CopperString 2.0

Air and greenhouse gas

Volume 2 Chapter 10

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10. Air and greenhouse gas

10.1 Introduction

10.1.1 Project overview

The CopperString 2.0 Project (the Project) involves the construction and operation of approximately 1,060 km of extra high voltage overhead electricity transmission line that will extend from Mount Isa to the Powerlink transmission network, via a new connection point near Woodstock, south of Townsville.

The Project involves construction of seven new substations near Woodstock, Hughenden, Dajarra Road (Cloncurry), Mount Isa, Selwyn, Cannington Mine and Phosphate Hill Mine.

The CopperString transmission network is divided into the following eight sections as shown in Figure 10-1:

1. Woodstock Substation
2. Renewable Energy Hub
3. CopperString Core
4. Mount Isa Augmentation
5. Southern Connection
6. Cannington Connection
7. Phosphate Hill Connection
8. Kennedy Connection (option).

10.1.2 Objectives

Development is planned, designed, constructed and operated to protect the environmental values of air.

10.1.3 Purpose of chapter

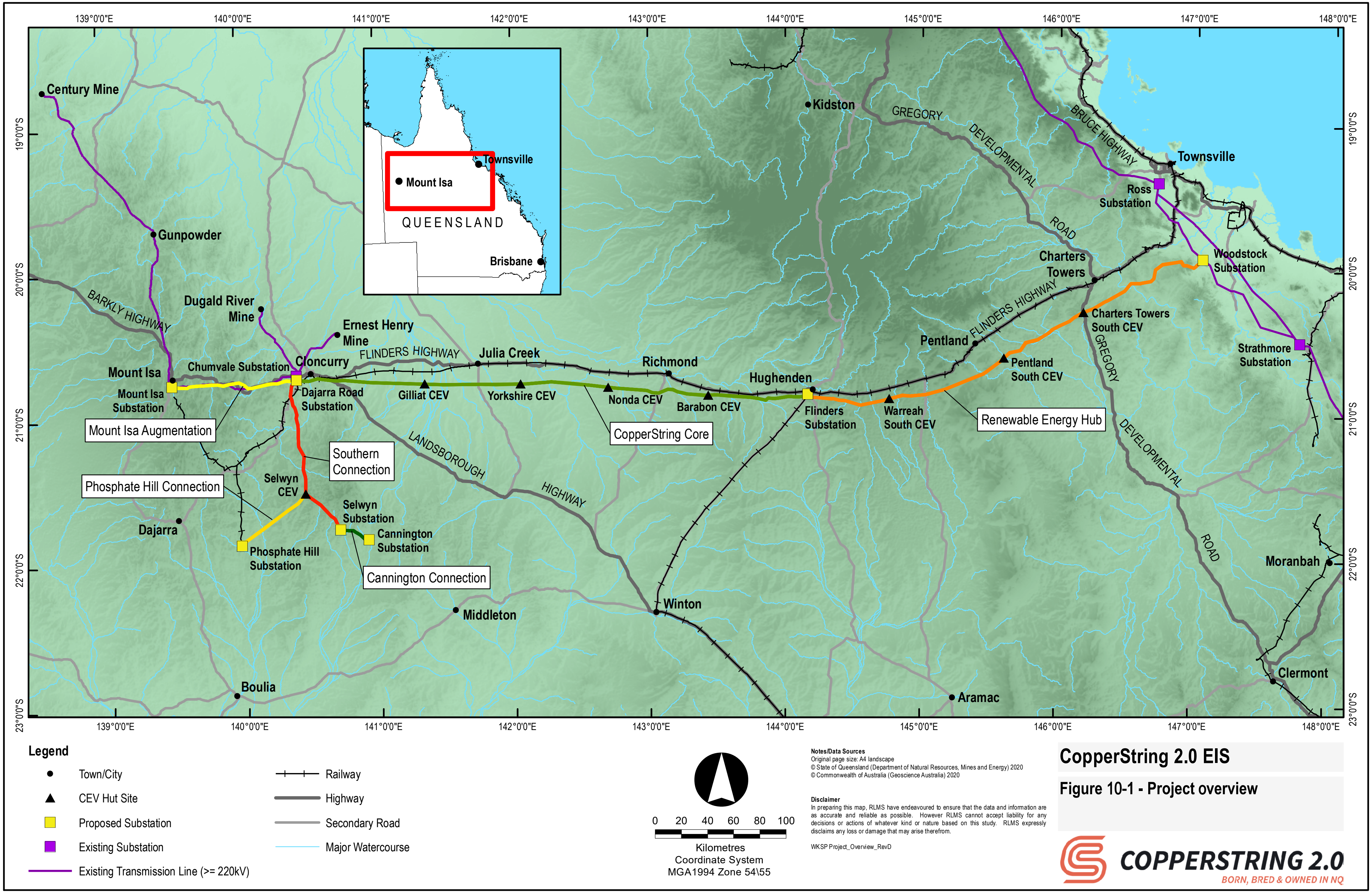
The purpose of this chapter is to identify the relevant air quality goals and standards for the Project (Section 10.2) and describe the existing air quality environment (Section 10.3). Airborne contaminants (emissions) associated with the construction and operation of the Project and associated infrastructure (Section 10.4) are discussed and recommended mitigation measures and reporting requirements to be adopted to achieve air quality goals are provided (Section 10.4).

The last section of this chapter characterises and quantify expected greenhouse gas emissions. This sections provides a comparison between the project and the total emissions relating to public electricity and heat production in Queensland and summaries GHG management and abatement opportunities for the Project (Section 10.5). A separate Greenhouse gas (GHG) Assessment has been undertaken and is provided in Volume 3 Appendix T Greenhouse gas assessment.

10.1.4 Defined terms

The following are a list of defined terms utilised throughout this chapter.

- **'Corridor selection'** – means the baseline investigation corridor of the transmission line (a nominal 1,060 km long corridor). The corridor selection is 120 m wide from Woodstock to Dajarra Road, and 60 m wide from Dajarra Road to Mount Isa, Dajarra Road to Selwyn, and Selwyn to Phosphate Hill and Cannington. The 4 km long section of the corridor selection from Dajarra Road Substation to Chumvale Substation is 60 m wide and a 3 km long section from Dajarra Road Substation to the Dugald River 220 kV overhead line is 80 m wide.
- **'Study area'** – mean the study area defined by individual technical studies in the methodology section or by default the 5 km wide study corridor defined in the Initial Advice Statement and referred to in the EIS ToR.
- **'Project area'** – means the 120 m, 80 m or 60 m wide easement and associated infrastructure (including laydown areas, substations, CEV huts, access tracks, brake and winch sites and construction camps) and works referred to in the EIS ToR (these include off-easement components).



CopperString 2.0 EIS

Figure 10-1 - Project overview

10.2 Methodology

10.2.1 Study area

The area of focus for this assessment is the updated corridor selection, paying particular attention to an area within two kilometres of the corridor selection centreline. On a regional scale, this assessment also covers the broader meteorological regions of the Project area across Queensland.

10.2.2 Data sources

The following data sources were used as part of this assessment:

- Bureau of Meteorology climate data online (Bureau of Meteorology, 2019).
- Queensland Government Air Monitoring Network Stations (Queensland Government, 2019).

10.2.3 Legislative context and standards

Under the *Environmental Protection Act 1994* (EP Act), proposals are assessed to ensure they will not adversely affect environmental values including air quality, public amenity and safety. This means ensuring the proposal is not likely to cause environmental nuisance or environmental harm.

