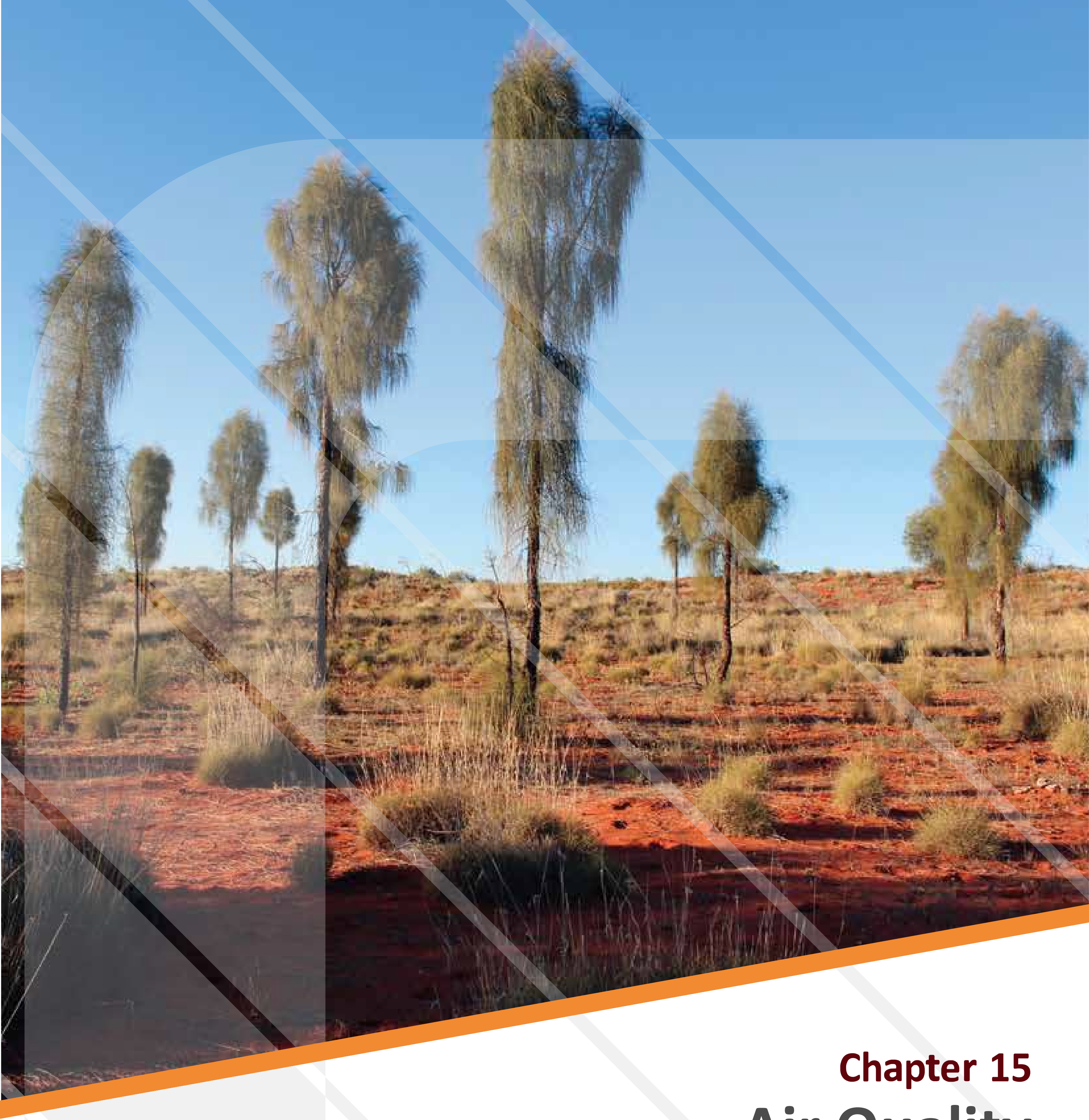

Chapter 15
Air Quality

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ABBREVIATIONS

AWS	Automated Weather Station
BoM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Authority
FIBC	Flexible Intermediate Bulk Container
NT	Northern Territory
OEMP	Operational Environmental Management Plan
PFS	Pre-Feasibility Study
RCP	Rehabilitation Closure Plan
TAPM	The Air Pollution Model
TEU	Twenty-foot Equivalent Unit
ToR	Terms of Reference
UK IAQM	United Kingdom Institute of Air Quality Management

15 AIR QUALITY

15.1 Introduction

This chapter provides a review of air quality and human health impacts that may result during construction, operation, and closure and rehabilitation of the Proposal. This chapter draws on a comprehensive air quality risk assessment, which is included as Appendix X. This chapter identifies land sensitivities and describes the existing air quality and meteorology within the vicinity of the Proposal. The potential impacts on air quality and human health are assessed and mitigation and management measures are identified to reduce potential impacts.

The assessment has been prepared in accordance with the Terms of Reference (refer to Appendix A).

15.2 Methodology

The methodology for the air quality risk assessment is presented below, with further detail provided in Appendix X.

15.2.1 Overview

The assessment and evaluation of potential emissions to air was performed using a standard predictive air quality impact assessment methodology, coupled with a risk assessment approach to provide context on the risks associated with various aspects of the study. Combined, the study is referred to as an air quality risk assessment.

The air quality risk assessment was performed to identify and quantify the risks associated with both the construction and the operation of the Proposal (in accordance with the Terms of Reference).

The risk methodology adopted for the construction phase air quality risk assessment and the operational phase air quality risk assessment were similar but not identical, and those methodologies were similar to that used to present the multi-disciplinary assessment presented in Chapter 6. To assist with transparency of interpretation, the methodologies used in the air quality risk assessment are briefly discussed in this methodology section, which also demonstrates how they have been interpreted into the over-arching risk assessment methodology.

The risks assessed in the air quality risk assessment are presented on a dimensionless scale of major significance to neutral significance.

The determined risk may be used to highlight the relative environmental risk and to highlight the general requirement for the application of appropriate controls and mitigation. It is noted that the above approach is designed to provide an overall impact risk, and is not intended to represent the defining determination for the requirement for mitigation and control.

Further details on the methodologies used for quantitative assessment by dispersion modelling and emissions estimation, is presented in Part A, Sections 5.4 and 5.5 of Appendix X.

15.2.2 Assessment context

The air quality risk assessment addresses various air quality impacts that may result during construction and operation of the Proposal. Specifically, the assessment addresses the construction and operation of the proposed Chandler Facility and Apirnta Facility. It also addresses the transfer of materials between the proposed Chandler Facility and Apirnta Facility.

The air quality risk assessment focuses on a number of key air quality issues associated with the construction and operational of the Proposal, including:

- Enabling works, ground clearance, development of construction routes, and other construction activities.
- The operation of the salt mine, including:
    - The mining of salt from a reserve located at approximately 800 metres underground.
    - Dry processing of run of mine salt.
    - Transfer of the product salt to road transport for transfer from the proposed Chandler Facility to the Apirnta Facility where it would be transferred to rail for transfer to the port at Adelaide.
- The operation of a waste storage facility within the salt mine void at approximately 800 metres underground, including:
    - The transfer of containerised waste materials from the rail siding at the proposed Apirnta Facility to the storage facility at the Apirnta Facility.
    - Temporary storage at the proposed Apirnta Facility and transfer to the Chandler Facility by road transport.
    - The emplacement of the containerised waste materials in the excavated salt mine voids at a depth of approximately 800 metres underground.

