the nominated air quality criteria. Without mitigation, regional and local residents will notice a short-term decrease in air quality/amenity and some may make a formal complaint. Some health complaints may arise. Regulator intervention likely, with possible negative media also.
Moderate	Local, long-term and minor exceedance of the nominated air quality criteria, OR regional, short-term and minor exceedance of the nominated air quality criteria OR local, short-term and major exceedance of the nominated air quality criteria. Without mitigation, local residents will notice a long-term decrease in air quality/ amenity and some will likely make a formal complaint, although impacts to health are unlikely. Some regional residents may notice a short-term decrease in air quality/amenity.

Impact/ Significance/ Consequence	Description
Minor	Local, short-term and no exceedance of the nominated air quality criteria. Without mitigation, some local residents may notice a short-term minor decrease in air quality/amenity, although no impact to health is predicted.
Negligible	No, or insignificant, impact to existing air quality. Local residents unlikely to notice a change in local air quality/amenity.
Beneficial	An improvement in air quality at a local or regional scale.

Table B11.5.1b Risk Matrix

Likelihood	Significance				
	Negligible	Minor	Moderate	High	Very High
Highly Unlikely/ Rare	Negligible	Negligible	Low	Medium	High
Unlikely	Negligible	Low	Low	Medium	High
Possible	Negligible	Low	Medium	Medium	High
Likely	Negligible	Medium	Medium	High	Extreme
Almost Certain	Low	Medium	High	Extreme	Extreme

Table B11.5.1c Risk Rating Legend

Extreme Risk	An issue requiring change in project scope; almost certain to result in a 'significant' impact on a Matter of National or State Environmental Significance
High Risk	An issue requiring further detailed investigation and planning to manage and reduce risk; likely to result in a 'significant' impact on a Matter of National or State Environmental Significance
Medium Risk	An issue requiring project specific controls and procedures to manage
Low Risk	Manageable by standard mitigation and similar operating procedures
Negligible Risk	No additional management required

B11.5.2 Construction and Operational Impacts

B11.5.2.1 Construction Impacts

This section addresses only the construction activities (as defined in **Chapter A4, Project Description**) that have the potential to significantly impact air quality, based on their duration or volume.

Emission sources during construction are likely to be:

- Dust generation where soil is exposed during excavation or generated by construction vehicle movement on unsealed surfaces. Dust generation is expected to be minimal during construction activities as the disturbance of soils is minor in scale and mostly takes place within sealed hardstand areas and roads
- Construction plant and equipment for dredging, wharf upgrade and landside infrastructure works including dredging vessels
- Construction related on-road vehicles, as assessed in **Chapter B14, Transport**. No haulage of fill or material would be required by the project.

Channel dredging is the largest construction activity associated with the CSDP and would take approximately 23 weeks. The construction period for the wharf upgrade would be approximately 12 months as outlined in the project description (refer to **Chapter A4, Project Description**). Construction associated with the wharf and landside infrastructure upgrades would occur simultaneously to the channel dredging. Hours of operation for the wharf and landside infrastructure will likely be normal construction hours of 6:30am to 6:30pm Monday to Saturday.

The likelihood of significant air emissions affecting nearby sensitive receivers from the disturbance of dredged material is considered to be negligible as the activity will be completed below the high water mark and placed of offshore.

Dust generation and vehicle exhaust emissions during construction have the potential to impact on air quality, however, the impact is likely to be minor due to the number of vehicles and the short-term period of construction (refer to **Table B11.5.5a**). Additionally, due to the good air quality within Cairns, construction activities are likely to have no major or ongoing exceedances of air quality criteria regionally or at sensitive receptors during construction, although it is possible that minor exceedances may occur should appropriate mitigation measures not be installed.