The *Environmental Protection (Air) Policy 2019* (EPP (Air)) under the EP Act establishes air environment values to be protected or enhanced. These values are conducive to:

- Protecting the health and biodiversity of ecosystems
- Human health and wellbeing
- Protecting the aesthetics of the environment, including the appearance of buildings structures and other property
- Protecting agricultural use of the environment.

The EPP (Air) provides long-term goals for sulphur dioxide, nitrogen dioxide, ozone, carbon monoxide, particles, lead and a number of air toxics in line with the objectives above.

These long-term goals generally apply to stationary sources of air pollution. However, as the construction period within proximity to a sensitive receptor is temporary in nature, the particulates and deposited dust criteria in the EPP (Air) were used for the assessment of potential construction impacts of the Project. The air quality goals set out in Schedule 1 of the EPP (Air) are provided in Table 10-1.

Table 10-1 Air quality goals from EPP (Air)

Pollutant	Averaging period	Concentration
Total suspended particles (TSP)	Annual	90 µg/m^3
Particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10})	24-hour	50 µg/m^3
	Annual	25 µg/m^3
Particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$)	24-hour	25 µg/m^3
	Annual	8 µg/m^3
Nitrogen dioxide (NO_2)	1-hour	250 µg/m^3
Sulphur dioxide (SO_2)	1-hour	570 µg/m^3
	24-hour	229 µg/m^3

The EPP (Air) does not provide goals for dust deposition. Dust deposition goals for this assessment are taken from the Department of Environment and Science (DES) document ESR/2015/1840 "*Application requirements for activities with impacts to air*" (DES 2017). DES provide dust deposition criteria as an indication of amenity-related concerns and potential for defining environmental nuisance. The dust deposition goal is listed in Table 10-2.

Table 10-2 Dust deposition goal from DES

Pollutant	Averaging period	Concentration
Dust deposition	Monthly	120 mg/m^2/day

10.2.4 Desktop assessment

A desktop assessment was undertaken in order to define the existing environment in terms of air quality. This included the following:

- A review of sensitive receptors that may be impacted by the Project
- A review of the meteorological regions of the area for local meteorological context and also to investigate variability in meteorology along the corridor selection
- A review of wind speed, wind direction and rainfall to assess the effect of local meteorology on dispersion of possible emissions associated with construction and operation of the Project
- A review of existing air quality using monitored data from several air quality monitoring stations in Queensland to provide context to consider a cumulative impact of possible emissions associated with construction and operation of the Project
- A climate change assessment in not included in this chapter but is provided in Volume 2 Chapter 3 Site description and climate of this EIS.

The desktop assessment is provided in Section 10.3.

10.2.5 Impact assessment

An impact assessment was undertaken in order to characterise potential impacts to the air environment and provide potential mitigation measures. This included a review of the Project's construction activities that have the potential to affect air quality, and operational conditions that have the potential to affect air quality. From this, potential impacts to air quality were identified and characterised (in terms of source and emission type, e.g. dust associated with earthworks, gases associated with combustion engines etc.). Finally, mitigation measures were recommended in order to manage possible emissions associated with the Project. The impact assessment is detailed in Section 10.4.

10.2.6 Terms of reference

The Terms of Reference (ToR) were used as a guide in completing this EIS chapter to provide an overview of the existing environment, methodology for assessing impacts, and to relate directly to the ToR relevant to Air Quality. The ToR addressed in this chapter are provided in Volume 3 Appendix A Terms of reference with cross reference table.

10.3 Existing environment

This section will characterise the existing environment in terms of identified sensitive receptors, meteorological regions and a number of meteorological parameters, which may affect sensitive receptors as a result of the Project.

10.3.1 Environmental values

The EPP (Air) defines four environmental values which are to be enhanced or protected under the policy. These values and a description of how these relate to the existing environment within the Project are described in Table 10-3.

Table 10-3 Environmental values

Environmental value	Existing environment
The qualities of the air environment that are conducive to protecting the health and biodiversity of ecosystems.	Agricultural activities are the predominant land uses across the Project with some discreet mining activities. Dust generated from these activities occurs in localised areas across the Project. Vegetated landscapes across the Project are a mix of open woodlands and sparse open plains. No permanent changes to the surrounding biodiversity are proposed as part of the Project.
The qualities of the air environment that are conducive to human health and wellbeing.	Existing activities generate localised short-term dust impacts e.g. undertaking mustering of livestock. Generally, the background air quality is considered good as described by the AQMSS monitoring locations. No permanent changes to the human health and wellbeing of local residents and communities are proposed as part of the Project.
The qualities of the air environment that are conducive to protecting the aesthetics of the environment, including the appearance of buildings, structures and other property.	The Project traverses a range of visual landscapes from roads with the predominant existing land use across the Project is for agricultural / grazing uses. No permanent changes to the aesthetics of the environment, including the appearance of buildings, structures and other property is expected as part of the Project.
The qualities of the air environment that are conducive to protecting agricultural use of the environment.	As described in Chapter 5 Land of this EIS, the predominant existing land use across the Project is for agricultural uses. No permanent changes to land uses are proposed as part of the Project.

10.3.2 Sensitive receptors

Potentially affected sensitive receptors include residential premises and other buildings which are in the vicinity of the corridor selection. For the study of the air quality impact assessment, residences within two kilometres of the centre line of the corridor selection or substation site are considered. The review identified 57 sensitive receptors, 55 of these being residential premises, one place of recreation and one workplace, for the purposes of the air quality assessment. These are provided in Table 10-4.

Table 10-4 Sensitive receptors

Residential (unless otherwise noted)	Approximate distance from transmission line (m)	Coordinates (GDA94 Zones 54-55) (m)	
		Easting	Northing
1	1,866	478,715	7,791,461
2	782	470,070	7,787,999
3	1,739	465,442	7,781,419
4	962	422,731	7,759,354
5	1,743	421,973	7,759,802
6	1,848	354,040	7,720,974
7	1,958	205,273	7,686,069
8	1,549	196,358	7,684,976
9	1,177	768,786	7,686,785
10	1,799	739,942	7,691,521
11	1,695	716,251	7,693,234
12	1,815	700,852	7,691,947
13	1,894	654,981	7,700,778
14	1,893	629,778	7,698,952
15	1,910	613,729	7,697,966
16	1,903	613,659	7,697,973
17	1,876	453,691	7,704,669
18	1,827	448,434	7,707,124
19	1,020	448,214	7,706,232
20	1,732	447,910	7,706,889
21	1,995	343,827	7,702,956
22	882	343,770	7,701,816
23	1,898	343,674	7,702,941
24	1,617	343,671	7,699,317
25	1,585	343,652	7,699,349
26	1,602	343,642	7,699,332
27	1,590	343,618	7,699,344
28	1,667	343,617	7,699,266
29	1,431	343,559	7,702,420
30	1,357	343,550	7,702,320
31	1,933	343,530	7,703,081
32	1,833	343,524	7,702,968
33	1,431	343,497	7,702,481
34	1,723	343,459	7,702,879
35	1,475	343,457	7,702,573
36	1,370	343,455	7,702,437
37	1,578	343,397	7,702,746
38	1,790	343,360	7,703,014
39	747	343,079	7,701,931
40	914	343,051	7,702,178
41	783	343,051	7,702,011