Due to the extended scope of the air quality risk assessment, covering potential impacts associated with the proposed Chandler Facility, Apirnta Facility, and transport of materials between the two proposed facilities, and the various aspects of the Proposal phasing, the air quality risk assessment has been prepared as a series of parts to make it easier to interpret. The structure of the overall air quality risk assessment report is in five parts, as shown in Figure 15-1 (refer to Appendix X).

Table 15-1 Structure of air quality risk assessment

Part	Study	File reference	Document reference
Part A	Common Study Components (Introduction, description, legislation, existing conditions)	16.1004.FR1A	Section 15.1 and Appendix X
Part B	Chandler Facility (Construction and operation risk assessment)	16.1004.FR1B	Section 15.3, Section 15.6 and Appendix X
Part C	Apirnta Facility (Construction and operation risk assessment)	16.1004.FR1C	Section 15.3, Section 15.6 and Appendix X
Part D	Transport Infrastructure (Construction and operational risk assessment of off-site transport)	16.1004-FR1D	Section 15.3, Section 15.6 and Appendix X
Part E	Management measures and cumulative Impacts (Cumulative impacts of Parts B, C and D)	16.1004.FR1E	Section 15.7, Section 15.6 and Appendix X

15.2.3 Construction phase risk assessment

The construction phase risk assessment used an adapted methodology based upon that published by the United Kingdom *Institute of Air Quality Management* (UK IAQM).

The published methodology adopted to assess the construction phase risks considers the potential risks associated with a range of construction activities including: demolition, earthworks, construction and track-out. For each of those construction activities, a component of each is the risks associated with construction traffic associated with the respective activity.

To reasonably delineate risks of construction traffic from the actual activity, the assessment adapted the UK IAQM methodology by assessing the impact of construction-phase traffic independently of the associated construction activities. The outcome of this adaption was to more reasonably identify the requirement for mitigation.

The methodology assesses the potential magnitude of emissions to air associated with demolition, earthworks, construction track-out and construction vehicles against an assessment of the sensitivity of the location to potential changes in air quality, to assess risk:

$$\textit{Construction risk}_{\textit{(receptors, construction activity)}} = \textit{sensitivity}_{\textit{(receptors)}} \times \textit{magnitude}_{\textit{(construction activity)}}$$

For almost all construction activities, the air quality risk assessment methodology notes that the aim should be to prevent significant effects on receptors through the use of effective mitigation and experience shows that this is normally possible. Given the limited size of the proposed development footprint, no demolition activities, the limited volume of earthworks expected to be involved during construction and the expectation that water would be readily available for dust suppression when required, residual impacts associated with fugitive dust emissions during construction would be anticipated to be 'not significant'.

15.2.4 Operation phase risk assessment

The risks associated with operation emissions to air were assessed by the examination of potential impact magnitude and receptor sensitivity. The risks associated with operation include:

- Mining emissions, including:
    - Controlled discharges, such as mechanical air handling system discharges from the underground mine and fugitive emissions.
    - Uncontrolled discharges, such as wind-blown dust from storage stockpiles.
- Accidental loss of containment, including:
    - Accidental spillages from containerised product salt.
    - Accidental spillages from containment of solid waste materials, such as fly ash or contaminated soil.
    - Accidental spillage from containerised sludge/liquid waste materials, such as spent fuels or contaminated water.

Mining emissions were assessed at the rate of maximum throughput, so that the risks associated with the worst-case conditions during the life of mine could be evaluated.

The potential risks associated with loss of containment requires further considerations in regard to:

- The potential composition of the spilled materials.
- The potential scale (spatial and time) of the spill.

The composition of the potential accidental spill was assumed to be salt (in the case of product salt), or otherwise for waste materials at the maximum permissible concentrations of a wide range of contaminants as prescribed in the *Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites* (NT EPA 2013). This guideline provides specifications for waste composition that may be accepted by the Proposal, and for the purpose of presenting a conservative assessment the maximum concentration of a range of potential contaminants was addressed.

Based upon a unit spill volume, the corresponding impacts as a proportion of their respective air quality standard was assessed. This approach was taken so that the content that would pose the highest level of risk of exceeding its standard has been assessed. For solid waste spills (such as fly ash or other dry wastes), the highest level of risk was determined to be associated with beryllium, and the corresponding component in sludge/liquid wastes (such as chemical processing residues) was determined to be formaldehyde. Correspondingly, beryllium and formaldehyde were used as the composition representing the highest levels of risk of causing an impact exceeding the standard for dry wastes and liquid wastes (respectively) in the air quality risk assessment.

For discrete receptor locations, the operational risk assessment procedure is a function of sensitivity and magnitude:

$$\textbf{\textit{Operational risk}}_{\textit{(receptors)}} = \textbf{\textit{sensitivity}}_{\textit{(receptors)}} \times \textbf{\textit{magnitude}}$$

It is also recognised that the proposed development footprint and vicinity is typified by a low density of receptor locations and it is important to evaluate the risks of a range of accidents occurring along the transportation routes and from the proposed Apirnta Facility and Chandler Facility that may result in a loss of containment of waste materials but at locations not impacting fixed receptor locations.

Coupled with this, as the scale of magnitude is also proportional to the assumed loss of containment volume, the assessment was further required to examine the potential risks associated with a range of incident scales. For the air quality risk assessment, the definitions and indicative frequency of industrial incidents was derived from that presented in UK Health and Safety Executive – '*Safety Report Assessment Guide*', and how these definitions were related to the potential volume of accidental loss of containment is presented in Part B, Section 4.5.2 (relating to the Chandler Facility), Part C, Section 4.5.2 (relating to the Apirnta Facility) and Part D, Section 4.2.2 (relating to the transport infrastructure), which are presented as Appendix X. Elements are reproduced in Table 15-2 by way of a summary.

Table 15-2 Definition of accident likelihood (Parts B, C and D)

Likelihood	Definition	Indicative frequency band (per year)	Loss of Containment Volumes (as TEU and FIBC/ IBC Units)		
			Part B and Part C		Part D
			Dry Wastes	Sludge Wastes	Dry/Sludge Wastes
Frequent	Event would occur regularly on the Proposal site	$F > 10$	< 1 FIBC Incidental spillage	<1 IBC Incidental spillage	not assessed
Likely	Likely to occur a few times in the lifetime of the Proposal	$10 > F > 10^{-1}$	1 FIBC Rupture of FIBC	1 IBC Rupture of IBC	Loss of containment of up to 1 TEU
Occasional	Could occur in Proposal lifetime; root causes likely to have occurred at the Proposal site	$10^{-1} > F > 10^{-3}$	1-17 FIBC Equivalent to up to 1 TEU	1-12 IBC Equivalent to up to 1 TEU	Loss of containment of 3 TEUs, representing a likely to ha
Unlikely	Unlikely; incidents known to have occurred in the industry but would require at least two failures	$10^{-3} > F > 10^{-5}$	18-34 FIBC Equivalent to up to 2 TEU	13-24 IBC Equivalent to up to 2 TEU	Loss of containment of 6 TEUs, representing an incident involving two equire at lea
Remote	Highly unlikely, but may exceptionally occur; would require multiple failures	$10^{-5} > F > 10^{-7}$	35-1,700 FIBC Equivalent to 2-100 TEU	25-1,200 IBC Equivalent to 2-100 TEU	not assessed
Incredible	Extremely unlikely that the event would ever occur	$F < 10^{-7}$	>1,701 FIBC (to site capacity)	>1,201 IBC (to site capacity)	not assessed