Odour

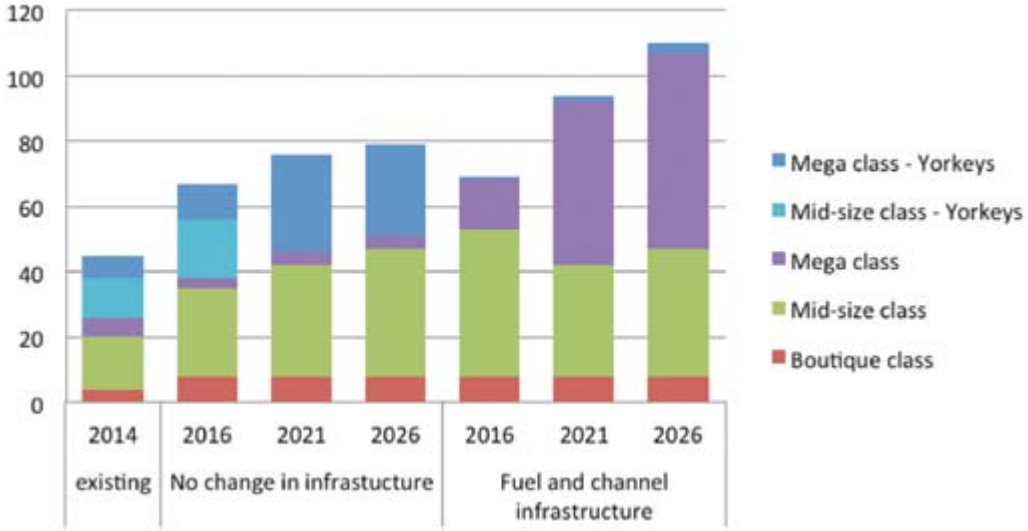
No odour emissions are likely to be generated by the construction of the CSDP project, therefore an odour assessment has not been undertaken, as required by the TOR. Dredge material would be disposed of offshore eliminating a major potential odour source of the project. Localised odour impacts may be generated by diesel fuelled vehicles, plant and equipment; however, these odours would be very localised and would have a negligible impact on sensitive receptors.

B11.5.2.2 Operational Impacts

Vessels

Larger cruise ships are currently unable to berth at the Port of Cairns and instead utilise an existing offshore mooring point at Yorkeys Knob approximately 10km north of the Cairns CBD or avoid Cairns all together. Once operational in 2016[1], infrastructure improvements would result in the larger cruise ships being able to berth at the CCLT resulting in more than 69 cruise ships, including 34 mega ships, berthing at Trinity Wharf each year. By 2026, approximately 110 cruise ships, including 63 mega ships, would be berthing at Trinity Wharf each year (refer to **Figure B11.5.2.2a**).

Figure B11.5.2.2a Cruise Demand projections (with and without infrastructure improvements)
Source: BMT WBM, Cairns Cruise Shipping Development –Demand Study Update 2014 (Appendix D)



Exhaust emissions from the vessels berthed in the Port of Cairns will vary depending on the age, condition, engine and fuel type of individual vessels. These emissions are difficult to control as maintenance and management are generally controlled by the vessel owners. However, it is anticipated that only one cruise ship will be docked at CCLT at any one time.

Although there may be an increase in emissions to air over time due to increasing cruise ship numbers berthing at the CCLT, due to good air quality within Cairns, it is unlikely that the increase would have a regional air quality impact.

[1] Note that due to program delays, the operational year may be 2017, however, for the purposes of the air quality assessment, 2016 is appropriate to use.

Worst Case Air Quality Emissions

Worst-case emissions have been modelled for the CCLT upgrade using an AUSPLUME model and using 'worst case' meteorological conditions (such as wind speed and direction) and generic topographical conditions (as opposed to site-specific terrain) to determine if the air quality exceeds the Air Quality Criteria at the nearest sensitive receivers following the methodology outlined in **Section B11.2.1**.

The results of the 'worst case' AUSPLUME modelling are described in **Table B11.5.2.2a**.