Residential (unless otherwise noted)	Approximate distance from transmission line (m)	Coordinates (GDA94 Zones 54-55) (m)	
		Easting	Northing
42	1,151	343,043	7,702,459
43	990	343,028	7,702,282
44	1,315	342,994	7,702,659
45	309	342,944	7,701,240
46	311	342,920	7,701,241
47	318	342,891	7,701,248
48	296	342,866	7,701,243
49	271	342,839	7,701,244
50	250	342,815	7,701,245
51	222	342,787	7,701,245
52 (Mica Creek Power Station)	305	342,771	7,701,611
53	199	342,763	7,701,244
54	174	342,737	7,701,249
55	145	342,707	7,701,246
56	1,878	341,786	7,703,158
57(Mt Isa Golf Club)	1,862	341,713	7,703,107
Note: Receptors 1-9 in MGA94 Zone 55, remainder in MGA94 Zone 54			

A review of potentially affected sensitive receptors along the corridor selection indicates that the 46 of the 57 identified sensitive receptors are greater than 750 m from the proposed transmission line. The exceptions to this include sensitive receptors 45-55, which are existing workers accommodation located between approximately 150 m and 350 m of the existing Mount Isa power stations and electrical substations. The sensitive receptors are displayed in Figure 10-2.

Legend

- Sensitive Receptor within 2km
- Kilometre Post
- CopperString Alignment
- 2 km buffer
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street

0 500 1,000 1,500
Metres
Coordinate System
GDA 1994 MGA Zone 55

Notes/Data Sources
Original page size: A4 landscape
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WKSP Sensitive_Receptors_RevE

CopperString 2.0 EIS

Figure 10-2A - Sensitive receptors -Air quality assessment

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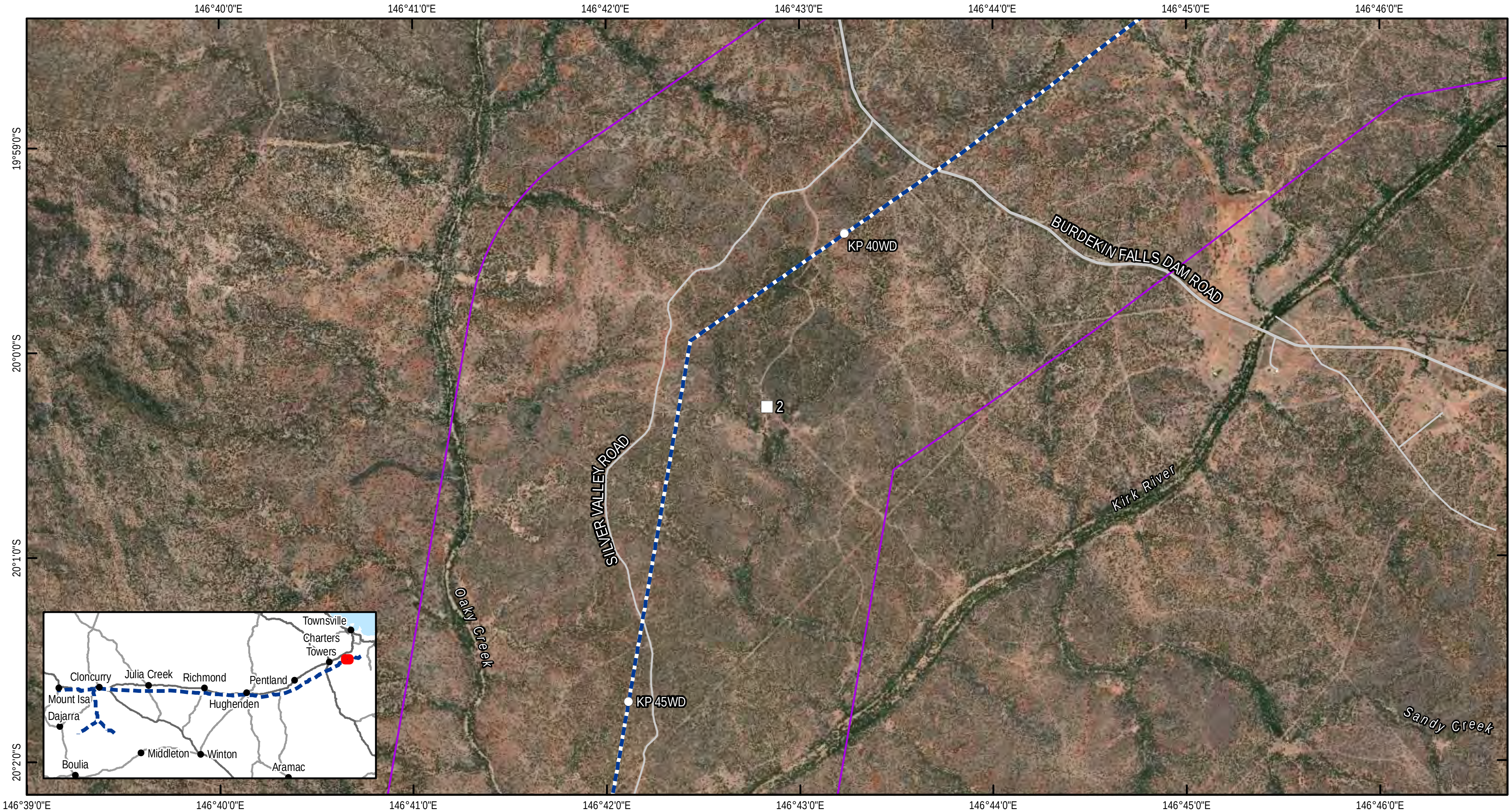
BORN, BRED & OWNED IN NQ



Legend

- Sensitive Receptor within 2km
- Kilometre Post
- CopperString Alignment
- 2 km buffer
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street

0 500 1,000 1,500

Metres

Coordinate System
GDA 1994 MGA Zone 55

Notes/Data Sources
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CopperString 2.0 EIS