In regard to the potential scale of accidental spillage, this was assessed for both beryllium (worst case dry waste) and formaldehyde (worst case sludge waste) from the partial loss of small volume storage vessels to the simultaneous loss of containment of all materials at the relevant facility (Chandler Facility and Apirnta Facility). The descriptors of incidents associated with transport infrastructure were maintained, although the 'scale' of accidents was cropped to reflect the more limited scale of accidents, as compared to the proposed Chandler Facility and Apirnta Facility.

Correspondingly, the risk was assessed as:

$$\textit{\textbf{Operational risk}}_{\textit{(receptors, accident likelihood)}} = \textit{\textbf{sensitivity}}_{\textit{(receptors)}} \times \textit{\textbf{impact magnitude}}_{\textit{(accident likelihood)}}$$

15.3 Existing environment

This section identifies land sensitivities and describes the existing air quality and meteorology within the vicinity of the Proposal.

15.3.1 Surrounding land sensitivity

Population dense locations within the vicinity of the Proposal are presented in Table 15-3 and are shown in Figure 15-1.

Table 15-3 Population dense locations in the vicinity of the Proposal (ABS 2011)

Rec	Location	Location (km, Australian Map Grid, zone 56)		Distance from proposed Apirnta Facility and Chandler Facility (km)	
		Easting	Northing	Apirnta	Chandler
1	Chambers Pillar Campground	381,119	7,249,134	21	15
2	Titjikala	406,307	7,270,646	44	25
3	Titjikala School	406,186	7,271,014	44	25

The receptor closest to the proposed Chandler Facility is located at Chambers Pillar Campground (Receiver 1), which is located approximately 15 kilometres from the Chandler Facility, and 21 kilometres from the proposed Apirnta Facility. The nearest place of permanent residence is the community of Titjikala (Receiver 2), which is located approximately 25 kilometres from the proposed Chandler Facility and 44 kilometres from the Apirnta Facility.

The discrete receptor locations that were identified as part of the air quality risk assessment are listed in Table 15-4. The table is not intended to represent a definitive list of sensitive land uses, but a cross section of available locations that are used to characterise larger areas, or selected as they represent more sensitive locations which may represent people who are more susceptible to changes in air pollution than the general population[1]. A map showing these locations is provided in Part A, Figure 5 in Appendix X.

[1] *The assessment of construction risks for the proposed Chandler Facility and Apirnta Facility present more accurate distance estimates to site boundaries and site entrances. The distances used above are generalised distances to a location generally representative of the respective site.*

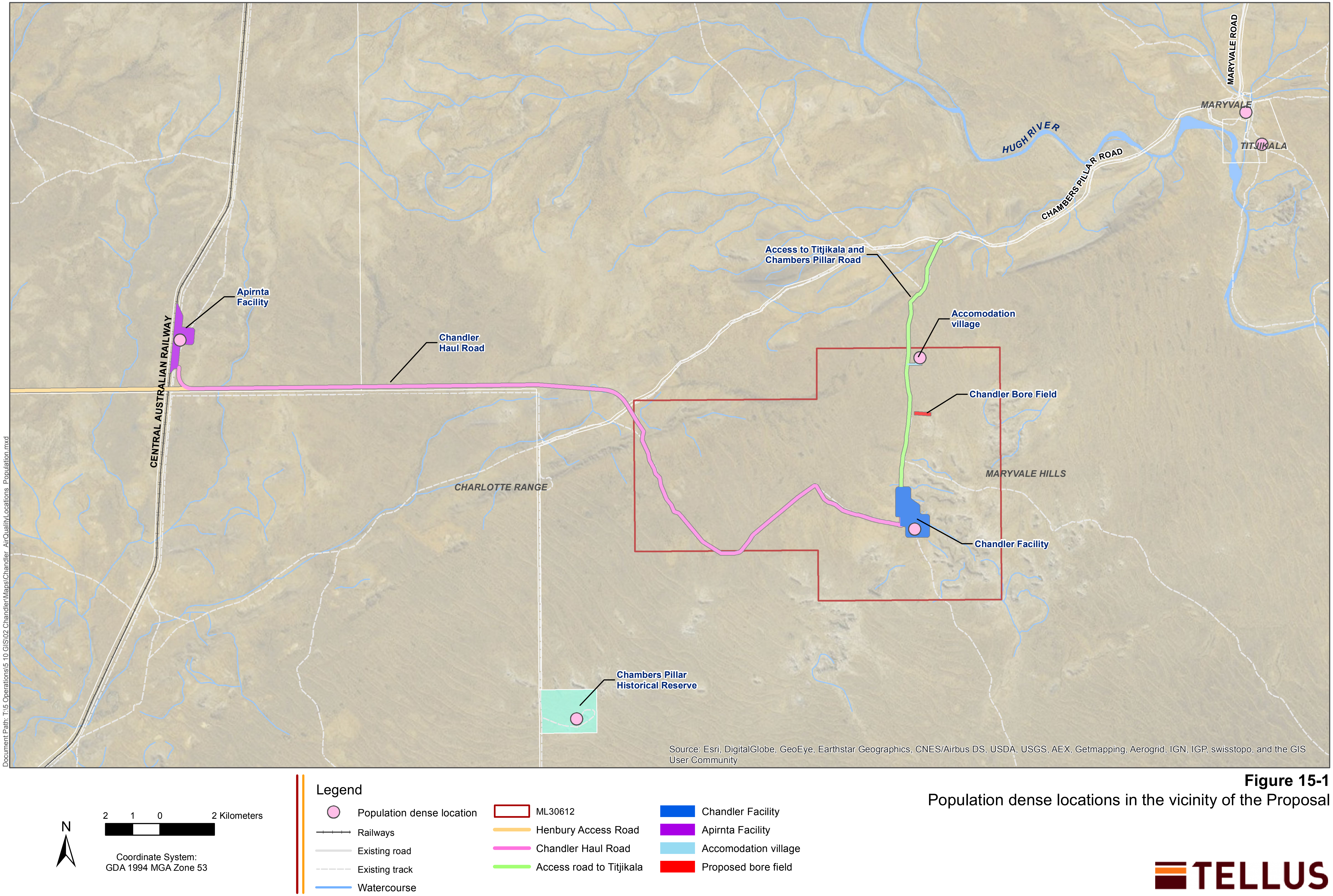


Figure 15-1
Population dense locations in the vicinity of the Proposal

Table 15-4 Discrete sensitive receptor locations used in the air quality risk assessment

