FLANAGAN CONSULTING GROUP
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Ports North

CAIRNS SHIPPING DEVELOPMENT PROJECT

Revised Draft Environmental Impact Statement

Chapter B11: Air Quality

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B11.1 Introduction

B11.1.1 Overview

This chapter presents the outcomes of a detailed assessment of potential air quality impacts which could result from the Cairns Shipping Development Project (CSD Project) undertaken as part of the CSDP Revised Draft EIS (Ports North 2014).

It describes the existing airshed of the various project areas, identifies locations of sensitive receptors, and conservatively estimates the emissions which could result from project activities using a range of quantitative and semi-quantitative methods. It considers both construction and operation phases, including cruise ship docking and at-dock operations. Consideration of potential air quality impacts of dredging previously undertaken in the Draft EIS has been reviewed and included where relevant and updated on the basis of revised project elements.

In the absence of detailed plant and equipment specifications and emission rates and types at this stage of the project planning process, it also recognises the conservative nature of some assumptions and provides a range of mitigations measures to ensure impacts are appropriately managed and mitigated.

The assessment of potential air quality impacts uses a risk based methodology, developing mitigation measures that can be incorporated into the design and future management of the project and assesses the residual impacts following mitigation.

The TOR/ guidelines require the assessment of air quality includes the following:

- Describe the existing air quality that may be affected by the project in the context of environmental values as defined by the EP Act and Environmental Protection (Air) Policy 2008 (EPP (Air)).
- Discuss the existing local and regional air shed environment, including:
  - background levels and sources of particulates, gaseous and odorous compounds and any major constituent
  - pollutants (including greenhouse gases)
  - baseline monitoring results, sensitive receptors
- Data on local meteorology and ambient levels of pollutants should be gathered
- Consider the following air quality issues and their mitigation:
  - an inventory of air emissions from the project expected during construction and operational activities (including source, nature and levels of emissions)
  - 'worst case' emissions that may occur during operation. If these emissions are significantly higher than those for normal operations, it will be necessary to separately evaluate the worst-case impact to determine whether the planned buffer distance between the facility and neighbouring sensitive receptors will be adequate
  - ground level predictions should be made at any site that includes the environmental values identified by the EPP (Air), including any sites that could be sensitive to the effects of predicted emissions
  - dust and odour generation from construction activities, especially in areas where construction activities are adjacent to existing road networks or are in close proximity to sensitive receivers
  - climatic patterns that could affect dust generation and movement
  - vehicle emissions and dust generation along major haulage routes both internal and external to the project site
  - human health risk associated with emissions from project activities of all hazardous or toxic pollutants
- Detail the best practice mitigation measures together with proactive and predictive operational and maintenance strategies that could be used to prevent and mitigate impacts.

- Discuss potential air quality impacts from emissions, with reference to the National Environmental Protection (Ambient Air Quality) Measure 2003 (Cwlth) and the EPP (Air). If an emission is not addressed in these legislative instruments, discuss the emission with reference to its risk to human health, including appropriate health-based guidelines/standards.

Note that Greenhouse Gases are addressed in **Chapter B16** (Climate Change and Greenhouse).

B11.1.2 The Study Area and Project Areas

The 'study area' for the EIS varies depending on the issue at hand while the 'project area' is the immediate footprint of the proposed works. In the consideration of water resources as defined above, the 'local scale' is appropriate. The local scale (**Figure B11-1**) is defined as follows:

- The township of Cairns.
- The marine environment including the Trinity Inlet, Trinity Bay and surrounding waters including:
  - all waters of Trinity Bay
  - the tidal waters of Trinity Inlet, including landward areas to the boundary of the Fish Habitat Area
  - Double Island
  - the coastline and nearshore waters of Cairns' Northern Beaches
  - Mission Bay
  - the coastline extending to Cape Grafton.

Project Areas are also shown on **Figure B11-1** and encompass:

- Channel Project Area including the shipping channel and the route to the pump out point at the seaward end of the pipeline to the Northern Sands DMPA.
- Landside Works Project Area for wharf upgrades and berthing of cruise ships.
- Northern Sands DMPA Project Area (includes the DMPA, delivery pipeline, tailwater ponds, and tailwater outlet works).
- Tingira Street Stiff Clay DMPA Project Area.

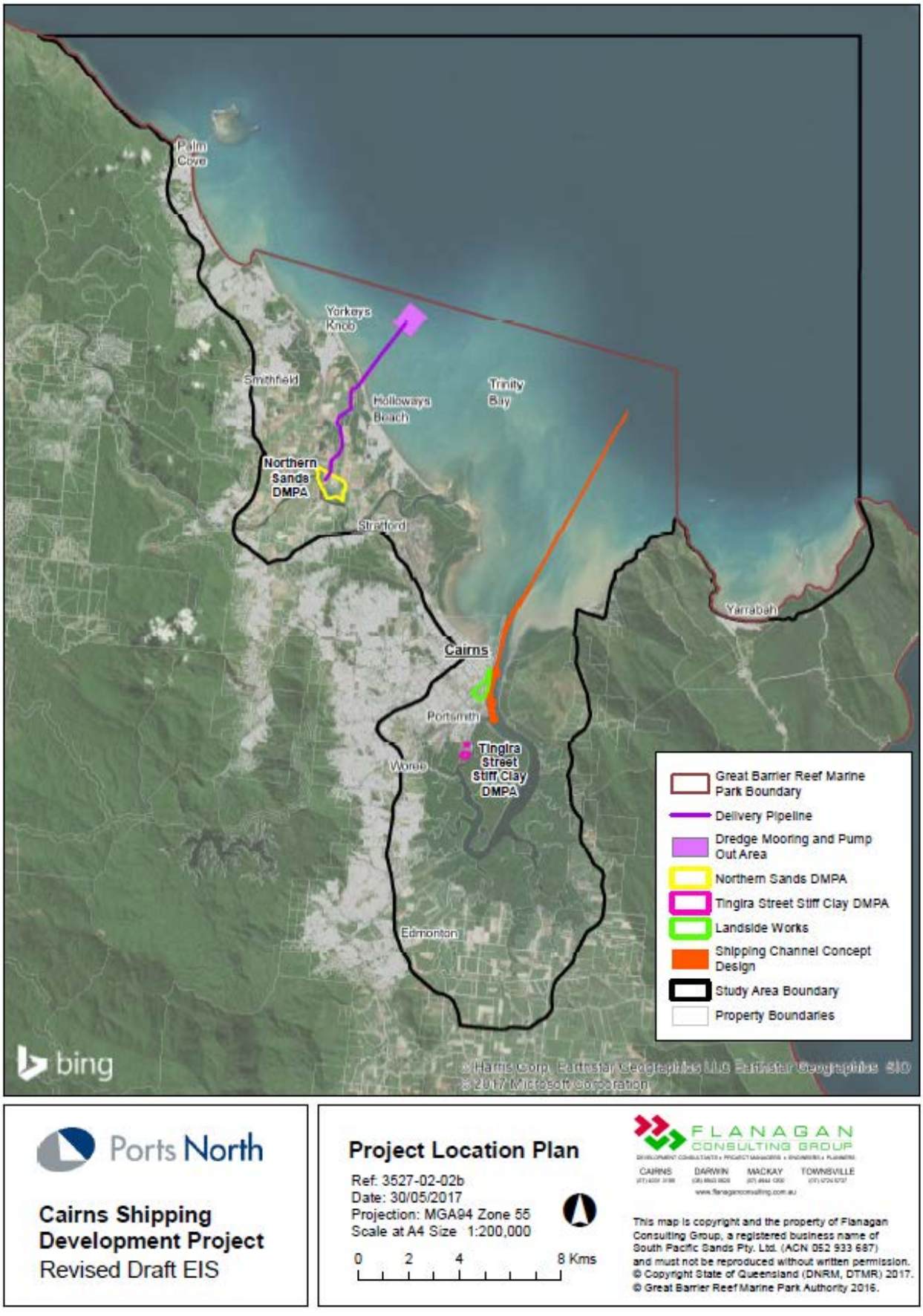

Figure B11-1 Study Area and Project Areas.

B11.1.3 Overview of the CSD Project

The following is a brief discussion of the CSD Project as it relates to assessment of potential air quality impacts. A more detailed description is provided in **Chapter A3** (Project Description). Management is proposed via two plans documented elsewhere in this Revised Draft EIS:

- **Chapter C1** (Construction Environmental Management Plan). This covers the works necessary to prepare the DMPAs for receiving the soft clays (Northern Sands DMPA) and stiff clays (Tingira Street DMPA) and wharf and services upgrades and then remove all temporary works and make good.
- **Chapter C2** (Dredge Management Plan). This covers the actual placement activities and will be integrated with dredging operations, including construction of the dredge material delivery pipeline.

B11.1.3.a Dredging and Delivery Pipeline

Dredge material is to be transported to shore based Dredge Material Placement Areas (DMPAs) at the Northern Sands sand extraction operation on the Barron Delta. The soft clays are to be dredged via a 5600 m^3 capacity Trailer Suction Hopper Dredge (TSHD) discharging to a temporary floating pump out facility between approximately 2.6 and 3.6 km NE of Yorkeys Knob.

Dredge material will be pumped from the pump out facility via a submerged steel pipeline, which will make landfall near the Richters Creek mouth, thence to the Northern Sands DMPA via cane farm headlands and Captain Cook Highway culverts (see **Figure B11-1** and **Figure B11-3**).

Due to the 8 km pipeline distance from pump out facility to the NS DMPA, up to three pipeline booster pumps will be required, depending on TSHD pumping capacity.

B11.1.3.b Landside Works Project Area

An additional IFO storage tank, with a capacity of approximately 10 000 m^3 may be required within the existing fuel farm to store monthly deliveries from fuel ships via the existing fuel wharf 10. Subject to commercial agreements between the fuel suppliers and cruise companies, fuel will be delivered from the storage tank to home porting cruise ships via a pump station and pipeline to Wharf 3.

New water, firefighting and sewerage services are required for Wharves 1 to 5. These will include replacement / extension of existing water mains and installation of a sewage pump station, underground storage tank and odour control system. As part of the CSD Project wharf 6 will be demolished and reconstructed.

Work for the wharf upgrade includes installation of new berthing structures including driving of piles into the seabed accessed with wharf and barge mounted equipment.

B11.1.3.c Northern Sands Project Area

The Northern Sands DMPA contains an operating sand mine and a 25 ha water-filled void (known locally as Lake Narelle) that is to be enlarged and used for the placement of soft clays pumped to the site. The current void contains fresh water from groundwater seepage and rainfall.

Site preparation at the DMPA will involve bunding and enlargement of the existing void to the north as part of future 'business as usual' quarry expansion plans, forming a total bunded placement area of 29.6 ha. The DMPA operations will be separated from ongoing sand extraction and construction and demolition waste disposal by a lined rock wall.

Dredged material will be delivered into the lake as a slurry through the dredged material delivery pipeline in pulses as the TSHD completes approximately six circuits per 24 hours over the dredging program. As the prepared void fills with the dredge material slurry, solids will settle and commence consolidation on the floor of the void leaving turbid supernatant waters (tailwater). These will gradually clarify on the Northern Sands DMPA and in the dedicated tailwater ponds prior to discharge via a discharge pipeline to the Barron River, once they have met the adopted water quality discharge standards.

All placement and tailwater management operations are as described in **Chapter C2** (Dredge Management Plan).

B11.1.3.d Tingira Street Project Area

Dredge material comprising the stiff clay portion, is to be dredged by a backhoe dredge and barged to an existing area of port land upon which a DMPA is to be established. The site preparation at the DMPA will be minor and will involve clearing and grubbing to remove the existing grass and regrowth vegetation and then the formation of bunds (estimated to be < 0.5 m high) around the perimeter of the placement areas using insitu clay materials. Erosion and sedimentation control works in accordance with FNQROC requirements will be installed as soon as possible in the site preparation process. Environmental management of establishment and disestablishment works will be as described in **Chapter C1** (Construction Environmental Management Plan).

The dredged material will progressively placed within the bunded area using heavy haulage vehicles and other plant.

B11.1.4 End Use of DMPAs and Pipeline

End uses of the DMPAs are described below because an appreciation of these is critical to the assessment of impacts.

B11.1.4.a Northern Sands DMPA

The soft clay placement campaign will fill all or most of the void over a period of some three months after which it will settle over one wet season. Once this filling is complete, the DMPA will revert to the control of the owner who will then determine subsequent uses. No assumptions can be made about this use although current approvals imply that at some time the void is to be completely filled.

B11.1.4.b Delivery Pipeline

After the completion of the soft clay placement campaign, the inlet pipeline (landward and marine sections) and booster stations will be disassembled and removed. The disturbed area will be restored and the small amount of natural vegetation cleared for its construction will be rehabilitated using appropriate native species as described in **Chapter C2** (Dredge Management Plan). A specific Restoration Plan will be prepared by the contractor during the detailed planning and approvals phase and implemented for this purpose.