Figure **10-2**B - Sensitive receptors -Air **q**uality **a**ssessment

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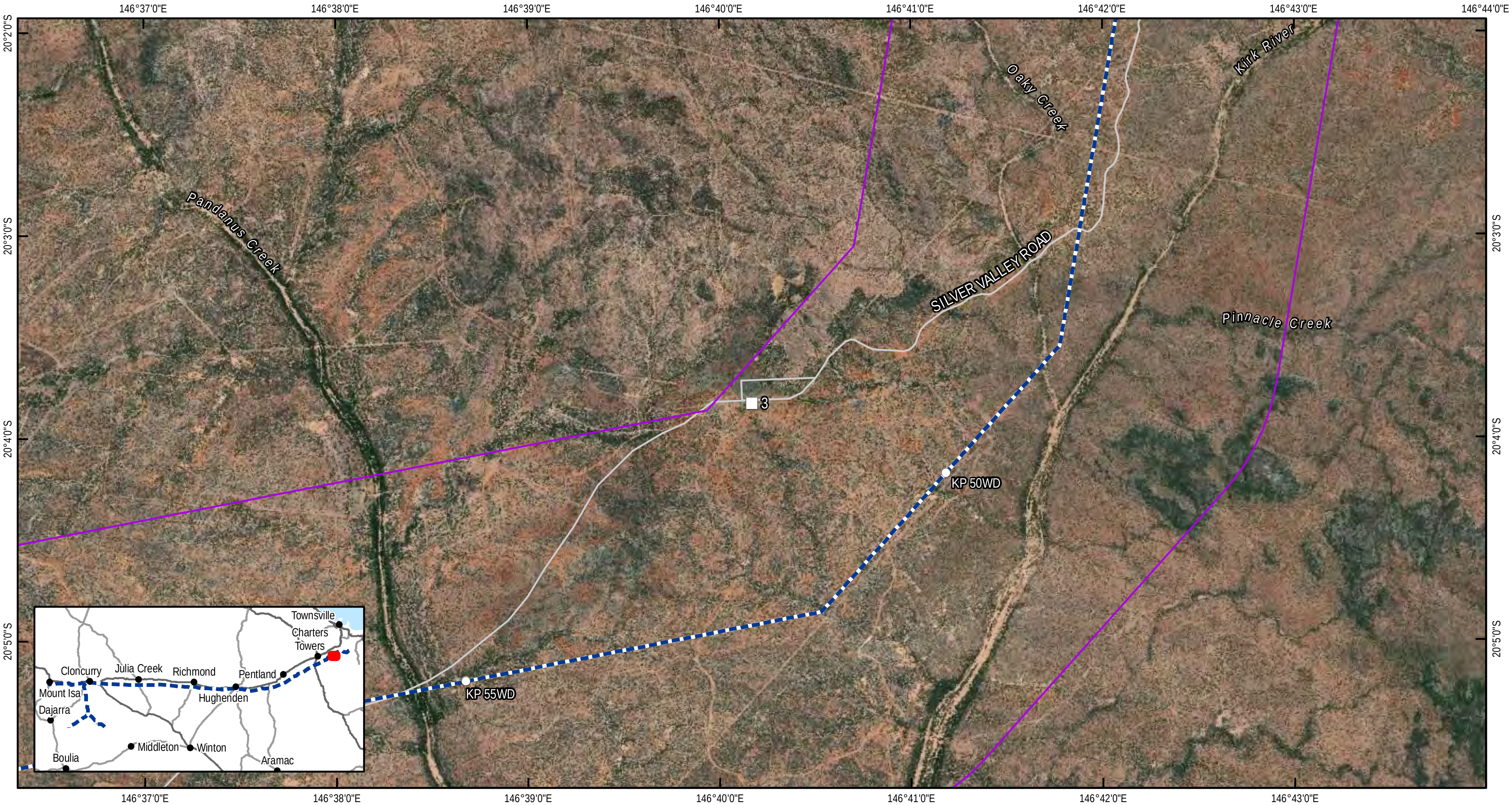

Legend

- Sensitive Receptor within 2km
- Kilometre Post
- CopperString Alignment
- 2 km buffer
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street

0 500 1,000 1,500

Metres

Coordinate System
GDA 1994 MGA Zone 55

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WKSP Sensitive_Receptors_RevE

CopperString 2.0 EIS

Figure **10-2**C - Sensitive receptors -Air **q**uality **a**ssessment

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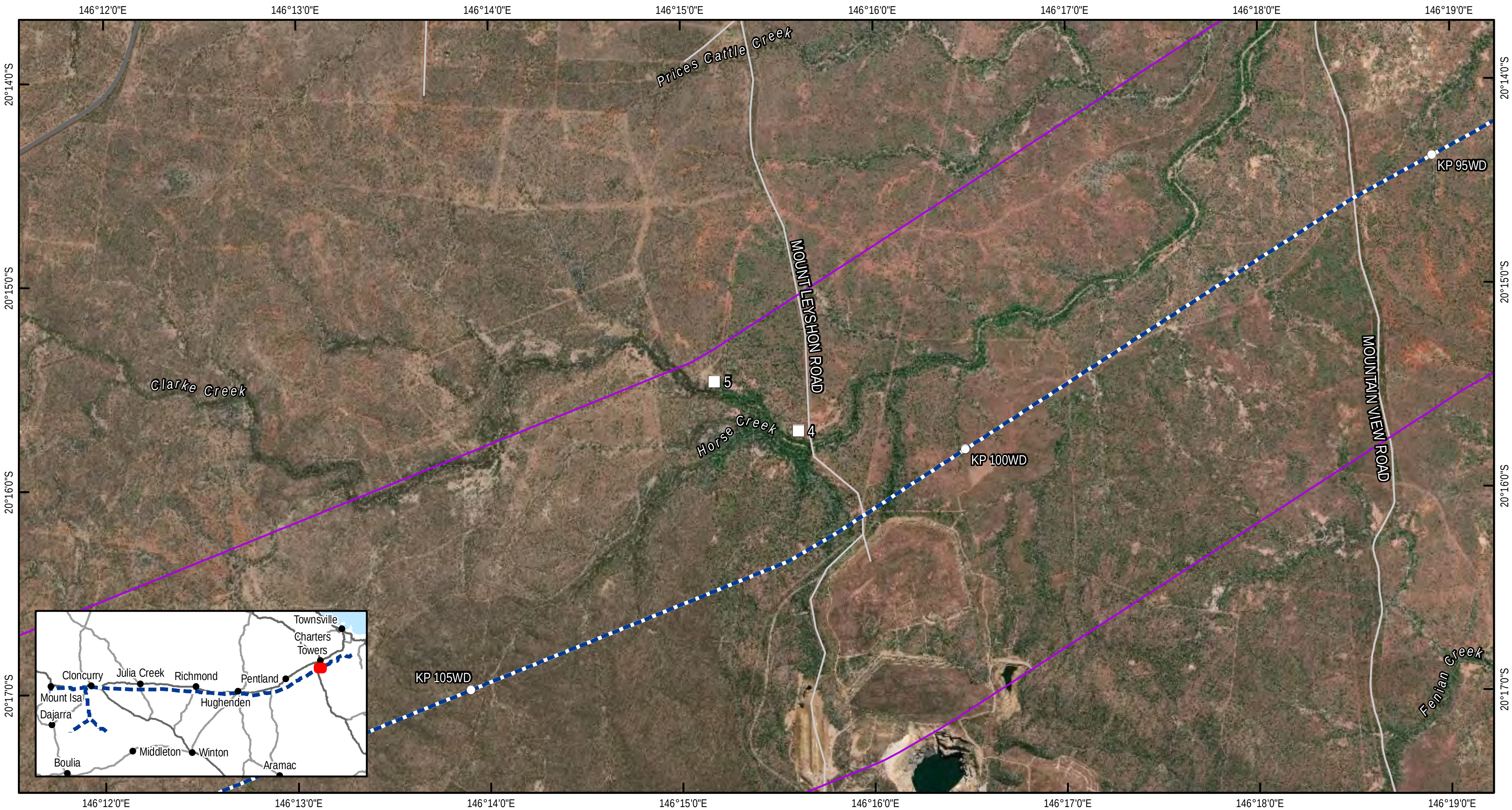

Legend

- Sensitive Receptor within 2km
- Kilometre Post
- CopperString Alignment
- 2 km buffer
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street

0 500 1,000 1,500
Metres
Coordinate System
GDA 1994 MGA Zone 55

Notes/Data Sources
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WKSP Sensitive_Receptors_RevE