Receptor	Location	Land Use	Location (km, Australian Map Grid, zone 56)		Approximate distance from (km)	
			Easting	Northing	Apirnta	Chandler
1	Chambers Pillar Campground	Recreation	381,119	7,249,134	21	7
2	Titjikala	Residential	406,307	7,270,646	44	13
3	Titjikala School	Residential	406,186	7,271,014	44	13
4	Titjikala Health Centre	Medical	406,520	7,270,953	44	13
5	Titjikala Residential Property	Residential	406,344	7,270,575	44	13
6	Idracowra	Residential	377,703	7,235,295	32	24
7	Palmer Valley	Residential	321,467	7,261,554	50	68
8	Henbury	Residential	323,051	7,283,404	53	71
9	Orange Creek	Commercial	340,874	7,304,951	54	68
10	Horseshoe Bend	School	424,055	7,211,255	85	55
11	Lilla Creek	Medical	406,755	7,172,781	110	90
12	Desert Oaks Motel	Residential	318,746	7,211,973	77	86
13	Rainbow Valley Cons. Area	Ecological	361,315	7,308,411	50	59
14	Stuarts Well	Residential	343,545	7,307,232	55	68
15	Henbury Meteorite Reserve	Commercial	311,972	7,281,271	63	82
16	Imanpa School	School	255,304	7,218,586	132	147
17	Finke	Residential	457,436	7,170,672	143	113
18	Mac Clark Cons. Res.	Ecological	550,594	7,221,590	207	173
19	Santa Teresa	Residential	436,531	7,331,140	107	88
20	Unknown	Unknown	353,746	7,310,481	54	65
21	Whitehorse Tank	Unknown	349,523	7,298,101	43	56
22	Walkabout Bore	Residential	380,344	7,302,987	46	47
23	Unknown	Residential	385,848	7,301,792	47	45
24	Oak Valley Camping Area	Recreation	391,696	7,302,707	50	45
25	Unknown	Unknown	402,936	7,291,878	50	33
26	Unknown	Unknown	391,157	7,280,672	33	20
27	Unknown	Unknown	370,752	7,273,218	14	20
28	Chandler Facility Accommodation Village	Commercial/ Residential	395,533	7,261,065	30	-
29	Apirnta	Commercial	367,113	7,263,097	-	18

15.3.2 Air quality

The air quality experienced at any location would be a result of emissions generated by natural and anthropogenic sources on a variety of scales (local, regional and global). The relative contributions of sources at each of these scales to the air quality at a location would vary based on a wide number of factors including the type, location, proximity and strength of the emission source(s), the meteorology, land uses and other factors affecting the emission, dispersion and fate of those pollutants.

When assessing the impact of any particular source of emissions on the potential air quality at a location, the impact of all other sources of an individual pollutant must also be assessed. This 'background' air quality would vary depending on the pollutants to be assessed, and can often be characterised by using appropriate air quality monitoring data.

The nearest air quality monitoring performed by the NT EPA to the Proposal is in Darwin, which is located approximately 1,300 kilometres to the north of the Proposal. Given the large distances between the Proposal and the closest air quality monitoring station, caution must be used when using these data.

It is of note that air quality criteria for all monitored pollutants, other than particulates (PM_{10} and $PM_{2.5}$), are achieved within Darwin, and for SO_2, NO_2 and CO concentrations represent between 4 % and 42 % of the relevant criteria.

Although the populations of Alice Springs and Darwin vary significantly (approximately 28,667 and 140,400, respectively) it may be reasonably assumed that combustion/traffic related pollutants such as SO_2, NO_2 and CO would be lower than those measured in Darwin, and the air quality pollutant concentrations at the Proposal site would be lower than those that would be measured in Alice Springs.

Correspondingly, whilst the air quality monitoring data measured in Darwin is acknowledged to be generally unrepresentative of the Proposal site, it should be regarded as being conservative when compared to the conditions expected at the Proposal site.

Air quality in Darwin is measured by the NT EPA at two locations:

- Palmerston air quality monitoring station located at UTM 52L 711,747 m E, 8,616,515 m S.
- Winnellie air quality monitoring station located at UTM 52L 706,817 mE, 8,625,742 mS.

A summary of the air quality data reported by the NT EPA for the period January 1 2015 to December 31 2015 is presented in Table 15-5.

Table 15-5 Assumed background concentrations for the air quality risk assessment

Pollutant	Averaging period	Criterion	Assumed background concentration	
Carbon monoxide (CO)	8 hours	9.0 ppm	1.12 ppm (1.28 $mg \cdot m^{-3}{}_{(at\ 298K)}$)	The maximum (100[th] percentile) 8-hour CO concentration measured at Palmerston and Winnellie
Nitrogen dioxide (NO_2)	1 hour	0.12 ppm (120 ppb)	32.85 ppb (61.80 $\mu g \cdot m^{-3}{}_{(at\ 298K)}$)	The maximum (100[th] percentile) 1-hour NO_2 concentration measured at Palmerston and Winnellie
	1 year	0.03 ppm (30 ppb)	3.63 ppb (6.83 $\mu g \cdot m^{-3}{}_{(at\ 298K)}$)	The maximum annual average NO_2 concentration measured at Palmerston and Winnellie
Ozone (O_3)	1 hour	0.1 ppm (100 ppb)	79.74 ppb (156.5 $\mu g \cdot m^{-3}{}_{(at\ 298K)}$)	The maximum (100[th] percentile) 1-hour O_3 concentration measured at Palmerston and Winnellie
Sulphur dioxide (SO_2)	1 hour	0.2 ppm (200 ppb)	4.82 ppb (21.62 $\mu g \cdot m^{-3}{}_{(at\ 298K)}$)	The maximum (100[th] percentile) 1-hour SO_2 concentration measured at Palmerston and Winnellie
	1 year	0.02 ppm (20 ppb)	0.35 ppb (0.92 $\mu g \cdot m^{-3}{}_{(at\ 298K)}$)	The maximum annual average SO_2 concentration measured at Palmerston and Winnellie
Particulates (as PM_{10})	1 day	50 $\mu g \cdot m^{-3}$	28.09 $\mu g \cdot m^{-3}$	The 75[th] percentile 24-hour PM_{10} concentration measured at Palmerston and Winnellie
	1 year	25 $\mu g \cdot m^{-3}$	22.25 $\mu g \cdot m^{-3}$	The maximum annual average PM_{10} concentration measured at Palmerston and Winnellie
Particulates (as $PM_{2.5}$)	1 day	25 $\mu g \cdot m^{-3}$	12.22 $\mu g \cdot m^{-3}$	The 75[th] percentile 24-hour PM_{10} concentration measured at Palmerston and Winnellie
	1 year	8 $\mu g \cdot m^{-3}$	8.55 $\mu g \cdot m^{-3}$	The maximum annual average $PM_{2.5}$ concentration measured at Palmerston and Winnellie
Lead (Pb)	1 year	0.5 $\mu g \cdot m^{-3}$	Nd	Nd

Given the isolation of the Proposal and the fact there is not air quality data recorded in Alice Springs, the measured air quality data by the NT EPA in Darwin has been used to represent the baseline conditions at the Proposal site. These assumed baseline concentrations are added to the predicted impact concentrations to determine the cumulative impact:

$$C_{it} = BG_{it} + PC_{it}$$

Where:

C_{it} = total predicted concentration value for pollutant i over time period t

BG_{it} = assumed background concentration of pollutant i over time period t

PC_{it} = predicted process concentration of pollutant i over time period t

For the purposes of the air quality impact assessment, the background concentration values presented in Table 15-5 have been used. For particulate matter, due to the high variability of short-term concentrations (1- hour averages), the use of the maximum measured values would cause undue distortion of the assumed background and corresponding total predicted concentration. For short-term particulate matter risks, the 75th percentile of measured 24-hour concentrations was adopted, in lieu of more representative data.