B11.1.4.c Tailwater Discharge Pipeline(s)

Similarly, the tailwater discharge pipelines will be disassembled and removed and the disturbed area restored and rehabilitated as described in **Chapter C2** (Dredge Management Plan).

B11.1.4.d Tailwater Ponds

When no longer required, the tailwater ponds will be back filled and the disturbed area restored such that the area can be re-used for existing use such as growing sugar cane. No rehabilitation will be necessary.

B11.1.4.e Tingira Street Project Area

The Tingira Street DMPA is currently cleared (although some salinity tolerant plants have recolonised portions of the area not covered by anthropogenic grasslands) and in its past has been filled to above Highest Astronomical Tide. The placed stiff clay will be used to fill and preload the site to accelerate settlement. As a separate project, Ports North intends to import additional fill and construct industrial hardstands and other infrastructure. This project has been under consideration for many years and most of the necessary approvals have already been obtained.

B11.2 Methodology

B11.2.1 Detailed Technical Assessments

Several detailed technical assessments were undertaken in support of both the concept design of the project (documented in **Chapter A2** (Project Background)) and this chapter. These are listed in **Table B11-1** below. The final column shows where these reports are located in this Revised Draft EIS.

TABLE B11-1 DETAILED TECHNICAL ASSESSMENTS

STUDY	DETAILS	APPENDIX NO
ASK (2016) Baseline Air Quality Constraints Assessment	Existing situation and assessment of air quality constraints and opportunities of Northern Sands DMPA and pipeline corridor and wharf areas.	**Appendix AV**
ASK (2017) Stiff Clay DMPA Air Quality Impact Assessment	Assessment of potential air quality impacts of stiff clay unloading and placement at Tingira Street DMPA	**Appendix AW**
ASK (2017) TS11: Air Quality Impact Assessment	Assessment of air quality impacts for construction and operation of Northern Sands DMPA, pipeline, pump out facility and construction of wharf and services upgrades and cruise ship operations	**Appendix AX**

In addition, air quality issues relating to dredging have not been reassessed and the findings from the Draft EIS (Ports North 2014) are presented in this chapter in the risk assessment (noting that the CSD Project now involves less than a quarter of the volume proposed in the Draft EIS).

These studies are referred to where appropriate. While all relevant findings have been incorporated into this chapter, readers are referred to the original reports for further details if required. Together these technical studies involved:

- literature reviews to gather emissions data and relevant information from previous studies
- desktop assessment of existing air quality
- establishment of air quality criteria (i.e. applicable standards and requirements)
- selection of a modelling methodology
- incorporation of local meteorological data into modelling of ambient conditions
- air quality modelling of potential impacts.

B11.2.2 Air Criteria (Air Quality Standards)

B11.2.2.a Queensland Legislation

The ToR identifies the environmental values defined in the Environmental Protection Policy (Air) (EPP (Air)) prepared under the *Environmental Protection Act 1994* (Qld). The EPP (Air) provides objectives for air quality indicators (pollutants). Those objectives that are relevant to this project and human health and wellbeing are summarised in **Table B11-3** below. This table includes details of all of the criteria used in this assessment.

The EPP (Air) also contains a criterion for visibility reducing particles, but this is a measure of regional air quality and is not relevant to point sources. The impact of visible particles from point sources is addressed by the $PM_{2.5}$ criteria.

B11.2.2.b National Environmental Protection (Ambient Air Quality) Measure

The EPP (Air) incorporates the goals nominated within the previous 2003 version of the National Environmental Protection (Ambient Air Quality) Measure. The current NEPM (Ambient Air Quality) dated February 2016 has multiple changes including the new standards and goals listed in Table 3.2. Exceedances of particulate standards are no longer allowed apart from the exceptional events defined below.

TABLE B11-2 NEW STANDARD AND GOALS IN 2016 NEPM (AMBIENT AIR QUALITY)

AIR QUALITY INDICATOR	PERIOD	CRITERIA (MG/M3)
$PM_{2.5}$ goals for 2025	1 day	20
	1 year	7
PM_{10}	1 year	25

Source: Appendix AV (Table 3.2).

Notes: For the purpose of reporting compliance against PM_{10} and $PM_{2.5}$ 1 day average standards, jurisdictions shall exclude monitoring data that has been determined as being directly associated with an exceptional event (bushfire, jurisdiction authorised hazard reduction burning or continental scale windblown dust that causes exceedance of 1 day average standards).

These goals have not yet been adopted into the EPP (Air) so it is thus not clear how much reduction of existing background concentrations is expected to assist with achievement of the 2025 goals, and how much is to be achieved by restrictions on development. Thus these goals have not been adopted for this assessment.

B11.2.2.c National Environmental Protection (Air Toxics) Measure

The EPP (Air) also incorporates as standards, the investigation levels contained in the National Environmental Protection (Air Toxics) Measure.

B11.2.2.d Dust Deposition

Whilst there are no quantitative limits for dust deposition specified in legislation, there are guidelines designed to avoid nuisance caused by dust deposition fallout onto near horizontal surfaces.

The Department of Environment and Heritage Protection (EHP 2013a) suggests the guideline that deposited matter averaged over one month should not exceed 120 mg/m^2/day (3.6 g/m^2/month). For extractive industries, it is the insoluble component of analysed dust that is used.

The NSW Department of Environment and Conservation (2005) specifies an annual average limit of 4 g/m^2/month (130 mg/m^2/day), and states that it is the insoluble component of analysed dust that is to be used.

It should be noted that these values are a guideline for the level that may cause nuisance at a sensitive receptor such as a residence or sensitive commercial land use. It is not normally necessary to achieve this level at the boundary, but boundary measurement can assist in the assessment of whether there is risk of nuisance occurring or not.

B11.2.2.e Odour

EHP (2013b) specifies an annoyance threshold for odour of 0.5 ou (odour units) for wake-free stacks and 2.5 ou for other sources, to be compared to the 99.5 percentile one hour model predictions.

B11.2.2.f Adopted Criteria for this Assessment

Table B11-3 below includes details of all of the above criteria used in this assessment and the source document where the standard is stipulated.

TABLE B11-3 ADOPTED CRITERIA FOR THIS ASSESSMENT

AIR QUALITY INDICATOR	PERIOD	CRITERIA (µG/M^3)	SOURCE
benzene	1 year	10	EPP (Air)
benzo(a)pyrene	1 year	0.3 ng/m^3	EPP (Air)
CO	8 hours	11,000 [2]	EPP (Air)
formaldehyde	1 day	54	EPP (Air)
NO_2	1 hour	250 [2]	EPP (Air)
	1 year	62	EPP (Air)
$PM_{2.5}$	1 day	25	EPP (Air)
	1 year	8	EPP (Air)
PM_{10}	1 day	50 [1]	EPP (Air)
sulfur dioxide	1 hour	570	EPP (Air)
	1 day	230	EPP (Air)
	1 year	57	EPP (Air)
toluene	30 minutes	1100	EPP (Air)
	1 day	4100	EPP (Air)
	1 year	410	EPP (Air)
TSP	1 year	90	EPP (Air)
xylenes	1 day	1,200	EPP (Air)
	1 year	950	EPP (Air)
odour from fugitives	99.5% 1 hour	2.5 ou	EHP (2013a)
dust deposition	1 month	120 mg/m^2/day	EHP (2013b)

Source: Appendix AV (Table 3.3).

Notes:

1. Five allowable exceedances are currently allowed although the intent of this was to cater for regional events.
2. Allowance is made to exclude one day.

B11.2.3 Modelling Methodology

B11.2.3.a Baseline Conditions

The meteorological component of The Air Pollution Model (TAPM) was used to provide wind fields over the region. TAPM has a prognostic three dimensional meteorological component which can be used to generate hourly meteorological data for input into dispersion models. It uses gridded terrain data at approximately 300 metre grid spacing to shape the windfields. Wind speed and direction has been monitored at the Cairns airport and this data was assimilated into the modelling. No other site specific meteorological data is publicly available for the vicinity. Detailed configuration of the model is described in **Appendix AV**.

TAPM was run over a full representative year for which data exists (2006) to include all seasons.

CALMET modelling of the wharf and inner channel domain was undertaken previously as described in **Appendix AV**. CALMET is a diagnostic meteorological model which reconstructs the 3D wind and temperature fields starting from meteorological measurements, orography, and land use data. The 2016 modelling adequately covers the Landside Works Project Area and the Tingira Street Project Area, while additional CALMET modelling of the Northern Sands DMPA area has now been completed. Details of the configuration and application of the model are provided in **Appendix AX**. **Appendix AX** also shows all relevant derived meteorological conditions used in the modelling.

B11.2.3.b Impact Modelling

Appendix AX details the reasons behind the selection of the CALPUFF (Version 7.2.1) model. With sources close to ground level, the critical wind conditions tend to be near-calm i.e. low wind speeds. CALPUFF is able to simulate stagnation over time, which is critical in near-calm conditions. In near-calm conditions there is little turbulent mixing and less dilution by incoming wind.

As explained in **Section B11.4.2**, CALPUFF uses CALMET inputs and a range of assumed emissions to predict impacts.

B11.2.4 Overview of Construction Emission Sources

Construction sources include:

- the dredger itself moving up and down the channel, motoring to a pump out point located offshore of Yorkeys Knob and pumping out the current load
- land-based wharf infrastructure construction
- dust from vehicle movement on unsealed surfaces
- exhaust emissions from plant and equipment for construction and dredging vessels
- exhaust emissions from on-road vehicles
- exhaust emissions from barge tugs
- construction, operation and decommissioning of the pipeline between the pump out point and the Northern Sands DMPA and especially exhaust emissions from the three booster stations
- construction and placement activities at the Northern Sands DMPA, including discharge of tailwater.

Wharf construction hours are likely to be 6:30 am to 6:30 pm Monday to Saturday. Dredging and DMPA operation are likely to be 24 hours per day seven days per week. The following timeframes are anticipated:

- For the Northern Sands placement option, the current time estimate is 12 weeks plus pipeline mobilisation and demobilisation. DMPA and pipeline construction (concurrent) for Northern Sands will be done during daylight hours only for an estimated duration of six weeks, with demobilisation also taking up to six weeks.
- The wharf upgrade will take approximately seven to eight months intermittently over a year.
- The other land infrastructure will be concurrent with the wharf upgrade.

B11.2.5 Overview of Operation Emission Sources

Operational sources include:

- cruise ship wharf activities
- cruise ships traversing the channel and manoeuvring to the wharf
- fuel tank farm fugitive emissions

AEC (**Appendix AQ**) have provided low, medium and high cruise ship arrival projections for the years 2016, 2021, 2026 and 2031. For this assessment, the medium baseline and high project projections have been used and these have been interpolated linearly to obtain 2018 and 2028. The assessment also considers freight and local shipping emissions but not those from navy or recreational vessels.

Ports North have advised that there are no waste storage bins at the cruise liner facility. Putrescible waste is removed directly by contractors. Typically two small sized skips may be placed behind the cruise liner terminal for baggage waste and terminal staff domestic waste. Quarantine waste will continue to be disposed by contractor at an incinerator at the airport. The balance of putrescible waste will be taken by a contractor directly off the ships to a commercial landfill such as the Remondis facility at Springmount, Mareeba.

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B11.3 Existing Situation

B11.3.1 Identification of Sensitive Receptors

It is standard practice in assessments of noise and vibration to consider 'sensitive receptors'.

Sensitive receptors are defined under the EPP (Noise) as 'an area or place where noise is measured'. There is no equivalent definition in the EPP (Air). Sensitive receptors are usually associated with what is defined under the State Planning Policy (2014) as a 'sensitive land use'. These are caretakers' accommodation, child care centre, community care centre, community residence, detention facility, dual occupancy, dwelling house, dwelling unit, educational establishment, health care services, hospital, hotel, multiple dwelling, non-resident workforce accommodation, relocatable home park, residential care facility, resort complex, retirement facility, rooming accommodation, rural workers accommodation, short-term accommodation or tourist park.

Boat berths where permanent pylons are provided for mooring are considered sensitive locations under the definition of relocatable home park.

A summary of the nearest sensitive receptors for each of the three project areas (Landside Works Project Area, Northern Sands Project Area, and Tingira Street Project Area) is included in **Table B11-4** below. These sensitive receptors have been located by inspection of aerial photographs and maps and are shown on **Figure B11-2** to **Figure B11-4** below. These are also relevant to the TSHD dredging campaign address in the Draft EIS and reported on in the risk assessment later in this chapter.