CopperString 2.0 EIS

Figure **10-2**D - Sensitive receptors -Air **q**uality **a**ssessment

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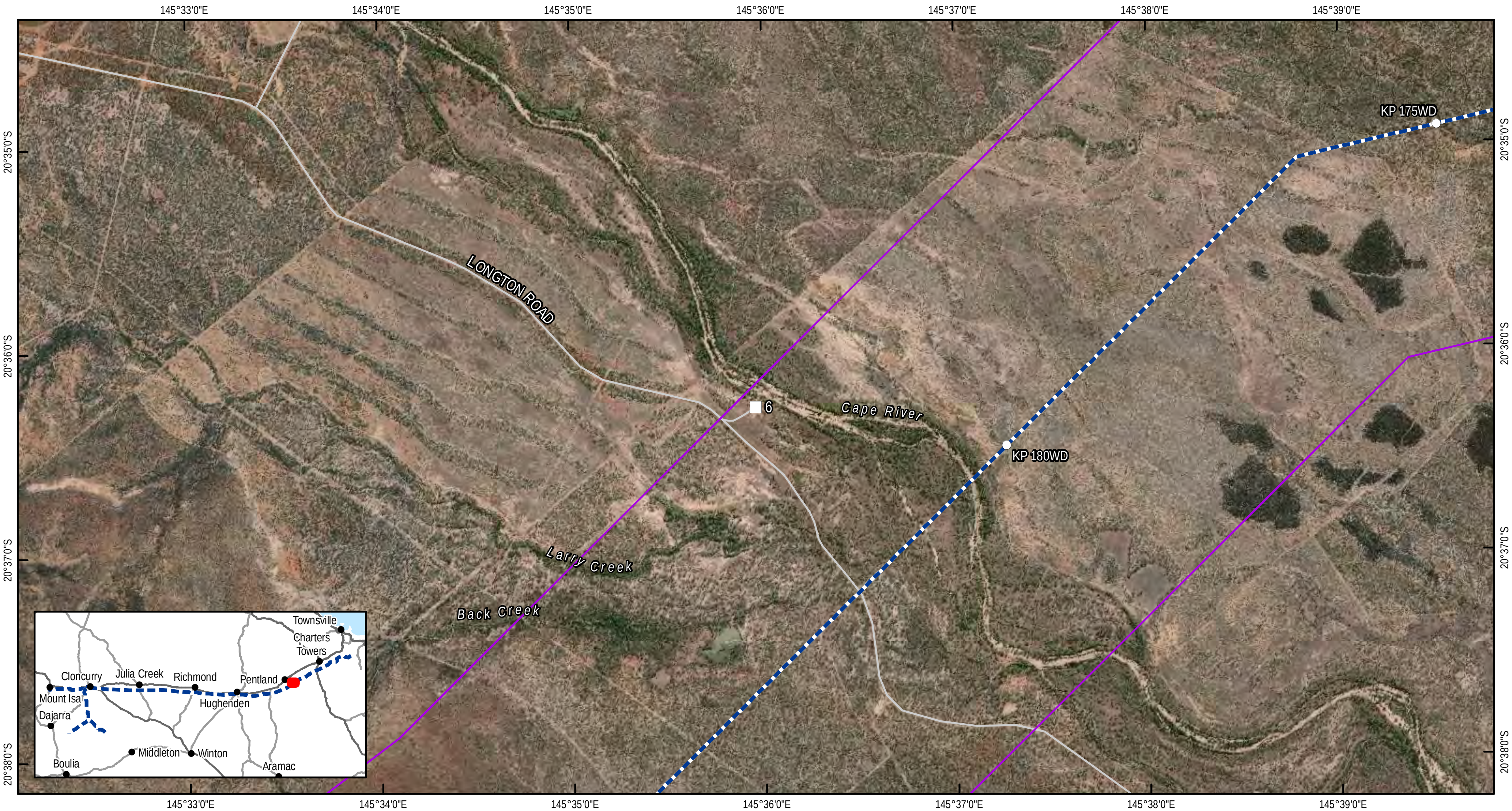

Legend

Sensitive Receptor within 2km	Railway
Kilometre Post	Highway
CopperString Alignment	Secondary Road
2 km buffer	Local Connector Road
	Street

0 500 1,000 1,500

Metres

Coordinate System
GDA 1994 MGA Zone 55

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WKSP Sensitive_Receptors_RevE

CopperString 2.0 EIS

Figure **10-2**E - Sensitive receptors -Air **q**uality **a**ssessment

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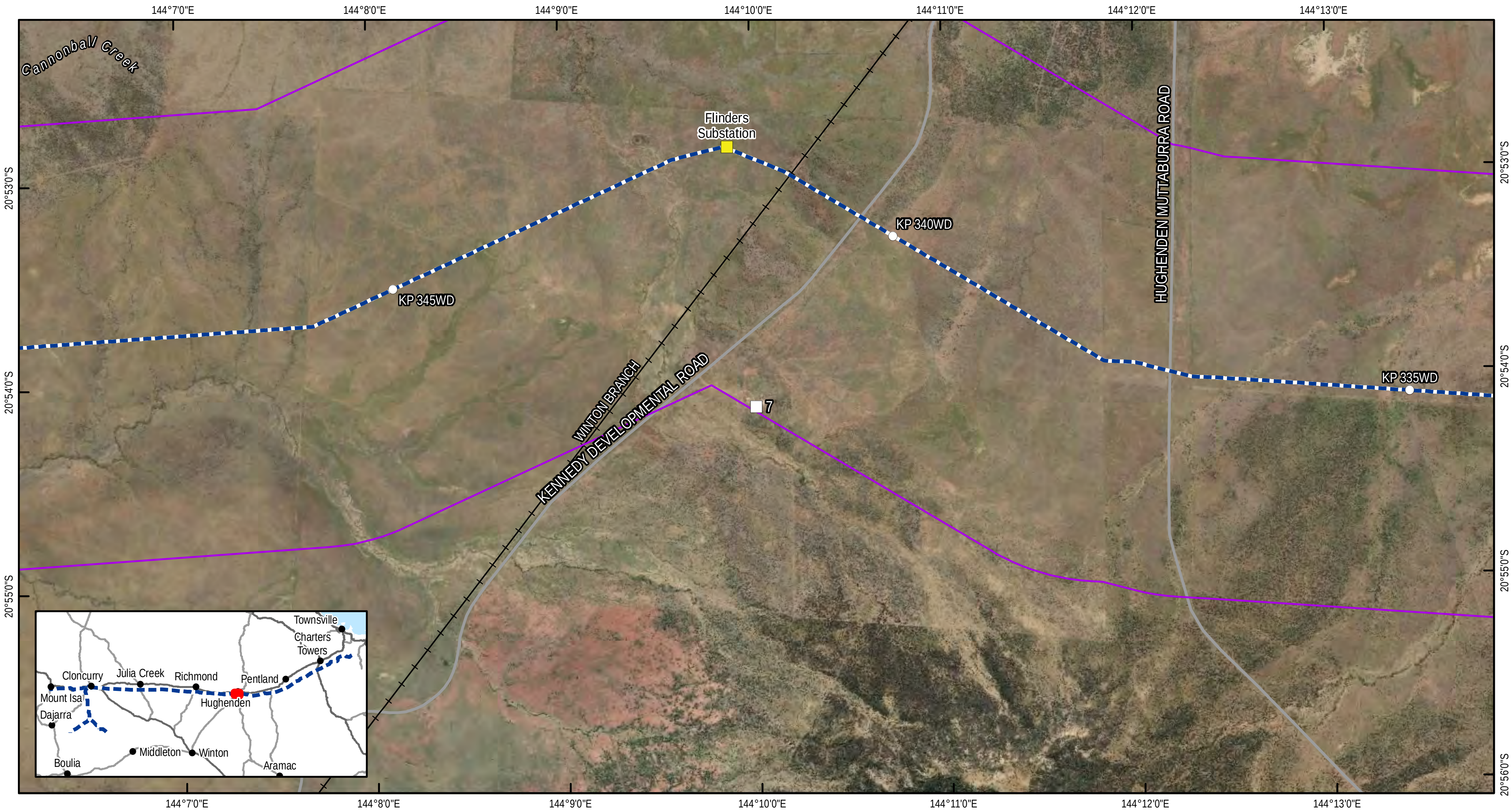