Based upon the data accessed from the NT EPA (and summarised in Table 14 of Part A in Appendix X), compliance with the relevant criteria is noted in Table 15-6.

Table 16-6 shows that air quality measured in Darwin by the NT EPA in 2015 is compliant with the relevant criteria, with the exception for PM_{10} and $PM_{2.5}$. Measured concentrations of CO, NO_2 and SO_2 are significantly below the relevant criterion value. Additional air quality baseline information is presented in Part A, Section 4.3, in Appendix X.

Table 15-6 Darwin air quality compliance with NEMP criteria (2015)

Pollutant	Averaging period	Criterion(1)	Measured value	NEPM Compliance
Carbon monoxide (CO)	8 hours	9.0 ppm	1.1 ppm, measured at Palmerston	✓
Nitrogen dioxide (NO_2)	1 hour	0.12 ppm	0.03 ppm (33 ppb), measured at Palmerston	✓
	1 year	0.03 ppm	0.004 ppm (3.6 ppb) measured at Palmerston	✓
Ozone (O_3)	1 hour	0.1 ppm	0.079 ppm (79 ppb) measured at Palmerston	✓
Sulphur dioxide (SO_2)	1 hour	0.2 ppm	0.005 ppm (4.8 ppb) measured at Palmerston	✓
	1 day	0.08 ppm	nd	✓
	1 year	0.02 ppm	0.0004 ppm (0.35 ppb) measured at Palmerston	✓
Particulates (as PM_{10})	1 day	50 $\mu g \cdot m^{-3}$	107.67 $\mu g \cdot m^{-3}$ measured at Winnellie	×
	1 year	25 $\mu g \cdot m^{-3}$	22.25 $\mu g \cdot m^{-3}$ measured at Winnellie	✓
Particulates (as $PM_{2.5}$)	1 day	25 $\mu g \cdot m^{-3}$	77.86 $\mu g \cdot m^{-3}$ measured at Winnellie	×
	1 year	8 $\mu g \cdot m^{-3}$	8.6 $\mu g \cdot m^{-3}$ measured at Winnellie	×
Lead (Pb)	1 year	0.5 $\mu g \cdot m^{-3}$	nd	nd

Notes (1) units presented as parts per million (ppm) or micrograms per cubic metre of air ($\mu g \cdot m^{-3}$)

15.3.3 Meteorology

The meteorological conditions surrounding the Proposal have been characterised using data collected by:

- The proponent, at a privately-owned meteorological monitoring station located at the site of the proposed Chandler Facility.
- The Australian Government Bureau of Meteorology (BoM) at Alice Springs Airport.

A summary of the relevant monitoring sites and the parameters measured at both monitoring sites is provided in Table 15-7.

Table 15-7 Details of the meteorological monitoring surrounding the Proposal

Site name	Relative location	Approximate location		Parameters measured	Site commissioned
		(E)	(S)		
Tellus Chandler Facility	On-site at Chandler Facility Zone 53J	392,510	7,258,500	Wind speed Wind direction Relative humidity Air temperature	Nov 2015
BoM Alice Springs Airport **Station #015590**	Alice Springs Zone 53K	386,800	7,367,940	Evaporation Wind speed Wind direction Sunshine radiation Rainfall Air temperature Mean sea level pressure Soil temperature Total cloud amount Upper air wind speed	1941 air wind

In order to determine a representative meteorological year for use in dispersion modelling, consecutive five years of meteorological data (2011-2015) from Alice Spring Airport were analysed against the long term meteorological conditions. Specifically, the following parameters were analysed:

- Percentage of calm wind speed events (wind speed <0.5 $m.s^{-1}$)[2].
- Hourly wind speeds observed at 9:00 am and 3:00 pm.
- Hourly temperature at 9:00 am and 3:00 pm.
- Hourly relative humidity at 9:00 am and 3:00 pm.

Based on this analysis, it was concluded that the year 2015 was representative of the last five years of meteorological conditions experienced within the proposed development footprint and, therefore, the 2015 calendar year was adopted for use in the air quality impact assessment.

The observations measured by the proponent at their Automated Weather Station (AWS) are clearly representative of the proposed Chandler Facility as that is the location of the meteorology station, however, its limits are:

- The monitoring period only covers the period from November 2015 to present.
- The compliance status of the station, its operation and maintenance/calibration are unknown.

[2] *Calm wind conditions are conducive to higher concentrations of odour due to poor dispersion of the odour plume.*

The Bureau of Meteorology (BoM) data adequately covers the issues of data quality assurance and monitoring period, however, it is limited by its location compared to the Proposal site. To address these uncertainties, a multi-phased assessment of the meteorology data was performed.

In absence of sufficient on-site meteorological data, site representative meteorological data for the Proposal was generated using a combination of The Air Pollution Model (TAPM) and AERMET meteorological models in a format suitable for subsequent use in the AERMOD dispersion model. TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model which may be used to predict three-dimensional meteorological data and air pollution concentrations.

TAPM predicts wind speed and direction, temperature, pressure, water vapour, cloud, rain water and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate site-specific hourly meteorological observations at user-defined levels within the atmosphere.

TAPM is known to predict less calm wind conditions than is usually recorded in the data from a monitoring station. TAPM may assimilate actual local wind observations to optimise the model solution. In this case, no data were assimilated into the TAPM model run.

Part A, Sections 4.4 and 4.5 and Part A, Appendix A-1 presented in Appendix X provide a detailed summary of the prevailing meteorology, and describe how the data was used in the air quality risk assessment. The summary of the meteorology representative of the Chandler Facility is presented in Part B, Appendix B-1, and that for the Apirnta Facility is presented in Part C, Appendix C-1.

15.4 Assessment of risks during construction

This section presents the potential impacts (both direct and indirect) on air quality during construction of the Proposal. Mitigation measures to avoid or reduce these impacts are discussed in Section 15.7.

In the air quality risk assessment, the sensitivity of the receiving environment was evaluated against the potential construction dust emission magnitude of emissions from each construction activity to categorise the pre-mitigated ('preliminary') risk, and to identify the key required mitigation measures.

In regard to the residential properties located within 50 metres of the Stuart Highway as it passes through Alice Springs, those locations were considered to have a 'high' sensitivity to changes in air quality that might be resultant from construction phase traffic movements. Based upon the number of construction traffic movements, the dust emission magnitude associated with that traffic was assessed as being 'medium', and the resultant preliminary (pre-mitigated) risk was assessed as being 'medium' for both dust soiling impacts and human health effects.