TABLE B11-4 SENSITIVE RECEPTORS

ID	NAME / ADDRESS	REAL PROPERTY DESCRIPTION	APPROXIMATE DISTANCE AND DIRECTION FROM SITE	EASTING	NORTHING
Landside Works Project Area					
A	Park Regis City Quays Hotel, 6-8 Lake Street	N/A	Approx. 130 m west of dockside.	369960	8128319
B	Park Regis Piermonde Apartments, 2-4 Lake Street	N/A	Approx. 130 m west of dockside.	369999	8128255
C	Jack & Newel Apartments, 27-29 Wharf Street	N/A	Approx. 130 m west of dockside.	370006	8128299
D	Madison on Abbott Apartments, 3 Abbott Street	N/A	Approx. 130 m west of dockside.	370001	8128362
E	Pullman Reef Hotel & Casino, 6-8 Abbott Street	N/A	Approx. 100 m west of dockside.	370054	8128412
F	Cairns Hilton Hotel, 34 Esplanade	N/A	Approx. 80 m west of shipping channel.	370141	8128578
G	Cairns Harbour Lights Managed Apartments, 101 Marlin Parade	N/A	Approx. 100 m west of shipping channel.	370151	8128632
H	Shangri-La Hotel, Pier Point Road	N/A	Approx. 220 m west of shipping channel.	370146	8128990
I	Boats used as residences, east side of Trinity Inlet	N/A	Variable	370558	8128061

(Continued over)

ID	NAME / ADDRESS	REAL PROPERTY DESCRIPTION	APPROXIMATE DISTANCE AND DIRECTION FROM SITE	EASTING	NORTHING
Northern Sands Project Area					
J	Holloways Beach Environmental Education Centre, 46 Poinsettia Street, Holloways Beach	122/NR840892	Approx. 500m from pipeline.	365190	8138963
K	2-4 Deauville Close, Yorkeys Knob	0/BUP105844	Approx. 1 km from pipeline.	364417	8140742
L	30 Acacia Street, Holloways Beach	328/H9082	Approx. 500 m from pipeline.	365130	8138811
M	280 Yorkeys Knob Road, Yorkeys Knob	2/RP800898	Approx. 300 m from pipeline.	363937	8138570
N	72 Baronia Crescent, Holloways Beach	40/RP742748	Approx. 500 m from pipeline.	364972	8138264
O	108 Baronia Crescent, Holloways Beach	22/RP742750	Approx. 700 m from pipeline.	364958	8137890
P	101-103 Wistaria Street, Holloways Beach	1/RP731885	Approx. 1 km from pipeline.	365220	8137538
Q	78 Wistaria Street, Holloways Beach	21/RP741077	Approx. 1 km from pipeline.	365265	8137228
R	613 Holloways Beach Access Road	5/RP857577	Approx. 400 m from pipeline.	364512	8136716
S	Dwelling under construction, Holloways Beach Access Road	22/SP211748	Approx. 850 m north of Northern Sands.	364587	8136488
T	637 Captain Cook Highway, Barron	4/RP800591	Approx. 200 m north-west of Northern Sands.	363235	8136373
U	637 Captain Cook Highway, Barron	4/RP800591	Approx. 200 m north-west of Northern Sands.	363162	8136228
V	Holloways Beach Access Road	1/RP804218	Approx. 400 m east of Northern Sands.	364663	8135785
W	Holloways Beach Access Road	1/RP804218	Approx. 300 m east of Northern Sands.	364566	8135742
X	Holloways Beach Access Road	1/RP804218	Approx. 300 m east of Northern Sands.	364561	8135676
Y	417-419 Captain Cook Highway	4/RP748713	Approx. 400 m east of Northern Sands.	364658	8135085
Tingira Street Project Area					
T1	Refer **Figure B11-4**	27/SP218291	Refer **Figure B11-4**	145.77098	-16.95270
T2	Refer **Figure B11-4**	27/SP218291	Refer **Figure B11-4**	145.77221	-16.95268
T3	Refer **Figure B11-4**	27/SP218291	Refer **Figure B11-4**	145.77020	-16.94923
T4	Refer **Figure B11-4**	27/SP218291	Refer **Figure B11-4**	145.77232	-16.95139

Source: Appendix AX (Table 2.1) and **Appendix AW**.

Figure B11-2 Location of sensitive receptors in Wharf Street.

Source: Appendix AX (Figure 2.1).

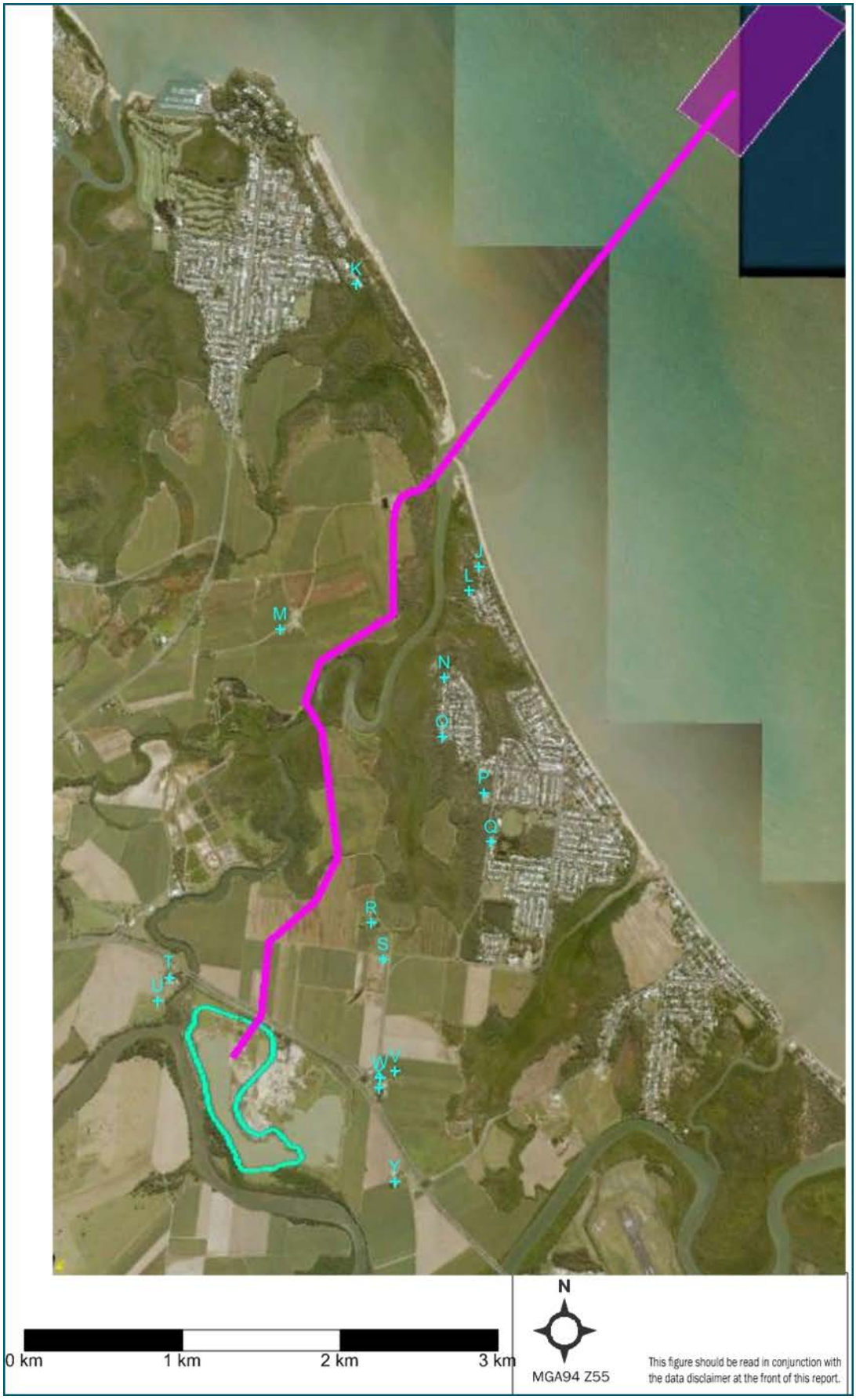

Figure B11-3 Location of sensitive receptors in Northern Sands Project Area.

Source: Appendix AX (Figure 2.2).

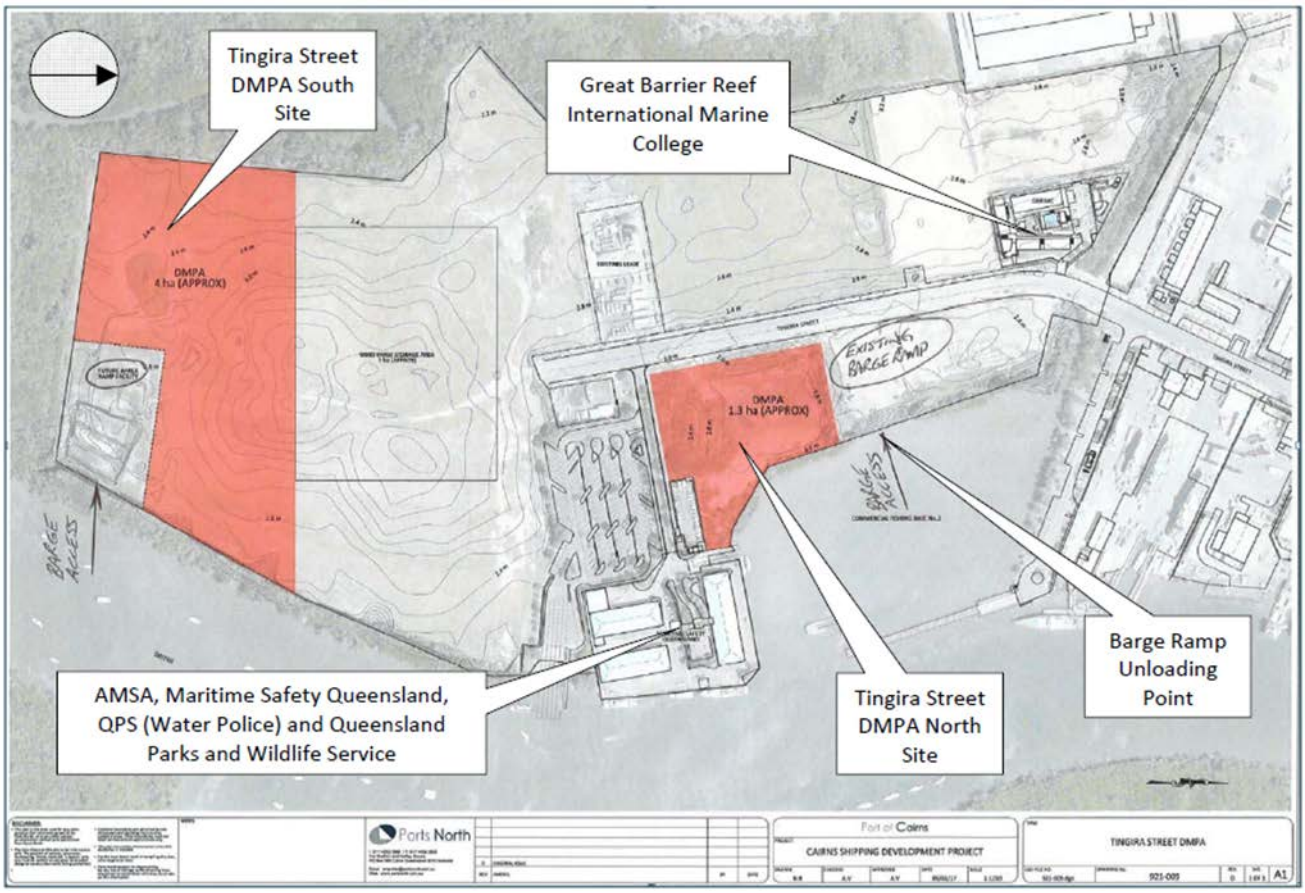

Figure B11-4 Tingira Street Project Area and nearest buildings.

Source: Appendix AT (Figure 2.2).

B11.3.2 Baseline Air Quality

B11.3.2.a Overview

While baseline air quality was not monitored for the Draft EIS or this Revised Draft EIS, monitoring data from similar locations has been used to simulate the existing background. The following is extracted from **Appendix AV**. In the absence of continuous monitoring data, it is recommended (State of Victoria 2001) to use the 70th percentile as a background concentration for dispersion modelling.

B11.3.2.b Existing Data

The nearest ambient air monitoring station operated by Department of Science, Information Technology and Innovation (DSITI) was Earlville in western Cairns in the 1990s, and more recently DSITI has monitored at three stations in Townsville, as discussed in the sections below. Additional monitoring has also been undertaken for two specific projects in the area:

- the Portsmith Waste Treatment Facility
- the Cityport Development.

Portsmith Waste Treatment Facility

Short-term monitoring of gaseous and particulate pollutants was undertaken from 27 to 29 March 2000 in and around Woree approximately 3 to 5 kilometres to the west of the wharf (Kamst & Simpson 2000). Due to the short duration of sampling and the distance to the wharf, these results are not considered representative of air quality at the wharf.

Cityport Development

Short-term monitoring (3 to 6 minute samples) of gaseous pollutants (Kamst & Simpson 1998) was undertaken within the Cityport area on 12 and 13 May 1998. No exceedances of criteria were detected. However this short duration sampling is not representative of ambient (environmental) air quality due to the high degree of variability of wind conditions and potentially source emissions.