Table B11.5.2.2a AUSPLUME modelled 'worst case' emissions

Pollutant	Criteria	Averaging Period	'Worst Case' modelling output (top emission point)	Distance from cruise ship	Exceedance
NO_2	246 µg/m^3 (NEPM) 320 µg/m^3 (DEHP)	1 hour	335 µg/m^3	250m	Yes - minor
CO	10 mg/m^3 (NEPM & DEHP)	8 hour	0.00932 mg/m^3	500m	No
SO_2	570 µg/m^3 (NEPM & DEHP)	1 hour	103 µg/m^3	250m	No
PM_{10}	50 µg/m^3 (NEPM)	24 hour	1.99 µg/m^3	500m	No

There may be a minor exceedance of the pollutant NO2 approximately 250m from the CCLT under worst-case meteorological and topographical conditions. No other exceedances of other pollutants are anticipated as a result of the project operation. As the model assumed worst-case meteorological and generic topographical conditions, it is considered unlikely for air quality standards to be exceeded at sensitive receptors, with potential minor local air quality impacts at sensitive receptors (approximately 250m from CCLT) (refer to **Table B11.5.5a**).

Vehicles

The traffic using the network of roads throughout the commercial and tourist areas near the Port of Cairns will mainly be buses and taxis, private vehicles with occasional deliveries by truck to the port, sewerage truck services and fuel tanker deliveries. As with vessels, vehicle emissions are difficult to control and will depend on the type of vehicle but are subject to government requirements for emission controls. Significant changes to existing road traffic are not anticipated as a result of the project (Refer to **Chapter B14, Transport**) and will not be a significant source of emissions.

As such, the project would have a negligible impact to local air quality once operational due to the minor increase in vehicle emissions (refer to **Table B11.5.5a**).

Fuel Storage and Dispensing

Cruise ships are not currently fuelled on site. It is proposed that Intermediate Fuel Oil (IFO) will be stored and dispensed as a result of the CSDP by 2016 at which time the nearby commercial fuel farm would deliver the IFO via a pipeline to the site. There is a minor potential for emissions to arise from storage of IFO at the commercial fuel farm through standing losses as a result of atmospheric changes, resulting in changes in pressure and temperature, causing vapour lost from the expansion and contraction of the vessel contents without any resulting change in liquid level. However, best practice fuel storage (such as attaching a roof structure to tanks to reduce losses) and dispensing practices (via pipeline to site) would ensure a negligible impact on local air quality during operation.

B11.5.3 Proposed Mitigation Measures

B11.5.3.1 Construction

An Air Quality Management plan would be prepared as part of the Construction Environmental Management Plan (refer to **Chapter C1, Environmental Management Plan (Construction and Operation)**). The plan will include the following measures to limit the release of air emissions, but not be limited to the following:

- Monitoring of dust onsite and weather conditions. Should strong winds occur, works will cease until weather conditions improve
- The provision of training to all project personnel, including relevant sub-contractors on sound air quality control practices through inductions, toolboxes and targeted training
- Water carts, sprinklers, sprays or dust screens will be utilised where applicable to control dust emissions from any exposed surfaces or dust creating activities. The frequency of use will be modified to accommodate prevailing conditions
- Rumble grids and large aggregate will be installed at entry/exit points to prevent dust, soil or mud from being deposited on public roads. Manual cleaning will also be carried out where appropriate. Waste will be segregated and collected on a regular basis to control odours
- Construction equipment (including dredging vessels) would be properly maintained to ensure exhaust emissions are minimised where practicable and comply with the *Environmental Protection Act 1994*.

B11.5.3.2 Operational

An Operational Air Quality Monitoring and Management plan would be instigated (refer to **Chapter C1, Environmental Management Plan (Construction and Operation)**). The plan will include the following management measures:

- The duration and extent of air quality monitoring should it be required by approval authorities

  While emissions from vessels are difficult to control by Port of Cairns management, cruise ship owners are to be informed of and encouraged to implement measures to improve engine efficiency, reduce fuel use and reduce emissions including:
- Regular maintenance and engine tuning
- Increased use of catalytic converters (which can reduce marine emissions by over 90 per cent)
- Reduced idling time at berth with main engines turned on as late as possible before departure and turned off as soon as possible after berthing
- Investigate future opportunities to control cruise ship emissions through the provision of shorepower as this technology becomes more prevalent in newer ships, allowing cruise ships to ‘power down’ engines during time in port.