Legend

Sensitive Receptor within 2km	Railway
Proposed Substation	Highway
Kilometre Post	Secondary Road
CopperString Alignment	Local Connector Road
2 km buffer	Street

0 500 1,000 1,500
Metres
Coordinate System
GDA 1994 MGA Zone 55

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CopperString 2.0 EIS

Figure **10-2**F - Sensitive receptors -Air **q**uality **a**ssessment

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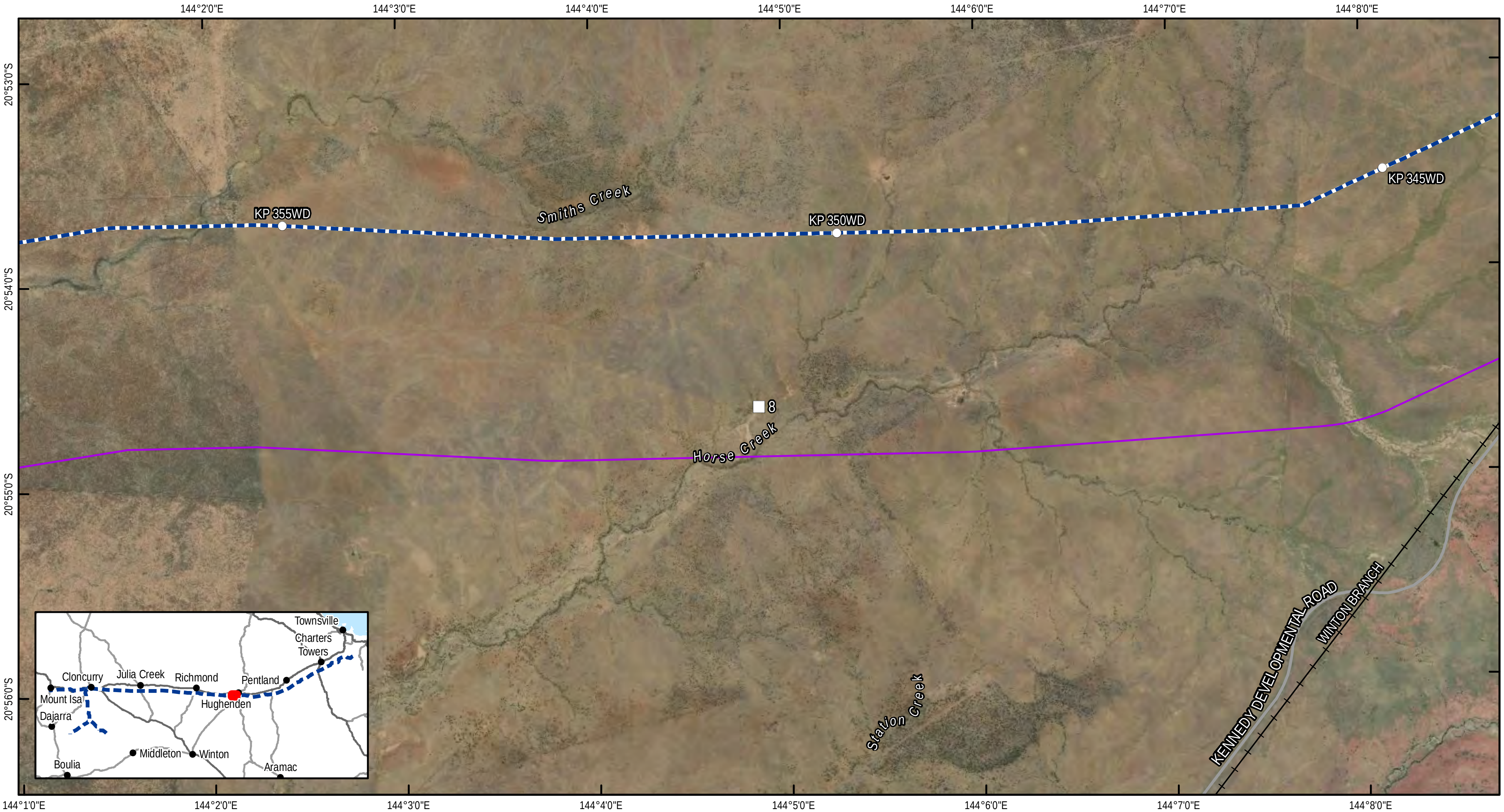

Legend

- Sensitive Receptor within 2km
- Kilometre Post
- CopperString Alignment
- 2 km buffer
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street

0 500 1,000 1,500

Metres

Coordinate System
GDA 1994 MGA Zone 55

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CopperString 2.0 EIS

Figure 10-2G - Sensitive receptors -Air quality assessment

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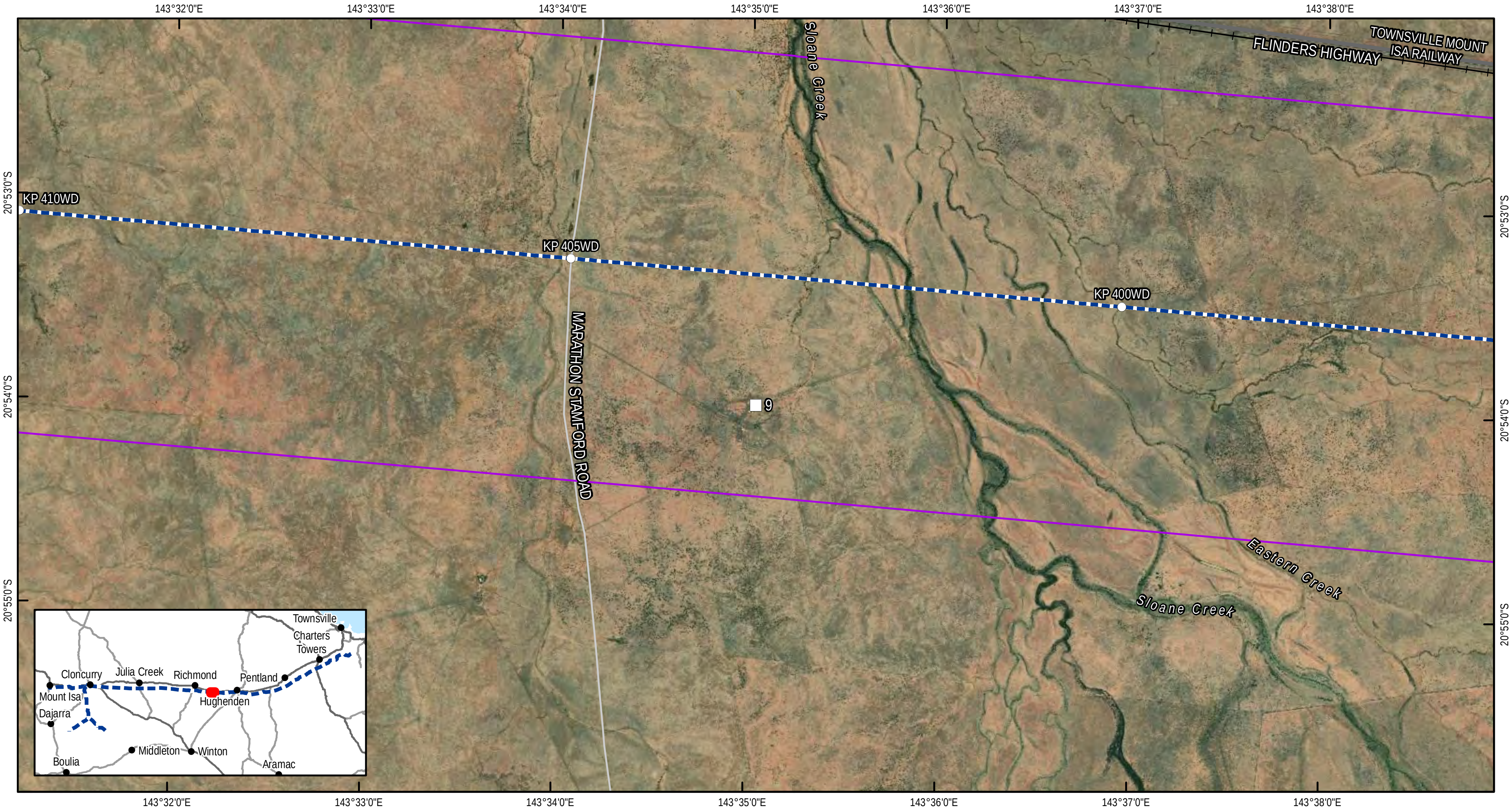