Short-term monitoring of TSP was undertaken on three days using a high volume sampler. The concentrations measured were 34 and 35 µg/m^3 on the walkway to the ships at Trinity Wharf and 23 µg/m^3 at the former Cairns Port Authority depot near the corner of Wharf and Sheridan Streets. These indicate that particulate levels close to the wharf may be higher although concentrations will vary greatly between days. Although this monitoring was at the location of the wharf, the small number of days sampled are not representative in time.

Earlville

Monitoring of TSP was undertaken in Mulgrave Road, Earlville, until 1999. The monitoring site is approximately 4 kilometres to the west of the wharf adjacent to a busy road and near light industry uses. The average concentration from 1995 to 1999 was 24 µg/m^3:

- 26 µg/m^3 in 1995
- 31 µg/m^3 in 1996
- 21 µg/m^3 in 1997
- 20 µg/m^3 in 1998
- 21 µg/m^3 in 1999.

This is considered to be the most representative long-term monitoring site and hence the TSP measurements from this location have been adopted as background.

Townsville Coast Guard

Monitoring at the Townsville Coast Guard site began in 2007 as part of the Townsville Dust Monitoring Program, implemented in response to community concerns about dust impacts from the Port of Townsville operations. In May 2014 the Townsville Coast Guard station and the Townsville Port monitoring station were amalgamated into one joint monitoring station at the Townsville Coast Guard. Due to the high activity levels from freight shipping including bulk handling, this location is likely to have higher pollutant concentrations than in the Cairns Port. The station measures:

- meteorological data
- PM_{10}
- TSP
- metals.

Townsville Port

Established by the Port of Townsville Limited in 1994, the Townsville Port monitoring station was located on the western boundary of the Townsville Harbour. It monitored the impact of port activities on nearby residential areas. In May 2014 this station was amalgamated with the Townsville Coast Guard station to form one joint monitoring station at the Townsville Coast Guard. It was classified as a peak (port operations) station and due to the high activity levels from freight shipping including bulk handling, is likely to have higher pollutant concentrations than in the Cairns Port. The station measured:

- meteorological data
- PM_{10}
- TSP.

Pimlico

The Pimlico monitoring station was established in June 2004 to measure air pollutants in the Townsville area. It is classified as a neighbourhood station and was located at Latitude: -19.2871; Longitude: 146.7813 within the TAFE North Pimlico Campus grounds until the site was redeveloped in February 2016. The station measured:

- meteorological data
- ozone
- sulfur dioxide
- oxides of nitrogen
- PM_{10}.

This is considered to be the most representative site for PM_{10} and acid gases, and the measured concentrations are presented in **Table B11-5**.

TABLE B11-5 CONCENTRATIONS RECORDED BY QUEENSLAND DSITI AIR QUALITY MONITORING STATION AT PIMLICO IN TOWNSVILLE FROM 2007 UNTIL 2015

YEAR	75TH PERCENTILE 1-HOUR NO_2 CONCENTRATION ($\mu g/m^3$)	ANNUAL NO_2 CONCENTRATION ($\mu G/M^3$)	75TH PERCENTILE 1-HOUR SO_2 CONCENTRATION ($\mu g/m^3$)	75TH PERCENTILE 24-HOUR SO_2 CONCENTRATION ($\mu g/m^3$)	ANNUAL SO_2 CONCENTRATION ($\mu g/m^3$)	75TH PERCENTILE 24-HOUR PM_{10} CONCENTRATION ($\mu g/m^3$)
2007	30	8	5	3	3	15
2008	32	11	3	0	0	19
2009	36	9	3	3	0	18
2010	30	9	5	3	0	16
2011	not available	11	10	5	3	18
2012	32	9	5	3	3	16
2013	24	8	3	3	0	18
2014	26	8	5	3	3	17
2015	28	8	5	3	3	21
Average	30	9	5	3	1	18

Source: Appendix AV (Table 4.1).

Gladstone Memorial Park

Established in 2009, the Memorial Park station uses differential optical absorption spectroscopy (DOAS) equipment to monitor pollutants over a light path from the Entertainment Centre to Memorial Park. It is classified as a neighbourhood station and is located at Latitude: -23.8426; Longitude: 151.2534. The station measures:

- ozone
- nitrogen oxides
- sulfur dioxide
- air toxics (organic pollutants).

This is considered to be the most representative site for organic pollutants, and the measured concentrations are presented in **Table B11-6**.

TABLE B11-6 CONCENTRATIONS RECORDED BY MONITORING STATION AT GLADSTONE MEMORIAL PARK

YEAR	ANNUAL AVERAGE BENZENE (µg/m^3)	MAXIMUM 24H TOLUENE (µg/m^3)	ANNUAL AVERAGE TOLUENE (µg/m^3)	MAXIMUM 24H XYLENE (µg/m^3)	ANNUAL AVERAGE XYLENE (µg/m^3))	MAXIMUM 24H FORMALDEHYDE (µG/M^3)
2009	i.d.	5	i.d.	34	i.d.	6
2010	i.d.	8	i.d.	33	i.d.	5
2011	i.d.	7	4	39	29	5
2012	i.d.	27	i.d.	149	i.d.	5
2013	i.d.	11	i.d.	79	i.d.	6
2014	4	18	8	127	51	5
2015	5	11	7	90	52	5
Average	**5**	**12**	**6**	**79**	**44**	**5**

Source: Appendix AV (Table 4.2). Note: i.d. = insufficient data

South Gladstone

Established in 1992, the monitoring station is located in the grounds of the South Gladstone State School in a residential district. Since the Townsville and Mackay monitoring stations do not include PM2.5, the South Gladstone station is considered the most representative for Cairns and the measured concentrations at this station are presented in **Table B11-7**.

TABLE B11-7 CONCENTRATIONS OF FINE PARTICULATES ($PM_{2.5}$) RECORDED BY QUEENSLAND DSITI AIR QUALITY MONITORING STATION AT SOUTH GLADSTONE FOR 2009-2015

YEAR	75TH PERCENTILE 24-HOUR $PM_{2.5}$ CONCENTRATION (µG/M^3)	ANNUAL $PM_{2.5}$ CONCENTRATION (µG/M^3)
2009	10.5 [1]	9.2 [1]
2010	7.6	6.2
2011	7.6	7.5
2012	5.9	5.2
2013	6.3	5.6
2014	7.5	6.0
2015	5.2	4.3
Average	**6.7**	**5.8**

Source: Appendix AV (Table 4.3). Note: This data was not included in the average since the DSITI NEPM report for 2009 stated that there was a much higher than normal incidence and severity of wind blow dust events throughout Queensland.

Toowoomba

The Toowoomba DSITI monitoring station located at Willowburn Oval was the only CO monitoring station in Queensland outside of the Brisbane CBD, but closed down recently due to flooding. It was surrounded by residential and light industry areas. It is considered the most representative station and will be used for estimating background levels of CO for the purposes of this assessment. **Table B11-8** shows that the averaged maximum 8-hour background CO is 2.2 ppm (2750 µg/m^3).

TABLE B11-8 CONCENTRATIONS OF CARBON MONOXIDE RECORDED BY QUEENSLAND DSITI AIR QUALITY MONITORING STATION AT TOOWOOMBA FOR 2003-2010

YEAR	MAXIMUM 8-HOUR AVERAGE CO (PPM)
2003	2.6
2004	3.4
2005	2.3
2006	1.9
2007	2.2
2008	1.9
2009	1.8
2010	1.7
Average	**2.2**

Source: Appendix AV (Table 4.4).

B11.3.2.c Dust Deposition

Dust deposition varies substantially depending on local sources and season. Any dust deposition data for the local area is not publicly available. In industrial areas, insoluble dust deposition levels are typically in the order of 50 mg/m^2/day.

4.13 Summary of Estimated Background Levels

Based on the discussions in the preceding sections, the expected background air quality for key pollutants has been summarised with the estimated concentrations listed in **Table B11-9**. These are well within the criteria contained in **Table B11-3**. It is anticipated that the criteria would only be exceeded during regional events such as bushfires, dust storms or the afternoon cane fire haze events during harvesting season.

In addition to the parameters listed in **Table B11-3**, benzo(a)pyrene (a polycyclic aromatic hydrocarbon or PAH) has been added to **Table B11-9** for completeness since emission factors for PAHs are included in the DSITI (2017) study.

TABLE B11-9 ESTIMATED BACKGROUND AIR QUALITY

POLLUTANT	AVERAGING PERIOD	ASSUMED BACKGROUND (µg/m^3)
TSP	1 year	24
PM_{10}	24 hours	18
$PM_{2.5}$	24 hours	6.7
	1 year	5.8
NO_2	1 hour	30
	1 year	9
SO_2	1 hour	5
	24 hours	3
	1 year	1
CO	8 hours	2.2
Benzene	1 year	5
Toluene	24 hours	12
	Annual average	6
Xylene	24 hours	79
	Annual average	44
Formaldehyde	24 hours	5
Benzo(a)pyrene	Annual average	0.1 ng/m^3
Dust deposition	Annual average	50 mg/m^2/day

Source: Appendix AX (Table 6.2).

B11.3.3 Landside Works Project Area

The Landside Works Project Area (wharf and port area) is influenced by light and medium industries air emission sources such as service stations, beverage processing, dry cleaning, port facilities, ship emissions, metal fabrication, surface coating, galvanising, and concrete batching. Key industrial uses are shown on **Figure B11-5**. These are detailed in **Appendix AX** (Table 6.1).

Figure B11-5 Location of neighbouring activities with potential air emission sources.

Source: Appendix AX (Figure 6.1). Labelled sites are detailed in **Appendix AX** (Table 6.1).

B11.3.4 Northern Sands Project Area

The Northern Sands Project Area (DMPA and delivery pipeline) is located in a rural area surrounded mainly by sugar cane farming. Cane firing is no longer widely practised in the area, so air pollution issues generated by existing activities would include dust from vehicle traffic, cane field preparation and harvesting, and wind erosion, with occasional smoke from canefiring during harvesting season. At the Northern Sands DMPA, there is currently an existing sand extraction and waste disposal operation (Northern Sands) with associated traffic. It is anticipated that these activities would generate particulates mostly of larger particle size. This would elevate dust deposition levels in the vicinity of the site at present and also ongoing during the project phase.

B11.3.5 Tingira Street Project Area

The Tingira Street DMPA air shed is influenced by industry such as asphalt plants and ship repair facilities, boating emissions, reclaimed area dust and odours associated with inter tidal environments.

The air quality values and criteria are listed in **Section B11.2.2**.

B11.4 Assessment of Potential Impacts

B11.4.1 Impact Assessment Methodology

B11.4.1.a Risk-based Assessment

The following impact assessment has been undertaken for each of the matters described in the previous chapter. It uses the risk-based process adopted for the Revised Draft EIS as outlined in **Chapter A1** (Introduction) and includes an assessment of the following:

- the magnitude of impacts (consequence) (**Table B11-10**)
- the duration of impact (from **Chapter A1** (Introduction))
- the likelihood of impact (from **Chapter A1** (Introduction))
- risk level (from **Chapter A1** (Introduction)).

These are considered together to determine the final level of impact risk, which is described in **Table B11-13**.

B11.4.1.b Impact Significance / Consequence Criteria

Impact consequence criteria are different for each matter under discussion. **Table B11-10** shows the criteria used for this chapter.

TABLE B11-10 IMPACT CONSEQUENCE CRITERIA

IMPACT SIGNIFICANCE / CONSEQUENCE	DESCRIPTION OF SIGNIFICANCE
Very High	The impact is considered critical to the decision-making process. A substantial exceedance of an air quality criterion occurs that may lead to death.
High	The impact is considered likely to be important to decision-making. An exceedance of an air quality criterion occurs that may lead to serious but non-fatal health effects.
Moderate	The effects of the impact are relevant to decision-making including the development of management measures. Predictions are that the cumulative impacts will exceed a health criterion by up to a factor of two, or exceed a nuisance criterion.
Minor	Impacts are recognisable/detectable but acceptable. Predictions are that incremental impacts are below the criterion, but within an order of magnitude, and cumulative impacts are also below the criterion.
Negligible	Minimal change to the existing situation. Predictions are that incremental impacts will be an order of magnitude below the criterion.
Beneficial	Action results in an improvement in air quality.

Likelihood of impact is described in **Table B11-11** below.

TABLE B11-11 LIKELIHOOD OF IMPACT

CATEGORY	DEFINITION
Almost Certain	Very likely to occur during construction or the operational phases.
Likely	Likely to occur during construction or operational phases.
Possible	Less than likely to occur but still appreciable with the probability of occurrence rated above 50 percent.
Unlikely	May occur during construction or during the life of the project with the probability of occurrence being below 50 percent, but not negligible.
Highly Unlikely/Rare	Highly unlikely to occur but theoretically possible.

Risk is described as the product of significance and likelihood as shown in **Table B11-12** below.