  Mitigation measures are to be adopted for fuel storage and dispensing activities to minimise the potential for release of vapours to the atmosphere from standing losses, working losses and spills including:
- Ensure fuel dispensing facilities and other health and safety measures are in place for fuel storage so vapours are managed to reduce the impact on air quality at sensitive receivers.

B11.5.4 Residual Impacts

The residual impacts on the project have been reassessed based on the proposed implementation of the mitigation measures (outlined in **Section B11.5.3**).

B11.5.4.1 Construction

With the implementation of an Air Quality Management Plan during construction with mitigation measures to reduce dust and combustion related impacts, the residual impact of construction of the CSDP is considered to be reduced to negligible.

B11.5.4.2 Operational

With the implementation of an Operational Air Quality Monitoring and Management Plan and mitigation measures to assist in the reduction of impacts from vessels over time as newer boats improve emissions, the residual impact of the operation of the project is considered to be reduced to negligible.

B11.5.5 Summary

The air quality impacting processes, as part of the construction and operation of project, have been assessed through an impact assessment framework including statutory mitigation measures, significance and likelihood of impact to produce an initial impact (refer to **Table B11.5.5a**).

The initial impact assessment shows construction and vessel stack emissions would have a 'low' risk of impact on air quality. Although mitigation measures will be applied which reduces the likelihood of impact, emissions are still considered to have a 'low' risk of impact. The residual impact assessment incorporated proposed mitigation measures which would reduce the air quality risk rating to 'Negligible or Low' for all construction and operational air quality impacting processes (refer to **Table B11.5.5a**).

Table B11.5.5a Impact assessment table

Primary Impacting Processes	Initial Assessment with Standard (Statutory) Mitigation Measures in Place			Residual Assessment with Additional (Proposed) Mitigation in Place		
	Significance of Impact	Likelihood of Impact	Risk Rating	Significance of Impact	Likelihood of Impact	Risk Rating
Construction						
Combustion and dust emissions reducing local air quality at nearest sensitive receivers.	Minor	Possible	Low	Minor	Unlikely	Low
Dredging and construction equipment reducing local air quality at nearest sensitive receivers.	Negligible	Unlikely	Negligible	Negligible	Unlikely	Negligible
Operational						
Vessel stack emissions reducing local air quality at nearest sensitive receivers.	Minor	Possible	Low	Minor	Unlikely	Low
Vehicle emissions reducing local air quality at nearest sensitive receivers.	Negligible	Unlikely	Negligible	Negligible	Unlikely	Negligible
Fuel storage and dispensing reducing local air quality at nearest sensitive receivers.	Negligible	Unlikely	Negligible	Negligible	Unlikely	Negligible

B11.6 Conclusion

DEHP have no ongoing air quality monitoring station in the Cairns Region (with limited monitoring undertaken in the late 1990s). DEHP state that on the basis of the results of monitoring conducted in larger population centres, monitoring of air pollutants is not required for the Cairns region as pollutant levels are reasonably expected to be consistently lower than the standards in the NEPM (DERM, 2011).

The likelihood of significant air emissions affecting nearby sensitive receivers from the disturbance of dredged material is considered to be negligible as the activity will be completed below the high water mark and placed of offshore.

Dust generation and vehicle exhaust emissions during construction have the potential to impact on air quality, however, the impact is likely to be minor due to the number of vehicles and the short-term period of construction.

As discussed, during operation there may be a minor exceedance of the pollutant NO2 approximately 250m from the CCLT under worst-case meteorological and topographical conditions. No other exceedances of other pollutants are anticipated as a result of the operation of the project. As the model assumed worst-case meteorological and topographical conditions, it is considered unlikely for air quality standards to be exceeded at sensitive receptors.

Air quality impacts would be managed by implementing the proposed mitigation measures as well as continuing air quality improvement on an international scale through the MARPOL convention (Annex VI prevention of Air Pollution from Ships) aiming to reduce nitrogen oxide and sulphur oxide emissions from ship exhausts.

The air quality impact as a result of the proposed project construction and operations is likely to be low due to good existing air quality in the Cairns region and air quality management and mitigation measures proposed.

B11.7 References

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