This pre-mitigation risk profile is common to the construction of both the proposed Chandler Facility and the Apirnta Facility and was used to identify the mitigation options necessary to adequately control construction-phase air quality impacts.

15.5 Assessment of risks during operation

15.5.1 Risks associated with emissions from mining

In regard to the pre-mitigated risks associated with mining activities at the proposed Chandler Facility, the predicted ground level concentrations of particulates from mining and combustion gases from local power generation (diesel generators) were assessed against the relevant air quality standards. Using the risk assessment protocol, the marginal impacts were assessed as an impact magnitude and compared to the sensitivity to air quality impacts at a range of receptor locations to derive a risk, which is summarised in Table 15-8.

Table 15-8 Pre-mitigated operational phase risk criteria

TSP	Dust Dep	PM_{10}		$PM_{2.5}$		NO_2		CO
Ann Ave	Ann Ave	Ann Ave	Max 24hr Ave	Ann Ave	Max 24hr Ave	Ann Ave	Max 1hr Ave	Max 8hr Ave
Neutral	Intermediate	Neutral	Intermediate	Neutral	Intermediate /minor	Neutral	Major/ intermediate	Neutral

15.5.2 Risks associated with emissions from loss of containment of product salt

The risks associated with the potential accidental loss of containment of product salt was determined to be negligible.

15.5.3 Risks associated with emissions from loss of containment of waste materials

The risks associated with the potential accidentals of containment of solid waste materials (as beryllium) and sludge/liquid waste materials (as formaldehyde) from the proposed Chandler Facility, Apirnta Facility and spillages during transportation are presented in Part B, Part C and Part D of the air quality risk assessment, respectively (refer to Appendix X).

Table 15-9 provides a succinct summary of the determined 'worst case' pre-mitigated risks associated with the accidental loss of containment of solid wastes (as beryllium) and sludge / liquid wastes (as formaldehyde) at the Chandler Facility and the Apirnta Facility across a range of accidental emission scenarios defined by their respective frequency estimates, based upon industrial accident statistics.

Table 15-9 Worst case pre-mitigated risks

Facility	Loss of containment	Frequent <1 FIBC/IBC	Likely 1 FIBC/IBC	Occasional ≤1 TEU	Unlikely 2 TEU	Remote ≤100 TEU	Incredible ≤ capacity
Chandler Facility (Part B)	Solid waste (beryllium)	Neutral	Neutral	Neutral	Neutral	Major / intermed.	Major
	Liquid waste (formaldehyde)	Neutral	Neutral	Intermed. / minor	Intermed.	Major	Major
Apirnta Facility (Part C)	Solid waste (beryllium)	Neutral	Neutral	Neutral	Neutral	Intermed.	Major
	Liquid waste (formaldehyde)	Neutral	Neutral	Neutral	Intermed./ minor	Major	Major

The loss of containment from transportation infrastructure is presented in Part D of the air quality risk assessment and follows a slightly different scale, as it is essentially limited by the tare capacity of the road vehicles. To assess that potential scale of loss of containment, the following were assumed:

- Loss of containment of one container (i.e. a container spillage on the roadway) (one TEU).
- Loss of containment of one truckload (i.e. a collision of one truck and the loss of the entire load) (three TEU).
- Loss of containment of two truckloads (i.e. the collision of two trucks and the loss of both loads) (six TEU).

The results of the risk assessment for the above scenarios are presented in Table 15-10.

Table 15-10 Transport infrastructure and potential loss of containment risks

Facility	Loss of Containment	Likely ≤1 TEU	Occasional 3 TEU	Unlikely 6 TEU
Transport Infrastructure (Part D)	Product salt (PM_{10})	Intermediate/ minor	Intermediate	Major/ intermediate
	Solid waste (beryllium)	Major/ intermediate	Major/ intermediate	Major/ intermediate
	Liquid waste (formaldehyde)	Neutral	Neutral	Intermediate/ minor

The determined risk profiles associated with loss of containment at the proposed Chandler Facility and Apirnta Facility are less than that determined by smaller scale losses during transport due to the possible accidental spills from transport occurring in close proximity to receptor locations.

15.6 Assessment of risks during closure and rehabilitation

The air quality risk assessment did not assess risks to air quality and human health during closure and rehabilitation of the Proposal. It is anticipated that the risks would be similar to those presented for construction.