TABLE B11-12 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

The rating of risk as assessed above is as shown in **Table B11-13** below.

TABLE B11-13 RISK RATING LEGEND

Extreme Risk	An issue requiring change in project scope to reduce risk.
High Risk	An issue requiring further detailed investigation and planning to manage and reduce risk. For air quality this rating requires gathering of detailed project-specific data to improve the accuracy of the assessment, and/or extensive monitoring to ensure control measures are effective.
Medium Risk	An issue requiring project scope specific controls and procedures to manage.
Low Risk	Manageable by standard mitigation and similar operating procedures.
Negligible Risk	No additional management required.

B11.4.2 Activities with Air Emissions

B11.4.2.a Overview

The CSD Project involves upgrading of existing infrastructure for the Port of Cairns to accommodate larger cruise ships, including expansion of the existing shipping channel and swing basin, and upgrades to the existing wharves and associated services. Associated with this is the construction of infrastructure for placing the dredge material on land and the placement process at the Northern Sands DMPA and Tingira Street DMPA.

Extensive details of all of these activities and their associated emissions sources are included in **Appendix AX** and **Appendix AW** and a brief summary is provided below.

B11.4.2.b Air Emission Sources during Construction

Construction activities that will involve air emissions include – see **Chapter A3** (Project Description) for more details:

- the TSHD dredger itself moving up and down the channel, motoring to a pump out point located offshore of Yorkeys Knob and pumping out the load
- the barge-mounted backhoe excavating stiff clay and the barge motoring to and from the Tingira Street DMPA
- land-based wharf infrastructure construction and demolition of Wharf 6
- dust from vehicle movement on unsealed surfaces
- exhaust emissions from plant and equipment for construction and dredging vessels
- exhaust emissions from on-road vehicles
- exhaust emissions from barge tugs
- construction, operation and decommissioning of the pipeline between the pump out point and the Northern Sands DMPA and especially exhaust emissions from the three booster stations
- construction and placement activities at the Northern Sands DMPA, including discharge of tailwater
- construction and placement activities at the Tingira Street DMPA.

Section B11.5.2 of the Draft EIS describes the substantial construction and operational sources of air emissions. These are largely relevant although no haulage or fill will be required for the project.

Wharf construction hours are likely to be 6:30 am to 6:30 pm Monday to Saturday. Dredging and DMPA operation are likely to be 24 hours per day seven days per week, unless limited by noise considerations as described in **Chapter C2** (Dredge Management Plan). The following timeframes are anticipated:

- Channel dredging is the largest construction activity associated with the CSD Project and is estimated to take approximately 12 weeks.
- For the Northern Sands DMPA, the current time estimate is 12 weeks plus pipeline mobilisation and demobilisation (an estimated 4-6 weeks for each). DMPA and pipeline construction (concurrent) for Northern Sands will be done during daylight hours only for a duration of six weeks, with demobilisation also taking up to six weeks.
- For the backhoe dredging and the associated Tingira Street DMPA, general hours of work are to be 14 x twelve hour shifts per week.
- The wharf upgrade will take approximately seven to eight months intermittently over a year.
- The other land infrastructure will be concurrent with the wharf upgrade.

B11.4.2.c Air Emission Sources of Operation

Operational activities that will involve air emissions include:

- cruise ship wharf activities
- cruise ships traversing the channel and manoeuvring to the wharf and while at-berth
- maintenance dredging.

The numbers of cruise ships berthing at the Port of Cairns is currently approximately 30 cruise ships, 76 bulk cargo ships (>100 metres in length) and 182 general cargo ships. In 2026 with the upgrade the number of cruise ships is projected to be up to a maximum of 177 cruise ships including 164 megaships per year. It is anticipated that only one cruise ship will be docked at any one time.

Other vehicles will include buses, taxis, private vehicles, delivery trucks, sewerage trucks and fuel tankers. The draft EIS traffic impact assessment concluded that road traffic volumes were not anticipated to change significantly, based on only one large cruise ship being berthed at any time, and it is understood that this is still the case. Traffic associated with the current largest vessel (*Legend of the Seas*), is typically 26 buses and 40 taxis in one day.

It is proposed that Intermediate Fuel Oil (IFO) will be stored and dispensed via pipeline from the nearby fuel farm to the wharf, depending on commercial negotiations between fuel suppliers and cruise companies.

B11.4.3 Assumed Mitigation

B11.4.3.a Design

The following mitigation arose from the design process:

- The Northern Sands DMPA was chosen because of its existing void thereby minimising the need for earthworks in preparing a cavity for placement. and is relatively distant from sensitive receptors,
- The Tingira Street DMPA was selected as it was an existing degraded site scheduled for future preloading and filling and the stiff clay placement would partly achieve this aim.

B11.4.3.b Construction

Air quality modelling assumes that the following measures will be included in the detailed Contractor's Construction Environmental Management Plan and are inherent in the proposal:

- Dust and wind will be monitored on site and work that may generate dust will cease if strong winds occur.
- All project personnel and relevant sub-contractors will receive training in air quality control practices at induction, toolbox talks, and targeted training for specific activities.
- Water carts, sprinklers, sprays and dust screens will be used where appropriate to control dust emissions from exposed surfaces and dust generating activities at a frequency appropriate to conditions.
- Rumble grids and coarse aggregate will be installed at exit roads to prevent soil being deposited onto public roads. Manual cleaning of vehicles and roads will be conducted as required.
- Waste will be segregated and collected regularly to control odours.
- Construction equipment including dredging vessels will be properly maintained to ensure exhaust emissions comply with relevant standards.

B11.4.3.c Operation

Air quality modelling assumes that the following measures are included in the Port's operational requirements and are considered assumptions inherent in this assessment of impacts:

- Cruise ship owners are to be encouraged to implement measures including:
  - regular maintenance and engine tuning
  - catalytic converters to reduce NOx emissions
  - reduced idling time at berth before departure and after arrival.
- Expected uptake of ship engine scrubber technology is as incorporated into the Brisbane Port study described by DSITI (2007). The IMO mandated use of low sulfur fuel post 2020 is included in the 2028 modelling scenario.
- Minimise standing losses, working losses and spills in fuel storage and dispensing activities.

B11.4.4 Cruise Shipping Industry Trends

Appendix AX includes considerable detail on industry trends and legislation aimed at reducing emissions from cruise ships. The most important impending change is the requirement from 2020 that all vessels use low sulfur fuel. Specifically, global fuel content limits (IMO 2008) for the sulfur content of residual fuel oil are:

- 3.50% before 1 January 2020
- 0.50% on and after 1 January 2020.

In Australian waters, the IMO limits are enforced either by state government (within 3 nautical miles of land where enacted by state legislation) or the Australian Maritime Safety Authority (AMSA) elsewhere.

Some state legislation prescribes higher limits such as the New South Wales Protection of the Environment Operations (Clean Air) Amendment (Cruise Ships) Regulation 2015, which regulates cruise ship emissions while berthed in Sydney Harbour. It mandates that cruise ships use a maximum fuel oil sulphur content limit of 0.1 per cent while at berth, or use an alternative method to achieve the same outcome.

AMSA have advised that there are no plans to implement a similar policy at other ports. Ports North have advised that the following will apply to Cairns:

- Compliance with fuel sulfur content will be in accordance with IMO and state regulations at the time.
- There is no intention to install shore power.

The move to low sulfur fuels will reduce the modelled gaseous concentration. In addition the use of scrubbers (i.e. mechanical filters and allied technology used to remove particulates) is also increasing, partly as this also allows vessels to use the higher sulfur fuels. This is discussed detail in **Section B11.4.6.b**.

These trends will have the effect of reducing both gaseous and particulate emissions.

B11.4.5 Impact Modelling

The air quality predictions undertaken for this assessment are based on the following methodology:

- The activity scenario selected for modelling was based on the highest reasonable potential to cause impact to nearby sensitive receptors and assumed a 2028 baseline and with project scenario of 100% usage of scrubbers (equivalent to using 0.5% sulfur fuel) and a 2028 project scenarios of 68% scrubber usage, with balance using 0.5%sulfur fuel.
- The main emission calculation methods utilised are described in Section 7 of **Appendix AX**.
- Prediction of input meteorology was completed using TAPM developed by the CSIRO Division of Atmospheric Research (see **Section B11.2.3.a**).
- TAPM input meteorology was enhanced using Calmet, the meteorological pre-processor for CALPUFF (see **Section B11.2.3.b**). This fits the windfields to the terrain based on gridded terrain data at approximately 30 metre grid spacing.
- Dust and gas concentrations and dust deposition were predicted using CALPUFF .

The emission rates entered into the dispersion modelling are based on the activity and source information provided by Ports North as listed in Section 3 of **Appendix AX**. Appendix B of **Appendix AX** provides the details of the calculation methods for significant particulate sources. All detailed inputs are described in Section 7 of **Appendix AW** for the Tingira Street Project Area and Section 7 of **Appendix AX** for the balance of the study area.

B11.4.6 Qualitative Assessments

B11.4.6.a Odour from Dredging, Placement and Tailwater

Channel Dredging

According to the Draft EIS, the likelihood of significant air emissions relating to odour 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 (as was then intended) placed of offshore. The same conclusions can be applied for the dredging component of the current project CSD Project (without allowing for the fact that the dredging volume is now less than one quarter of that considered in the Draft EIS). However, the material is now to be pumped from the dredge to the pump out facility, while moored adjacent. From the pump out facility the material will be within a sealed pipeline all the way to the DMPA.

According to EPA (2001), odour from anaerobic sediments from dredging is rarely more than a temporary problem. When first discharged it is initially anaerobic and may smell, but the smell is lost within a few days of its exposure to air. Odour is also associated with hydrogen sulphide (H_2S) released from acid sulphate materials. Sulfur varies according to soil texture. Given that the pump out point is located approximately 2.6 to 3.6 km NE of Yorkeys Knob, it is unlikely that odour will be experienced at any sensitive receptors or along the pipeline route.

Northern Sands DMPA

The majority of the dredged material to be taken to the Northern Sands DMPA will be very soft silty clay. This has potential to form hydrogen sulfide (H_2S) as a by-product of the oxidation of pyrite. If the material is drained, it will be readily oxidised. However, at Northern Sands it is to be placed and remain under water and so oxidation will not occur. Refer to the comment above from EPA (2001).

The odour is expected to be highest at the outlet of the pipeline where agitation of the surface may occur. However this should be minimal provided the outlet is kept below the surface. Additionally this location is distant from sensitive receptors.

Tingira Street DMPA

In contrast to soft clay, stiff clay from the older sediments that will be raised by the backhoe dredge has lower potential for H_2S formation than the soft clays. It is anticipated that this will have less odour than mangrove mud. However it will still vary spatially, requiring ongoing monitoring by personnel to ensure that soft clays are not accepted by the backhoe dredge.

B11.4.6.b Dark Smoke from Ship Exhausts

High emission levels of fine particulates are observable as dark smoke. These typically occur when a large diesel engine starts up or is under high engine load. Ship engines are typically under high load when arriving at or departing from the wharf.

Future uptake of particulate filter controls and scrubbers on new modern engines should prevent this from occurring. Although emission controls for particulates are not mandated, there is an indirect mechanism that may lead to uptake of scrubbers. In 2020, it may be difficult to obtain fuel that is compliant with the IMO (2008) requirement that the sulfur content of fuel be limited to 0.5% (and 0.1% in emission control areas). IMO will allow ships to continue using fuel with up to 3.5% sulfur if they install and operate scrubbers that will reduce SO_2 emissions by a factor that offsets the fuel content. It is anticipated that major cruise ship companies (refer **Table B11-14**) will meet the 2020 regulations with the scrubber technology option, considering uptake levels to date, giving the ships greater flexibility when in regions with variable supply of low sulfur fuels. For ships that take up this option, there will be the additional benefit that the scrubbers will reduce particulate (and hence black smoke) emissions. Future ship engine fuel such as LNG will see particulate emissions reduced further.

TABLE B11-14 EXAMPLES OF CRUISE SHIPS WITH SCRUBBERS INSTALLED 2017

BRAND	TOTAL FLEET NUMBER OF SHIPS	NUMBER OF SHIPS WITH SCRUBBERS
Carnival	101	70
Royal Caribbean	23	19
Norwegian	14	8
Genting	9	3

Source: Appendix AX (Table 8.2).

In addition to the above, the use of marine diesel, as typically used by ship's generators whilst at berth, instead of fuel oil would greatly reduce these emissions.

Use of shipboard incinerators is not permitted whilst alongside or at the Port, hence these will not contribute to dark smoke.

B11.4.6.c Odour from Ship Waste

Ship waste is to be removed directly off the cruise ships and taken off site by contractors. Odour emissions should be similar to those from waste removal from land-based restaurants (without the storage emissions). Proper handling to avoid spillage and uncovered loads should reduce odour detection to the immediate vicinity of activities. Thus these activities should not cause odour nuisance at sensitive receptors.