Legend

- Sensitive Receptor within 2km
- Kilometre Post
- CopperString Alignment
- 2 km buffer
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street

0 500 1,000 1,500

Metres

Coordinate System
GDA 1994 MGA Zone 54

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Figure **10-2**H - Sensitive **r**eceptors -Air **q**uality **a**ssessment

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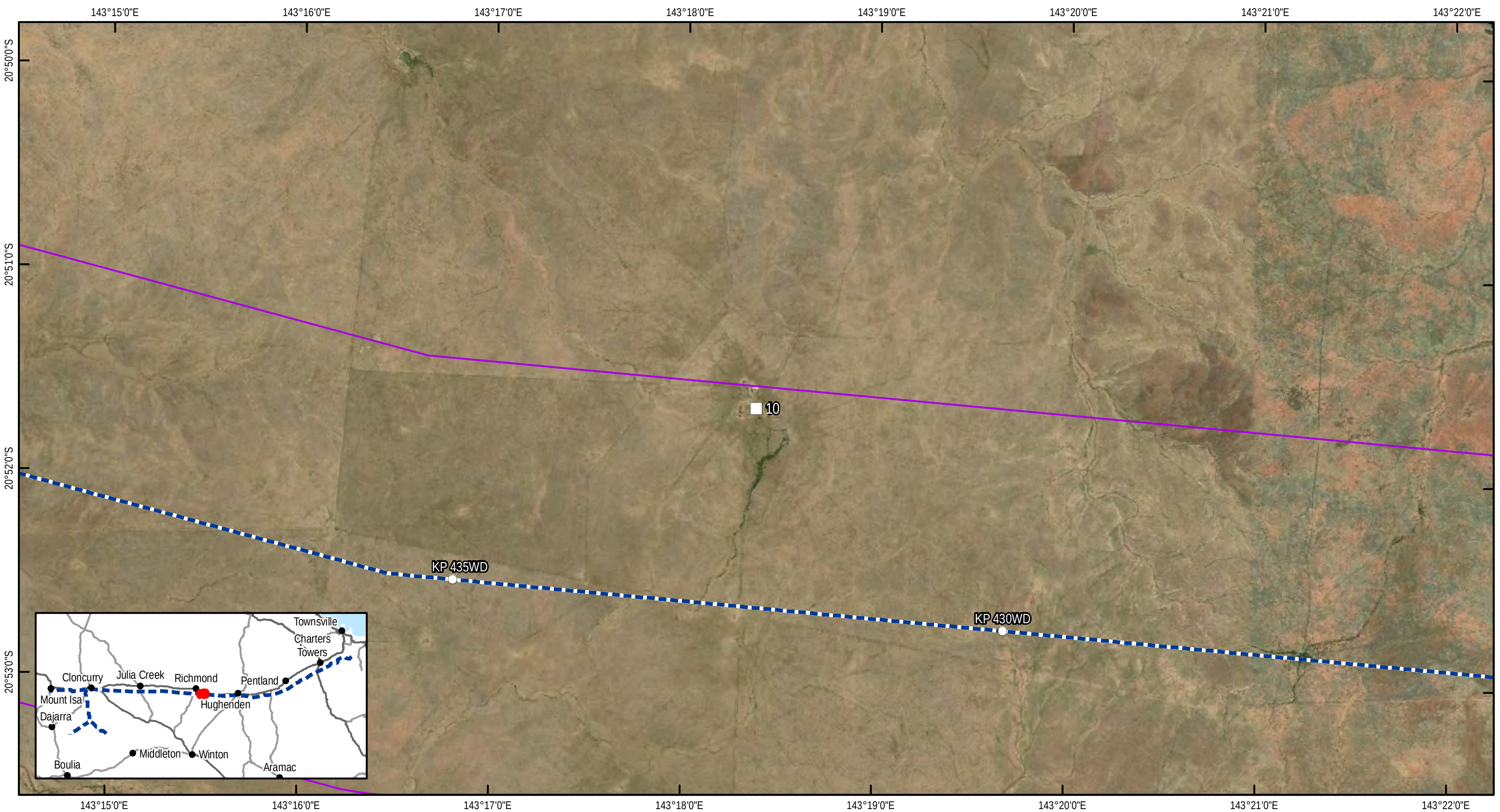

Legend

Sensitive Receptor within 2km

Kilometre Post

CopperString Alignment

2 km buffer

Railway

Highway

Secondary Road

Local Connector Road

Street

0 500 1,000 1,500

Metres

Coordinate System
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Figure **10-2l** - Sensitive receptors -Air **q**uality **a**ssessment