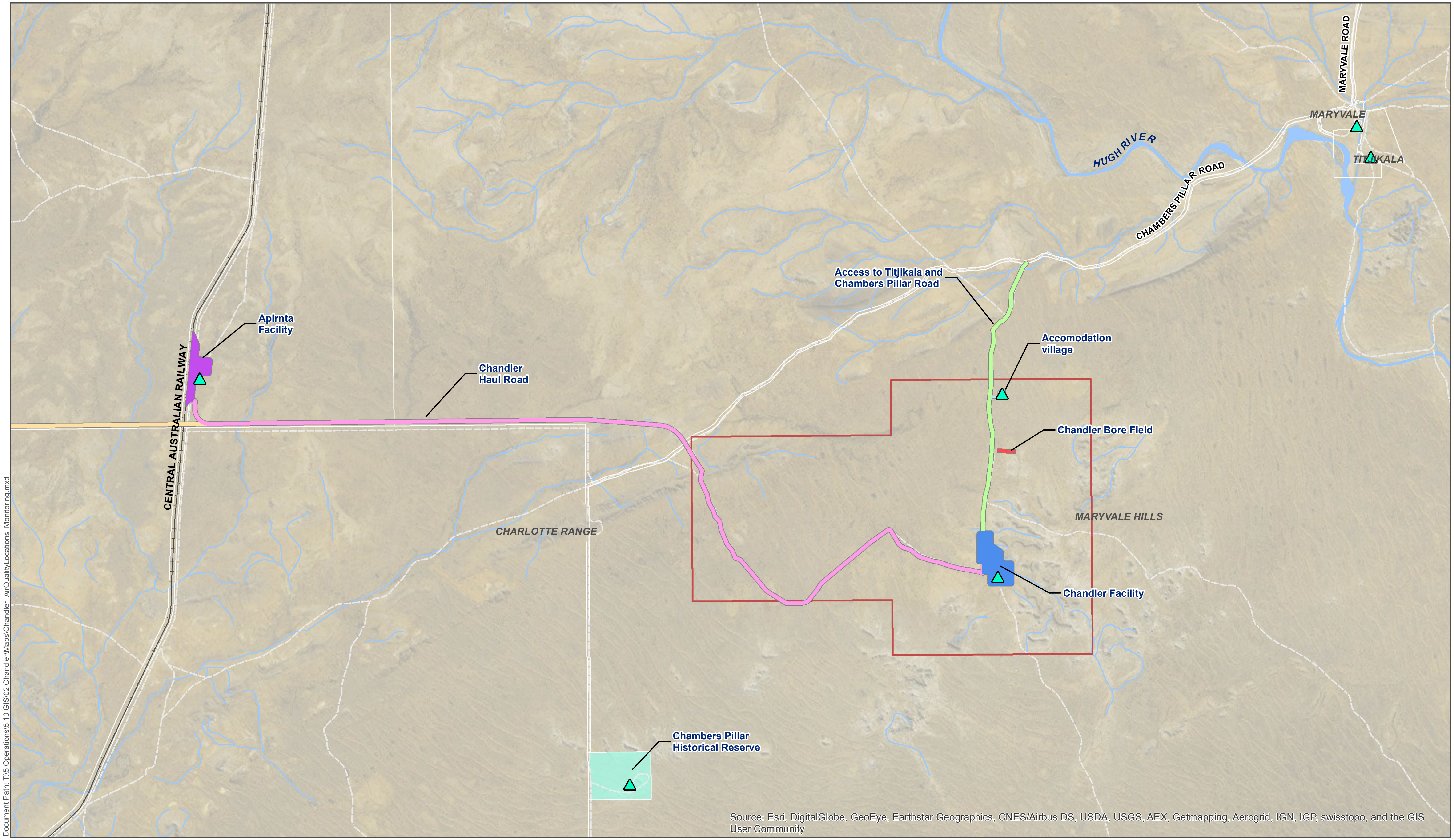
15.7 Mitigation and monitoring

Mitigation and management measures proposed to minimise the potential impacts on air quality and human health during construction, operation, and closure and rehabilitation of the Proposal are listed in Table 15-11. These measures would be incorporated into the CEMP, OEMP and/or RCP for the Proposal.

Table 15-11 Mitigation and management measures (air quality)

ID	Outcome	Mitigation/management measure	Timing
AQ.1	Minimisation of air quality and human health impacts	Prepare an Air Quality Management Plan.	Pre-construction
AQ.2	Minimisation of dust and associated human health risks	Ensure effective communication between potentially affected communities and the proponent.	Construction
AQ.3	Minimisation of dust and associated human health risks	Perform daily on-site and off-site inspections.	Construction
AQ.4	Minimisation of dust and associated human health risks	Promote a program of considerate vehicle operation and sustainable travel.	Construction
AQ.5	Minimisation of dust and associated human health risks	Use enclosed tankers for the transportation of bulk materials.	Construction
AQ.6	Minimisation of dust and associated human health risks	Implement measures to ensure that vehicle track-out is adequately controlled.	Construction
AQ.7	Minimisation of dust and associated human health risks	Establish a dust monitoring network to monitor dust emissions within the development envelope. Dust monitors would likely be installed at: • Chandler Facility • Apirnta Facility • Accommodation village • Community of Titjikala (refer to Figure 15-2).	Construction
AQ.8	Minimisation of particulate emissions from mine surface operations	Ensure use of diesel engines that comply with the emission standards of the United Stated Environmental Protection Agency (Tier 4 Emission Standards).	Operation
AQ.9	Minimisation of particulate emissions from mine surface operations	Install windbreaks at run-of-mine salt stockpiles.	Operation
AQ.10	Minimisation of particulate emissions from mine surface operations	Install windbreaks at sandstone, shale, limestone and topsoil stockpiles. In addition to windbreaks, shape and profile and rehabilitate stockpiles, as necessary.	Operation
AQ.11	Minimisation of dust and associated human health risks	Enforce vehicle speed restrictions, undertake surface improvements or surface treatments (including wet suppression and chemical stabilisation).	Operation
AQ.12	Minimise risk of loss of containment of waste materials	Ensure handling of IBC/FIBC from TEU containers is performed on a strict one-at-a-time basis, to avoid the potential for spillage of contents of multiple containers.	Operation
AQ.13	Minimise risk of loss of containment of waste materials	Ensure containers are removed from trucks in an appropriately bunded area to minimise the surface area of any spills and to enable efficient clean-up of any spilled materials. Ensure liquid waste is managed through a liquid waste collection system designed to allow for sufficient capacity of liquids to be removed (e.g. 110% of potential spill volume).	Operation

ID	Outcome	Mitigation/management measure	Timing
AQ.14	Minimise risk of loss of containment of waste materials (transportation)	Develop a collision avoidance system that provides a visible and audible positive confirmation of the presence of other vehicles travelling along the proposed Chandler Haul Road. Visible and audible alarm would alert drivers when haul trucks are within 500 metres of each other, requiring a reduction in speed.	Operation
AQ.15	Minimise risk of loss of containment of waste materials (transportation)	Restrict loads containing common and/or more toxic waste components, such that: • Less than one TEU equivalent is carried in one movement. • Less than one TEU equivalent is carried in any two sequential movements (to manage out the potential of loss of containment from collisions).	Operation
AQ.16	Minimise risk of loss of containment of waste materials (transportation)	Manage loss of containment at Orange Creek, Desert Oaks Motel, Stuart Wells and at the Apirnta Facility through the implementation of specific mitigation measures, which include: • A pre-prepared management response plan would be prepared for each location. • Restrictive speed limits imposed for road transport as it passes each of the locations. • The content of the response plan would need to be communicated to the respective residents, and also posted prominently for public reference in the unlikely event of a loss of containment at those locations. • The provision of spill kits at each location.	Operation



Document Path: T:\5 Operations\5 10 GIS\02 Chandler\Maps\Chandler_AirQualityLocations_Monitoring.mxd

N

2 1 0 2 Kilometers

Coordinate System:
GDA 1994 MGA Zone 53

Legend

- Air quality monitoring location
- Railways
- Existing road
- Existing track
- Watercourse
- ML30612
- Henbury Access Road
- Chandler Haul Road
- Access road to Titjikala
- Chandler Facility
- Apirnta Facility
- Accomodation village
- Proposed bore field

Figure 15-2
Population air quality monitoring locations

TELLUS

15.8 Assessment of post-mitigated risks

The same risk assessment procedure was re-applied, with consideration of the additional mitigation measures that have been identified by the preliminary (pre-mitigated) risk assessment. These residual risks are presented below.

15.8.1 Post-mitigation construction-phase risks

For almost all construction activity, the adapted methodology notes that the aim should be to prevent significant effects on receptors through the use of effective mitigation and experience shows that this is normally possible. Given the limited size of the Proposal site, no demolition activities, the limited volume of earthworks expected to be involved in the Proposal and the expectation that water would be readily available for dust suppression when required, residual impacts associated with fugitive dust emissions from the Proposal would be anticipated to be not significant.

15.8.2 Post-mitigation operational-phase risks

In regard to the post-mitigated risks associated with mining activities at the proposed Chandler Facility, the significant control is the adoption of US EPA Tier 4 compliant diesel engines, which controls the risk from major/intermediate to neutral (refer to Table 15-12).

Table 15-12 Post mitigation operational phase risks

TSP	Dust Dep	PM_{10}		$PM_{2.5}$		NO_2		CO
Annual Average	Annual Average	Annual Average	Max 24hr Ave	Annual Average	Max 24hr Ave	Annual Average	Max 1hr Average	Max 8hr Average
Neutral	Intermed.	Neutral	Intermed.	Neutral	Intermed./ minor	Neutral	Neutral	Neutral

In terms of particulate matter, quantification of the potential reduction in emissions associated with control measures is not possible. A detailed Air Quality Management Plan would be prepared for the Proposal. It would include measures designed to minimise particulate emissions from the operation of the Proposal.