This is also the current practice for existing ships, so emissions will not be worse, just more frequent.

B11.4.7 Dispersion Modelling Results

B11.4.7.a Limitations

Appendix AX includes details of dispersion modelling, noting that there are uncertainties associated with this type of assessment. These are normally only dealt with in a qualitative manner, but include:

- emission factor estimation techniques
- source strength variability
- meteorological data variability
- inherent uncertainty in dispersion modelling.

Typically 95% confidence intervals are estimated to require a multiplicative factor of 2 or 3. In this case, the uncertainty is mostly due to assumptions regarding the details of emission sources and operating information. As per the Terms of Reference requirements, this has been addressed by conservative assumptions that will over-predict the ambient concentrations including the following:

- In the absence of detailed activity data, the plant was assumed to operate continuously.
- The project shipping scenario modelled assumes high projections and consequent more frequent emissions.
- The model assumes that the high emission rates coincide with most adverse meteorological conditions, which is unlikely.
- During adverse meteorological conditions, additional effort is given to management measures such as spraying and reducing drop heights, and the model does not allow for this.
- Conservative Scrubber efficiency ratings (scrubber efficiency increases of up to 20% are now available in the market).

Thus the results presented below should be considered to be 'worst case' and should be interpreted with caution.

The outputs of **Appendix AX** and **Appendix AW** are highly technical and detailed and are not repeated here in full. Interested readers should consult the detailed appendices if more information is required. In the following analysis two scenarios of cruise shipping numbers are used where relevant:

- Baseline – AEC (**Appendix H**) baseline (AEC Scenario 1 without Brisbane Cruise Terminal and without home porting)
- Project – AEC Scenario 16 with Brisbane Cruise Terminal and home porting and bunkering. Voyager class will not be able to negotiate the inlet even with the proposed channel widening, and have been excluded from all calculations.

AEC provided low, medium and high projections for the years 2016, 2021, 2026 and 2031. For this assessment, the medium baseline and high project projections have been used (with linear interpolation to obtain 2018 and 2028).

B11.4.7.b Channel Project Area and Landside Works Project Area– Construction

The following discussion relates to construction phase impacts of channel dredging and building works at the Landside Works Project Area for suspended particulates and gas concentrations. As these works will take place in the next few years (if the CSD Project is approved and funded), they are relevant to the baseline scenario.

Predicted concentrations and levels of all indicators are summarised in **Table B11-15** for the worst-affected receptors: B, C, D or E (apartments on the corner of Lake, Wharf and Abbott Streets) depending on the criterion. PM_{10}, $PM_{2.5}$, NO_2, and dust deposition levels (shown in red) all exceed the relevant criterion. The concentrations of all other pollutants arising from the project are expected to be less than the criteria.

TABLE B11-15 SUMMARY OF PREDICTED LEVELS AT THE MOST AFFECTED RECEPTOR FOR BASELINE SCENARIO

POLLUTANT	AVERAGING PERIOD	ASSUMED BACKGROUND ($\mu g/m^3$)	CONCENTRATION AT MOST AFFECTED RECEPTOR DUE TO CONSTRUCTION ($\mu g/m^3$)	CUMULATIVE CONCENTRATION AT MOST AFFECTED RECEPTOR ($\mu g/m^3$)	CRITERIA ($\mu g/m^3$) (TABLE B11-3)
TSP	1 year	24	22	46	90
PM_{10}	24 hours	18	52	**70**	50
$PM_{2.5}$	24 hours	7	48	**55**	25
	1 year	5.8	16	**22**	8
NO_2	1 hour	30	576	**606**	250
	1 year	9	20	29	62
SO_2	1 hour	5	197	202	570
	24 hours	3	74	77	230
	1 year	1	24	25	57
CO	8 hours	2	171	173	11,000
Benzene	1 year	5	0.05	5	10
Toluene	30 minutes	12	0.2	12	1,100
	24 hours	12	0.02	12	4,100
	Annual average	6	0.008	6	410
Xylene	24 hours	79	0.02	79	1,200
	Annual average	44	0.006	44	950
Formaldehyde	24 hours	5	0.07	5	54
Benzo(a)pyrene	Annual average	0.1 ng/m^3	0.06 ng/m^3	0.16 ng/m^3	0.3 ng/m^3
Dust deposition	Annual average	50 mg/m^2/day	85 mg/m^2/day	**135 mg/m^2/day**	120 mg/m^2/day

Source: Appendix AX (Table 9.18).

The exceedances predicted due to the wharf construction and stiff clay dredging activities are likely due to the conservatism of the model which includes the assumption that the backhoe dredger and tug use fuel oil whereas they will use marine diesel fuel and are constantly emitting relatively close to the sensitive receptors and that the excavation and crane emissions are constantly emitting from 7.00 am to 7.00 pm, Monday to Saturday. The exhaust emissions from the excavators and cranes were calculated from conservative NPI emission factors and assumed SCR emission controls were not fitted. As the months of construction activities are currently unknown, the model assumes that activities occur all year, so long-term averages of relevant pollutants be are conservatively high.

In reality, the backhoe dredge will only be in the vicinity of the sensitive receptors for a small proportion of the campaign (as indicated by the dredge logs) and such activity will occur intermittently within each working day while barge transfers occur. Hence emissions estimated in table above for the TSHD, backhoe and landside works occurring concurrently presents an unlikely scenario.

Additional mitigation measures to reduce particulate and NOx emissions are proposed in **Section B11.5**.

B11.4.7.c Landside Works Project Area – Operation

The following discussion relates to operational impacts at the Landside Works Project Area (wharf area) associated with cruise ships after completion of the project works for suspended particulates and gas concentrations. Both the baseline case and project case are assessed.

Predicted concentrations and levels of all indicators are summarised in **Table B11-16** and **Table B11-17** for the worst-affected receptor, Jack & Newel Apartments C.

TABLE B11-16 SUMMARY OF PREDICTED LEVELS AT THE MOST AFFECTED RECEPTOR FOR BASELINE SCENARIO (100% OF CRUISE SHIPS USING SCRUBBERS)

POLLUTANT	AVERAGING PERIOD	ASSUMED BACKGROUND (µG/M3)	CONCENTRATION AT MOST AFFECTED RECEPTOR DUE TO SHIPS (µg/m^3)	CUMULATIVE CONCENTRATION AT MOST AFFECTED RECEPTOR (µg/m^3)	CRITERIA (µg/m^3) (TABLE B11-3)
TSP	1 year	24	2	26	90
PM_{10}	24 hours	18	19	37	50
$PM_{2.5}$	24 hours	6.7	17	24	25
	1 year	5.8	1	7	8
NO_2	1 hour	30	197	227	250
	1 year	9	6	15	62
SO_2	1 hour	5	311	316	570
	24 hours	3	153	156	230
	1 year	1	10	11	57
CO	8 hours	2.2	96	98.2	11,000
Benzene	1 year	5	0.015	5	10
Toluene	30 minutes	12	0.21	12	1,100
	24 hours	12	0.08	12	4,100
	Annual average	6	0.005	6	410
Xylene	24 hours	79	2	81	1,200
	Annual average	44	0.09	44	950
Formaldehyde	24 hours	5	0.023	5	54
Benzo(a)pyrene	Annual average	0.1 ng/m^3	0.022 ng/m^3	0.12 ng/m^3	0.3 ng/m^3
Dust deposition	Annual average	50 mg/m^2/day	4 mg/m^2/day	54 mg/m^2/day	120 mg/m^2/day

Source: Appendix AX (Table 9.16).

TABLE B11-17 SUMMARY OF PREDICTED LEVELS AT THE MOST AFFECTED RECEPTOR FOR PROJECT SCENARIO (100% OF CRUISE SHIPS USING SCRUBBERS)

POLLUTANT	AVERAGING PERIOD	ASSUMED BACKGROUND ($\mu g/m^3$)	CONCENTRATION AT MOST AFFECTED RECEPTOR DUE TO SHIPS ($\mu g/m^3$)	CUMULATIVE CONCENTRATION AT MOST AFFECTED RECEPTOR $\mu g/m^3$)	CRITERIA $\mu g/m^3$) (TABLE B11-3
TSP	1 year	24	2	26	90
PM_{10}	24 hours	18	19	37	50
$PM_{2.5}$	24 hours	6.7	17	24	25
	1 year	5.8	1	7	8
NO_2	1 hour	30	197	227	250
	1 year	9	6	15	62
SO_2	1 hour	5	311	316	570
	24 hours	3	153	156	230
	1 year	1	10	11	57
CO	8 hours	2.2	96	98.2	11,000
Benzene	1 year	5	0.015	5	10
Toluene	30 minutes	12	0.21	12	1,100
	24 hours	12	0.08	12	4,100
	Annual average	6	0.005	6	410
Xylene	24 hours	79	2	81	1,200
	Annual average	44	0.09	44	950
Formaldehyde	24 hours	5	0.023	5	54
Benzo(a)pyrene	Annual average	0.1 ng/m^3	0.022 ng/m^3	0.12 ng/m^3	0.3 ng/m^3
Dust deposition	Annual average	50 mg/m^2/day	4 mg/m^2/day	54 mg/m^2/day	120 mg/m^2/day

Source: Appendix AX (Table 9.17).

These tables show that PM_{10} and $PM_{2.5}$ concentrations exceed the criterion (shown in red) for the project scenario. The exceedance only occurred on one day in the modelled year, when there was moderate south-easterly wind with neutral stability class and relatively high mixing height throughout the 24-hour day.

The 1-hour NO_2 concentrations for the baseline scenario are close to but within the criterion. The 1-hour NO_2 concentrations for the project scenario exceed the criteria for ten hours in the modelled year from within 6pm to 7am, when winds were light and blowing from the south and southeast and mostly having low mixing (inversion) heights at approximately 50 metres.

The concentrations of all other pollutants arising from the project are expected to be less than the criteria.

Figure B11-6 shows a typical plot of particulate concentrations (in this case the Year 2028 project scenario (with 100% cruise ships using scrubbers) maximum 24 hour $PM_{2.5}$ concentrations). Additional plots are contained in **Appendix AX**. It should be noted that concentrations provided in tabular form are a prediction at a point in space and hence more accurate than the contours, which are graphical interpolations. Note that in the plot below some contours are labelled (e.g. 25 = 25 $\mu g/m^3$). However there are higher concentrations depicted by the orange and red shading and the highest values are listed in the associated table.]

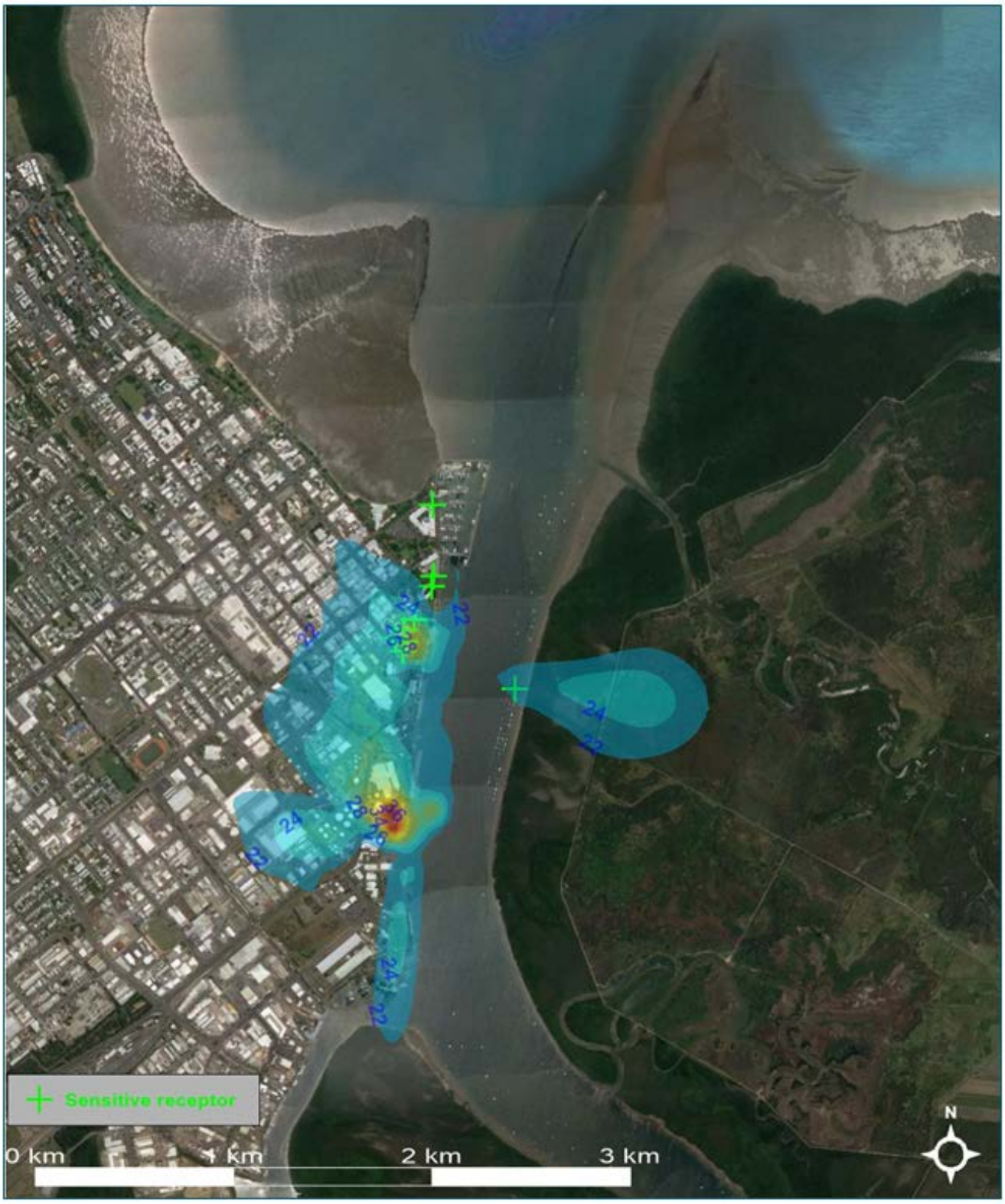

Figure B11-6 Trinity Wharves – Year 2028 project scenario(100% of Cruise Ships Using Scrubbers) maximum 24 hour $PM_{2.5}$ concentrations (µg/m^3).

Source: Appendix AX (Figure 9.5).

B11.4.7.d Northern Sands DMPA

The following discussion relates to construction phase impacts at the Northern Sands DMPA for suspended particulates and gas concentrations. As these works will take place in the near future, they are relevant to the

baseline scenario.

For construction of the DMPA, predicted concentrations for all pollutants are well within the criteria. For operation (i.e. while the soft clay placement in in progress), predicted concentrations and levels of all indicators are summarised in **Table B11-18** for the worst-affected receptors: M, W or X depending on the criterion.

TABLE B11-18 SUMMARY OF PREDICTED LEVELS AT THE MOST AFFECTED RECEPTOR FOR BASELINE SCENARIO

POLLUTANT	AVERAGING PERIOD	ASSUMED BACKGROUND ($\mu g/m^3$)	CONCENTRATION AT MOST AFFECTED RECEPTOR DUE TO CONSTRUCTION ($\mu g/m^3$)	CUMULATIVE CONCENTRATION AT MOST AFFECTED RECEPTOR ($\mu g/m^3$)	CRITERIA ($\mu g/m^3$) (TABLE B11-3)
TSP	1 year	24	0.6	25	90
PM_{10}	24 hours	18	13	31	50
$PM_{2.5}$	24 hours	7	13	20	25
	1 year	5.8	0.4	6.2	8
NO_2	1 hour	30	326	**356**	250
	1 year	9	1	10	62
CO	8 hours	2	120	122	11,000
Benzene	1 year	5	0.004	5	10
Toluene	30 minutes	12	3.8	16	1,100
	24 hours	12	0.2	12	4,100
	Annual average	6	0.005	6	410
Xylene	24 hours	79	0.16	79	1,200
	Annual average	44	0.004	44	950
Formaldehyde	24 hours	5	0.05	6	54

Source: Appendix AX (Table 9.19).

The maximum 1-hour NO_2 concentration (shown in red) exceeds the criterion. This is based on the assumption that the tailwater pumps have no emission controls. The concentrations of all other pollutants arising from the project are expected to be less than the criteria.

Simple mitigation measures to reduce particulate and NOx emissions are proposed in **Section B11.5**.

B11.4.7.e Tingira Street DMPA

The predicted concentrations at the single sensitive receptor (i.e. the Marine College) are shown in **Table B11-19** along with the relevant criterion. The estimated background levels are shown in the tables separately but have not been added to the predicted concentrations shown. As these works will take place in the near future, they are relevant to the baseline scenario.

Although the sensitive receptor was modelled at two heights (at ground level and at 4.5 metre height), the predicted concentrations at the two receptor heights were similar and thus, only the results at ground-level are presented.

For haul roads, dozer and grader, a control factor of 75% has been applied to the result. This is based on the following factors relevant to the dominant emission sources (Environment Australia 2012):

- The standard wind erosion equation assumes no wind erosion on days with greater than 0.25 millimetres of rain, whereas the model used in this report assumed no rain.
- The control factor for hauling is doubled for a higher level of watering.
- Loading and unloading of trucks with wet dredge material was not included in the dust emissions due to the high degree of water present.

TABLE B11-19 PREDICTED CONCENTRATIONS AT THE MOST AFFECTED RECEPTOR FOR BASELINE SCENARIO

POLLUTANT	AVERAGING PERIOD	MODELLING PREDICTION AT SENSITIVE RECEPTOR (µg/m^3)	BACKGROUND (µg/m^3)	CUMULATIVE IMPACT (µg/m^3)	CRITERION (µg/m^3) (TABLE B11-3)
TSP	1 year	13	24	37	90
PM_{10}	24 hours	19	18	37	50
$PM_{2.5}$	24 hours	13	6.7	20	25
	1 year	2.6	5.8	**8.4**	8
NO_2	1 hour	201	30	231	250
	1 year	10	9	19	62
CO	8 hours	254	2.2	256	11,000
Benzene	1 year	0.06	5	5	10
Toluene	30 minutes	0.05	-	0.05	1,100
	24 hours	0.008	12	12	4,100
	Annual average	0.0009	6	6	410
Xylene	24 hours	0.005	79	79	1,200
	Annual average	0.0006	44	44	950
Formaldehyde	24 hours	5	5	10	54
Dust deposition	One month	66 mg/m^2/day	50 mg/m^2/day	116 mg/m^2/day	120 mg/m^2/day

Source: Appendix AW (Table 9.1).

The cumulative impact is assessed by adding the background to the predicted values in the above table.

The cumulative (including background) annual average PM2.5 at the sensitive receptor is 8.4 µg/m3, slightly exceeding the criterion of 8 µg/m3. It should be noted that the modelled activities at Tingira St DMPA would only occur for approximately 30 days whereas it has modelled as occurring for a full calendar year, since the month of activity cannot be precisely stipulated. Hence in reality, the annual average $PM_{2.5}$ concentration at the sensitive receptor due to the modelled activities is likely to be significantly lower than predicted and presented above.

All the other assessed pollutants are within their respective criteria.

B11.4.8 Risk Assessment

B11.4.8.a Assessment

Table B11-20 sets out the results of the risk assessment for air quality issues based on the previous analysis. This assumes that only standard mitigation (i.e. statutory) is applied. The assessment of dredging impact is extracted from the Draft EIS (without allowing for the fact that the dredging volume is now less than one quarter of that considered in the Draft EIS).

TABLE B11-20 RISK ASSESSMENT

PROJECT AREA	CONSTRUCTION ACTIVITY / NOISE SOURCE	INITIAL ASSESSMENT WITH STANDARD MITIGATION MEASURES		
		CONSEQUENCE	LIKELIHOOD	RISK RATING
Construction				
Dredging (TSHD) – from Draft EIS	Odour from TSHD dredging and placement at pump out facility	Negligible	Unlikely	Negligible
Dredging (Backhoe)	Included in Tingira Street DMPA assessment	N/A (see Tingira Street DMPA)	N/A (see Tingira Street DMPA)	N/A (see Tingira Street DMPA)
Construction of wharf and tank farm and dredging of channel	Exceedance of 24 h particulate criteria	Moderate	Likely	Medium
	Exceedance of annual $PM_{2.5}$ criterion	Moderate	Possible	Medium
	Exceedance of dust deposition criterion	Minor	Possible	Low
	Exceedance of gas criteria	Moderate	Possible	Medium
Construction of pipeline	Exceedance of 24 h particulate criteria	Negligible	Unlikely	Negligible
	Exceedance of annual $PM_{2.5}$ criterion	Negligible	Unlikely	Negligible
	Exceedance of gas criteria	Negligible	Unlikely	Negligible
Operation of DMPA, boosters and pumps at Northern Sands	Exceedance of 24 h particulate criteria	Moderate	Possible	Medium
	Exceedance of annual $PM_{2.5}$ criterion	Negligible	Unlikely	Negligible
	Exceedance of gas criteria (see **Section B11.4.8.b**)	Moderate	Likely	Medium
	Odour from dredged material	Negligible	Possible	Negligible
Operation of Tingira Street DMPA	Exceedance of 24 h particulate criteria	Minor	Possible	Low
	Exceedance of annual $PM_{2.5}$ criterion	Minor	Possible	Low
	Exceedance of dust deposition criterion	Minor	Possible	Low
	Exceedance of gas criteria	Minor	Possible	Low
	Odour from dredged material	Negligible	Possible	Negligible

PROJECT AREA	CONSTRUCTION ACTIVITY / NOISE SOURCE	INITIAL ASSESSMENT WITH STANDARD MITIGATION MEASURES		
Operation				
Shipping and future maintenance dredging at wharf and channel	Exceedance of 24 h particulate criteria	High	Likely	High
	Exceedance of annual $PM_{2.5}$ criterion	High	Possible	Medium
	Exceedance of dust deposition criterion	Negligible	Unlikely	Low
	Exceedance of gas criteria	Minor	Unlikely	Low
	Visible black smoke from ship exhausts	Minor	Likely	Medium
	Nuisance odour from ship waste	Negligible	Unlikely	Negligible
Shipping and ferries at Yorkeys Knob	Particulate emissions	Beneficial	Almost certain	NA
Vehicular traffic near wharf	Exhaust emissions	Negligible	Unlikely	Negligible

B11.4.8.b Discussion

This assessment shows that all risks are Medium or less, with the exception of the following.

Exceedance of Gas Criteria (Northern Sands DMPA)

Table B11-18 shows that the maximum 1-hour NO_2 concentration exceeds the criterion during the placement activity. This is based on the assumption that the tailwater pumps have no emission controls, leading to **Appendix AX** assigning a High consequence (and hence High risk) in some climatic circumstances. Reference to **Table B11-10** shows that High consequence is defined as: 'The impact is considered likely to be important to decision-making. An exceedance of an air quality criterion occurs that may lead to serious but non-fatal health effects'.

Application of the table reveals that 'Moderate' is more applicable: 'The effects of the impact are relevant to decision-making including the development of management measures. Predictions are that the cumulative impacts will exceed a health criterion by up to a factor of two, or exceed a nuisance criterion.' This is appropriate given that the health criterion is 250 $\mu g/m^3$ and the predicted is 356 $\mu g/m^3$ (i.e. less than a factor of two). This would result in a Medium risk and **Table B11-20** has been amended accordingly. In reality, simple mitigation measures to reduce NOx emissions are available and these are detailed in **Section B11.5.1.b**. As shown in **Table B11-21** the residual risk can be reduced to Low.

Exceedance of 24 h Particulate Criteria (Wharf Area)

The exceedance of the 24 hour $PM_{2.5}$ level associated with operation phase at sensitive receptors near the wharf area is greater than a factor of two and therefore the High consequence (and hence High risk) is appropriate.

High risk (**Table B11-13**) is defined as 'An issue requiring further detailed investigation and planning to manage and reduce risk. For air quality this rating requires gathering of detailed project-specific data to improve the accuracy of the assessment, and/or extensive monitoring to ensure control measures are effective'. As noted in **Section B11.4.4**, trends towards a greater use of emissions reduction mechanisms by the worlds shipping fleet, including low sulfur fuels and scrubbers, will have the effect of reducing both gaseous and particulate emissions.

This issue is discussed in **Section B11.6.2.c**.

B11.5 Recommended Mitigation Measures

B11.5.1 Standard Recommendations

B11.5.1.a Landside Works Project Area

- Haul truck loads are to be covered.
- Mobile plant engines are to be maintained to adhere to relevant emission criteria.
- A rumble strip is to be used to shake dust of wheels leaving the site.
- Daily monitoring is to be undertaken by site supervisors including visual checks for dust crossing the site boundary.
- Drop heights when front end loaders load onto trucks should be reduced to less than two metres.
- Any complaints from public are to trigger assessment by the operator and liaison between the operator, Ports North, EHP and the complainant to determine appropriate control measures.

B11.5.1.b Northern Sands DMPA and Tingira Street DMPA

The following generic measures should be implemented during construction of the DMPAs and operation (i.e. placement):

- Haul truck loads are to be covered.
- Mobile plant engines are to be maintained to adhere to relevant emission criteria.
- A rumble strip is to be used to shake dust of wheels leaving the site.
- A speed limit of 20 km/h is to be enforced on site.
- Daily monitoring is to be undertaken by site supervisors including visual checks for dust crossing the site boundary and odour surveys close to the site boundary.
- Undertake watering of all haul routes at a rate suitable for the conditions.
- Unsealed tracks and area are to be watered as required.
- Vegetation is to be maintained on the site boundaries.
- Any complaints from public are to trigger assessment by the operator and liaison between the operator, Ports North, EHP and the complainant to determine appropriate control measures.