Although the air quality risk assessment is limited in its ability to model certain management practices upon 'dust' emissions from the mining activities, the Air Quality Management Plan would focus upon the minimisation of dust emissions from mining activities and a program of environmental performance testing would be commissioned to confirm that the assumptions presented in the air quality risk assessment are:

- Reasonably represented.
- Identify where dust emissions may be controlled further.
- Quantify the efficacy of any further controls implemented.

The risks associated with the potential accidentals of containment of solid waste materials (such as beryllium) and sludge/liquid waste materials (such as formaldehyde) from the proposed Chandler

Facility, Apirnta Facility and spillages during transportation are presented in Part B, Part C and Part D in Appendix X.

Table 15-14 provides a succinct summary of the determined 'worst case' post-mitigated risks associated with the accidental loss of containment of solid wastes (as beryllium) and sludge / liquid wastes (as formaldehyde) at the proposed Chandler Facility and the Apirnta Facility.

Table 15-13 Worst case post mitigated risks

Facility	Loss of Containment	Frequent	Likely	Occasional	Unlikely	Remote	Incredible
		<1 FIBC/IBC	1 FIBC/IBC	≤1 TEU	2 TEU	≤100 TEU	≤ Capacity
Chandler Facility (Part B)	Solid waste (beryllium)	Neutral	Neutral	Neutral	Neutral	Intermed.	Major/ intermed.
	Liquid waste (formaldehyde)	Neutral	Neutral	Neutral	Intermed./ minor	Major/ intermed.	Major/ intermed.
Apirnta Facility (Part C)	Solid waste (beryllium)	Neutral	Neutral	Neutral	Neutral	Intermed./ minor	Major/ intermed.
	Liquid waste (formaldehyde)	Neutral	Neutral	Neutral	Minor	Major/ intermed.	Major/ intermed.

The loss of containment from transportation infrastructure is presented in Part D of Appendix X and is summarised in Table 15-15. A range of operational constraints have been identified that would be implemented as mitigation controls to restrict the potential impacts of loss of containment from transportation by active limitation of more hazardous components from some truck loads (to reduce the magnitude on impacts from one truckload) and consecutive truck loads (to reduce the magnitude of impacts from two-vehicle collisions).

Further, collision avoidance system, as has been successfully implemented by Yancoal at the Moolarben Coal Operations site would be developed to reduce the potential for vehicle collisions both on-site and off-site.

Table 15-14 Loss of containment risk from transportation infrastructure

Facility	Loss of Containment	Likely	Occasional	Unlikely
		≤1 TEU	3 TEU	6 TEU
Transport Infrastructure (Part D)	Product salt (PM_{10})	Intermediate / minor	Neutral	Neutral
	Solid waste (beryllium)	Major / intermediate	Neutral	Neutral
	Liquid waste (formaldehyde)	Neutral	Neutral	Neutral

15.9 Summary of risk assessment

A summary of the risk assessment undertaken for air quality during construction, operation, and closure and rehabilitation of the Proposal is provided in Table 15-15.

Table 15-15 Summary of risk assessment (air quality)

Hazard	Pre-mitigated risk			Post-mitigated risks			Risk outcome
	Likelihood	Consequence	Risk ranking	Likelihood	Consequence	Risk ranking	
Construction phase impacts (construction traffic in Alice Springs)	Almost certain	Moderate	High	Almost certain	Insignificant	High	Risk reduced
Emissions to air (combustion gases and particulates) from mining activities (NO2 at Chambers Pillar Campsite) (B) (F)	Likely	Major	High	Likely	Minor	Medium	Risk reduced
Loss of containment of 1 TEU of product salt at the Chandler Facility impacting all receptors (C)	Possible	Insignificant	Low	Unlikely	Insignificant	Low	Risk reduced
Loss of containment of 1 TEU of solid waste (as beryllium) at the Chandler Facility affecting all receptors	Possible	Insignificant	Low	Unlikely	Insignificant	Low	Risk reduced
Simultaneous loss of containment of 2 TEU of solid waste (as beryllium) at Chandler Facility	Unlikely	Insignificant	Low	Remote	Insignificant	Low	Risk reduced
Loss of containment of 1 TEU liquid/sludge waste (as formaldehyde) at the Chandler Facility impacting Chambers Pillar Campground	Possible	Minor	Medium	Unlikely	Minor	Low	Risk reduced
Simultaneous loss of containment of 2 TEU liquid/sludge waste (as formaldehyde) at Chandler Facility	Unlikely	Moderate	Medium	Remote	Moderate	Low	Risk reduced
Loss of containment of 1 TEU of product salt at Apirnta Facility	Possible	Insignificant	Low	Unlikely	Insignificant	Low	Risk reduced
Loss of containment of 1 TEU of solid waste (as beryllium) at Apirnta Facility	Possible	Insignificant	Low	Unlikely	Insignificant	Low	Risk reduced
Simultaneous loss of containment of 2 TEU of solid waste (as beryllium) at Apirnta Facility	Unlikely	Insignificant	Low	Remote	Insignificant	Low	Risk reduced
Loss of containment of 1 TEU liquid/sludge waste (as formaldehyde) at Apirnta Facility	Possible	Insignificant	Low	Unlikely	Insignificant	Low	Risk reduced
Loss of containment of 1 TEU of product salt at Apirnta Facility	Possible	Insignificant	Low	Unlikely	Insignificant	Low	Risk reduced
Loss of containment of 1 TEU of solid	Possible	Insignificant	Low	Unlikely	Insignificant	Low	Risk reduced

Hazard	Pre-mitigated risk			Post-mitigated risks			Risk outcome
	Likelihood	Consequence	Risk ranking	Likelihood	Consequence	Risk ranking	
waste (as beryllium) at Apirnta Facility							
Simultaneous loss of containment of 2 TEU of solid waste (as beryllium) at Apirnta Facility	Unlikely	Insignificant	Low	Remote	Insignificant	Low	Risk reduced
Loss of containment of 1 TEU liquid/sludge waste (as formaldehyde) at Apirnta Facility	Possible	Insignificant	Low	Unlikely	Insignificant	Low	Risk reduced
Simultaneous loss of containment of 2 TEU of solid waste (as beryllium) at Apirnta Facility	Unlikely	Insignificant	Low	Remote	Insignificant	Low	Risk reduced

15.10 Conclusion

A risk assessment of potential point and diffuse source impacts of the Proposal on air quality, including ambient air quality (e.g. PM_{10} fraction), dust and odour/gases, has been undertaken for the following activities:

- Power generation.
- Movements of mobile plant and vehicles.
- Wind erosion mobilising dust from exposed surfaces, such as from laydown areas, access tracks and sites of vegetation clearing.
- Storage, processing (e.g. hydraulic backfilling plant) and/or testing of any hazardous waste materials.

The assessment has shown that pre-mitigated construction and operation risks on air quality range from neutral to major. Major risks relate to the transport of solid and liquid waste materials.

Measures for managing and monitoring the impacts of air quality have been considered with respect to the receiving environment and human health. In addition, a construction and operation Air Quality Management Plan would be prepared.

Post-mitigated construction and operation risks on air quality were assessed. With mitigation and management measures in place, risks were reduced. They ranged from neutral to intermediate.

The results of the air quality risk assessment suggest that the Proposal would be acceptable from an air quality and human health perspective.