B11.5.2 Mitigation by Design

B11.5.2.a Landside Works Project Area

- A survey of fuel consumption and fuel type, whilst vessels are berthed at the wharf is to be undertaken to include at least cruise ships and tankers. This data can then be used to enhance and improve model predictions. This will allow more accurate assessment of impacts, inform management mitigation planning, and potentially refine the control measures required. Another important consideration is the trend towards low sulfur fuels and scrubbers within the shipping industry. The former is mandated by the IMO and will have effect from 1 January 2020 which is about the time that the CSD Project will be completed, and facilities operational for such vessels. For the purposes of the assessment of residual risk, it is assumed that industry trends will reduce the emissions of both gases and particulates to below the acceptance levels, resulting in a Low mitigated risk level.
- Cranes are to be powered by mains electricity (if practical) or alternatively, be fitted with selective catalytic reduction (SCR) for NOx reduction. SCR typically reduces NOx emissions by 90%, so this would provide a major reduction in NOx emissions.

B11.5.2.b Northern Sands DMPA

- The tailwater discharge pumps at the Northern Sands DMPA are to have exhaust stacks at least 4 metres high and NOx SCR control technology. Subject to outcomes of the process for selection of such plant and equipment, and review of manufacturers verified emissions performance, controls around hours of operation informed by prevailing metrological conditions may be required. SCR typically reduces NOx emissions by 90%, so this would provide a major reduction in NOx impacts and result in a mitigated risk level of Low. Alternatively, after a specific pump and location is selected, modelling can be repeated to assess the impacts and if required, management controls can be more accurately defined for inclusion in the respective portion of the Construction EMP.

B11.5.3 Mitigation by Management

- The backhoe dredge and associated tugs will use marine diesel, PM_{10} and $PM_{2.5}$ concentrations should meet the criteria. This would also provide a major reduction in particulate and black smoke emissions.
- If long-term monitoring demonstrates that the existing air quality is such that exceedances may occur with future increases in shipping numbers, then further management measures include increasing the use of marine diesel, IFO or 0.1% sulfur fuel while at berth or use of high efficiency scrubber technology to achieve an equivalent SO_2 emission.
- If cruise ships that do not have scrubbers were to use marine diesel while berthed at the wharf, this could result in lower $PM_{2.5}$ emissions as noted above for the backhoe dredge. This would provide a major reduction in particulate and black smoke emissions.
- The construction management plan for the wharf and associated land area is to include hourly visual monitoring for dust and having a suitable water spray truck available when the excavator is loading trucks. See **Chapter C1** (Construction Environmental Management Plan).

B11.5.4 Monitoring

Monitoring during operation provides a measure of actual impacts at the monitoring locations and can be used to validate or calibrate models. Similarly, monitoring prior to construction could provide additional information to improve the assumptions regarding background air quality.

- Monitor $PM_{2.5}$ concentrations at a location representative of the apartments on Wharf Street between Lake and Abbott Streets using an Australian Standard method such as one of the following for one year, and review findings to determine the extent of future monitoring. This should commence as soon as practical to obtain baseline data as input to a future emissions model.
  - AS/NZS 3580.9.10 Determination of suspended particulate matter – PM2.5 low volume sampler – Gravimetric method. This monitoring should be undertaken every sixth day.
  - AS/NZS 3580.9.12 Determination of suspended particulate matter – PM2.5 beta attenuation monitors.
  - AS/NZS 3580.9.13 Determination of suspended particulate matter – PM2.5 continuous direct mass method using a tapered element oscillating microbalance monitor.
- Should a valid complaint regarding dust nuisance be received, undertake dust deposition monitoring at a site representative of the complainant's residence according to AS/NZS 3580.10.1 Methods for sampling and analysis of ambient air – Determination of particulate matter – Deposited matter – Gravimetric method. This monitoring would be undertaken for 12 months and the results reviewed to determine the extent of future monitoring.

B11.6 Residual Impacts and Assessment Summary Conclusion

B11.6.1 Assessment

Table B11-21 summarises in standard risk matrix format, the likelihood and consequences of air impacts associated with the CSD Project. The unmitigated risk is as assessed in **Table B11-20**.

TABLE B11-21 RESIDUAL RISK ASSESSMENT

SOURCES AND LOCATION	IMPACTS	INITIAL ASSESSMENT WITH STANDARD MITIGATION MEASURES			RESIDUAL ASSESSMENT WITH ADDITIONAL MITIGATION IN PLACE		
		CONSEQUENCE	LIKELIHOOD	RISK RATING	CONSEQUENCE	LIKELIHOOD	RISK RATING
Construction							
Construction of wharf and tank farm and dredging of channel	Exceedance of 24h particulate criteria	Moderate	Likely	Medium	Minor	Unlikely	Low
	Exceedance of annual $PM_{2.5}$ criterion	Moderate	Possible	Medium	Minor	Unlikely	Low
	Exceedance of dust deposition criterion	Minor	Possible	Low	Minor	Possible	Low
	Exceedance of gas criteria	Moderate	Possible	Medium	Minor	Unlikely	Low
Construction of pipeline	Exceedance of 24h particulate criteria	Negligible	Unlikely	Negligible	Negligible	Unlikely	Negligible
	Exceedance of annual $PM_{2.5}$ criterion	Negligible	Unlikely	Negligible	Negligible	Unlikely	Negligible
	Exceedance of gas criteria	Negligible	Unlikely	Negligible	Negligible	Unlikely	Negligible
Operation of DMPA, boosters and pumps at Northern Sands	Exceedance of 24h particulate criteria	Moderate	Possible	Medium	Minor	Unlikely	Low
	Exceedance of annual $PM_{2.5}$ criterion	Negligible	Unlikely	Negligible	Negligible	Unlikely	Negligible
	Exceedance of gas criteria	High	Likely	High	Minor	Unlikely	Low
	Odour from dredged material	Negligible	Possible	Negligible	Negligible	Possible	Negligible
Operation							
Shipping and dredging at wharf and channel	Exceedance of 24h particulate criteria	Moderate	Possible	Medium	Minor	Possible	Low
	Exceedance of annual $PM_{2.5}$ criterion	Moderate	Possible	Medium	Minor	Possible	Low
	Exceedance of dust deposition criterion	Negligible	Unlikely	Low	Negligible	Unlikely	Low

SOURCES AND LOCATION	IMPACTS	INITIAL ASSESSMENT WITH STANDARD MITIGATION MEASURES			RESIDUAL ASSESSMENT WITH ADDITIONAL MITIGATION IN PLACE		
	Exceedance of gas criteria	Moderate	Possible	Medium	Minor	Possible	Low
	Visible black smoke from ship exhausts	Minor	Likely	Medium	Minor	Possible	Low
	Nuisance odour from ship waste	Negligible	Unlikely	Negligible	Negligible	Unlikely	Negligible
Shipping and ferries at Yorkeys Knob	Particulate emissions	Beneficial	Almost Certain	N/Aa	Beneficial	Almost Certain	N/A
Vehicular traffic near wharf	Exhaust emissions	Negligible	Unlikely	Negligible	Negligible	Unlikely	Negligible

The table above shows that all residual risks are Negligible or Low. Certain assumptions are made in this regard as summarised below.

B11.6.2 Conclusions

The following conclusions can be drawn for the above assessment. In summary, there is Low residual risk associated with project provided the recommendations in **Section B11.5** are implemented. However, there are some predicted exceedances of emissions in some areas generally over limited durations of less than one day per year . As required by the Terms of Reference, a number of conservative assumptions have been made that could predict worst-case issues that are unlikely. These are based upon following:

- In the absence of detailed activity data, some plant and equipment was assumed to operate continuously. In some cases, such as the operation of the Northern Sands DMPA, a full year of activity was assumed whereas pumping and placement will last for only short periods within the few months of the placement activity. Similarly, a full year of activity was allowed at the Landside Works Project Area and the Tingira Street DMPA.
- The project shipping scenario modelled assumes high projections and consequent more frequent emissions.
- The model assumes that the high emission rates coincide with most adverse meteorological conditions, which is unlikely.
- During adverse meteorological conditions, additional effort is typically given to management measures by those managing construction works for actions including water spraying and reducing drop heights of loose material, and the model does not allow for this.

Accordingly, many of the results presented in this chapter should be considered to be worst-case, highly unlikely, and over representative, and therefore should be interpreted with caution.

B11.6.2.a Channel Project Area (Dredging)

- The Draft EIS concludes that the impact of the TSHD dredging operation will be negligible. The same conclusions can be applied for the dredging component of the current project CSD Project (without allowing for the fact that the dredging volume is now less than one quarter of that considered in the Draft EIS). However, the material is now to be pumped from the dredge to the pump out facility. Transit time of the dredge to the pump out mooring and time taken for the discharge will result in a shorter period of time in which the dredge is operating within the channel and hence a lower potential emissions load in that area. The period of emission during transit and whilst alongside the dredge mooring and pump out facility is distant from, and therefore unlikely to result in adverse impacts on, any sensitive receptors and hence has not be modelled or plotted.
- Odour from anaerobic sediments from dredging is rarely more than a temporary problem and given that the pump out point is located approximately 2.6 to 3.6 km NE of Yorkeys Knob, it is unlikely that odour will be experienced at any sensitive receptors.
- If the backhoe dredge and associated tugs use marine diesel when near the wharf, PM_{10} and $PM_{2.5}$ concentrations should meet the criteria. The impacts of dredge exhausts will also be reduced compared to the previous development proposal due to the reduction in quantity of dredging required. The influence of backhoe dredge and barge cycle time on overall period of time that the backhoe is emitting within the inner port, or adjacent to wharf areas will result in lower overall emissions than that predicted in the Draft EIS.

B11.6.2.b Landside Works Project Area – Construction

- The use of SCR (selective catalytic reduction) emission controls on diesel cranes during construction should lead to compliance with the criteria.
- The assumption of use of diesel cranes and pumps without emission controls during construction leads to the prediction of exceedances of the 1-hour NO_2 criterion at nearby receptors. The criterion would be met if SCR controls were installed on the cranes and pumps.

- Management of construction dust by providing hourly visual monitoring and having a high pressure water spray available when the excavator is loading trucks in the construction management plan, should lead to compliance with the criteria. If excavators were loading dump trucks without sprays throughout the year, modelling predicts minor exceedance of the 30-day dust deposition nuisance criterion at nearest receptors to wharf.

B11.6.2.c Landside Works Project Area – Operation (Cruise Shipping)

- Emissions from shipping should not cause exceedances of the air quality criteria if ships at berth use marine diesel or 0.1% low sulfur fuel or a scrubber to achieve equivalent. Worst case modelling predicts that there is a potential for the cruise ships to cause exceedances of the PM2.5 and NO2 criteria for the project scenario. The PM2.5 exceedance only occurred on one day in the modelled year, when there was moderate south-easterly wind with neutral stability class and relatively high mixing height throughout the 24-hour day. NO2 exceedances are predicted for ten hours in the modelled year from within 6pm to 7am, when winds were light and blowing from the south and southeast and mostly having low mixing (inversion) heights at approximately 50 metres.
- If monitoring indicates potential exceedances may occur, requiring the use of marine diesel, 0.1% IFO, 0.1% sulfur fuel or more efficient scrubbers equivalent to 0.1%, would achieve compliance.
- As noted previously, future uptake of particulate filter controls and scrubbers on new modern engines should prevent this from occurring. Although emission controls for particulates are not mandated, in 2020, it may be difficult to obtain fuel that is compliant with the IMO (2008) requirement that the sulfur content of fuel be limited to 0.5% (and 0.1% in emission control areas). IMO will allow ships to continue using fuel with up to 3.5% sulfur if they install and operate scrubbers that will reduce SO_2 emissions by a factor that offsets the fuel content. It is anticipated that major cruise ship companies will meet the 2020 regulations with the scrubber technology option (as evidenced by the high proportion of existing ships that have taken up this technology) giving the ships greater flexibility when in regions with variable supply of low sulfur fuels. For ships that take up this option, there will be the additional benefit that the scrubbers will reduce particulate (and hence black smoke) emissions. Use of future ship engine fuel such as LNG will see particulate emissions reduced further.
- Dust deposition levels from shipping are predicted to be within the nuisance criterion but deposition of diesel soot may accumulate over time and be observable due its dark colour. This will be reduced by the uptake of high efficiency scrubbers or use of low sulfur fuel in cruise ships.
- Dark smoke from ship engines under load can be reduced by using marine diesel fuel or low sulfur fuel instead of a high sulfur fuel oil in ships that do not have scrubbers, when arriving to and departing from the wharf.

B11.6.2.d Northern Sands DMPA

- The use of SCR emission controls on diesel tailwater pumps during construction should lead to compliance with the criteria.

B11.6.2.e Tingira Street DMPA

- With the observance of proper mitigation measures, no exceedances of the air quality criteria are likely to occur at the sensitive receptor in Tingira Street.

B11.7 References

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