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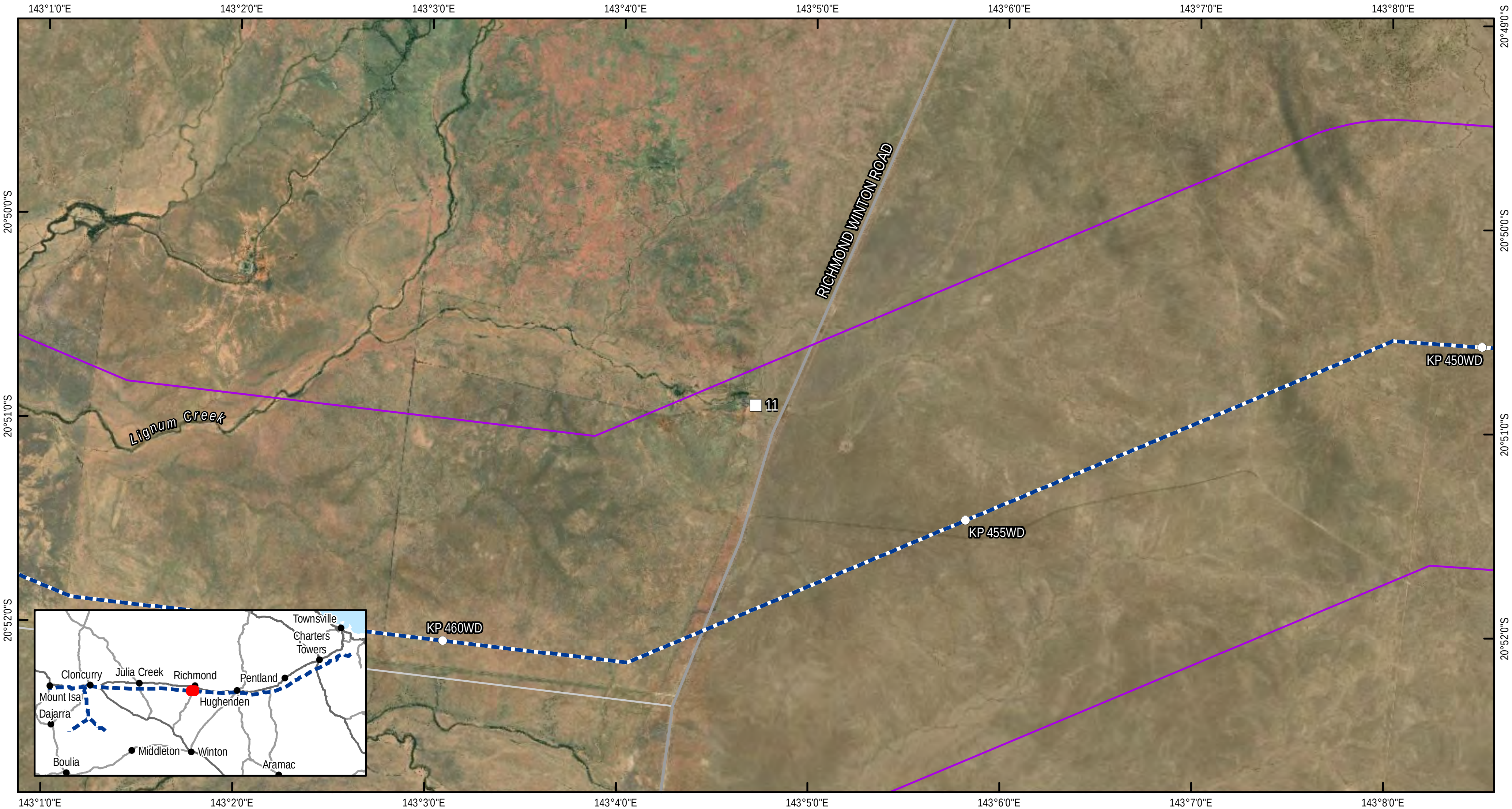
CopperString 2.0 EIS

Figure 10-2J - Sensitive receptors -Air quality assessment



Legend

- Sensitive Receptor within 2km
- Kilometre Post
- CopperString Alignment
- 2 km buffer
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street

0 500 1,000 1,500

Metres

Coordinate System GDA 1994 MGA Zone 54

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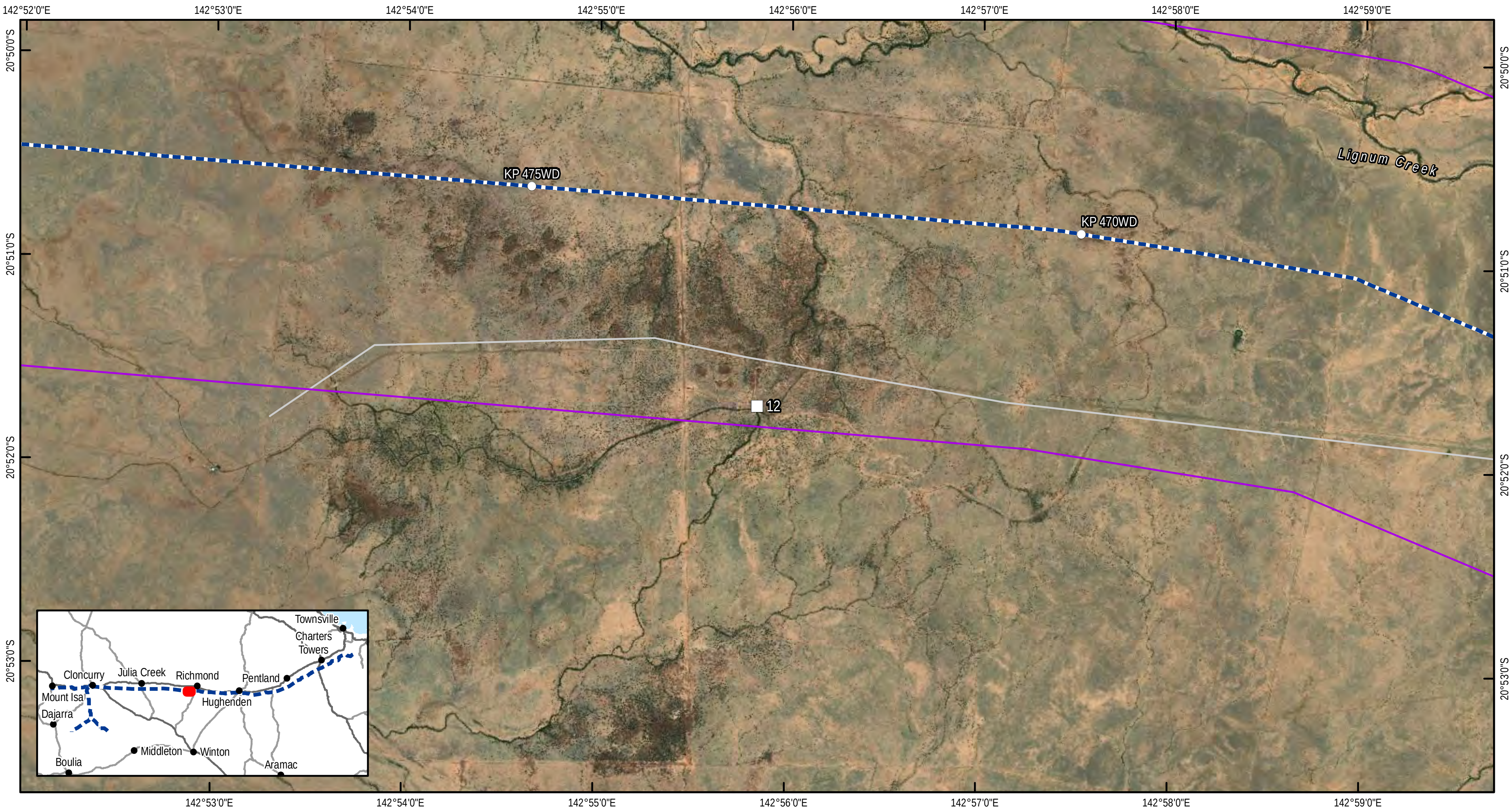

Legend

- Sensitive Receptor within 2km
- Kilometre Post
- CopperString Alignment
- 2 km buffer
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street

0 500 1,000 1,500
Metres
Coordinate System
GDA 1994 MGA Zone 54

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Figure 10-2K - Sensitive receptors -Air quality assessment

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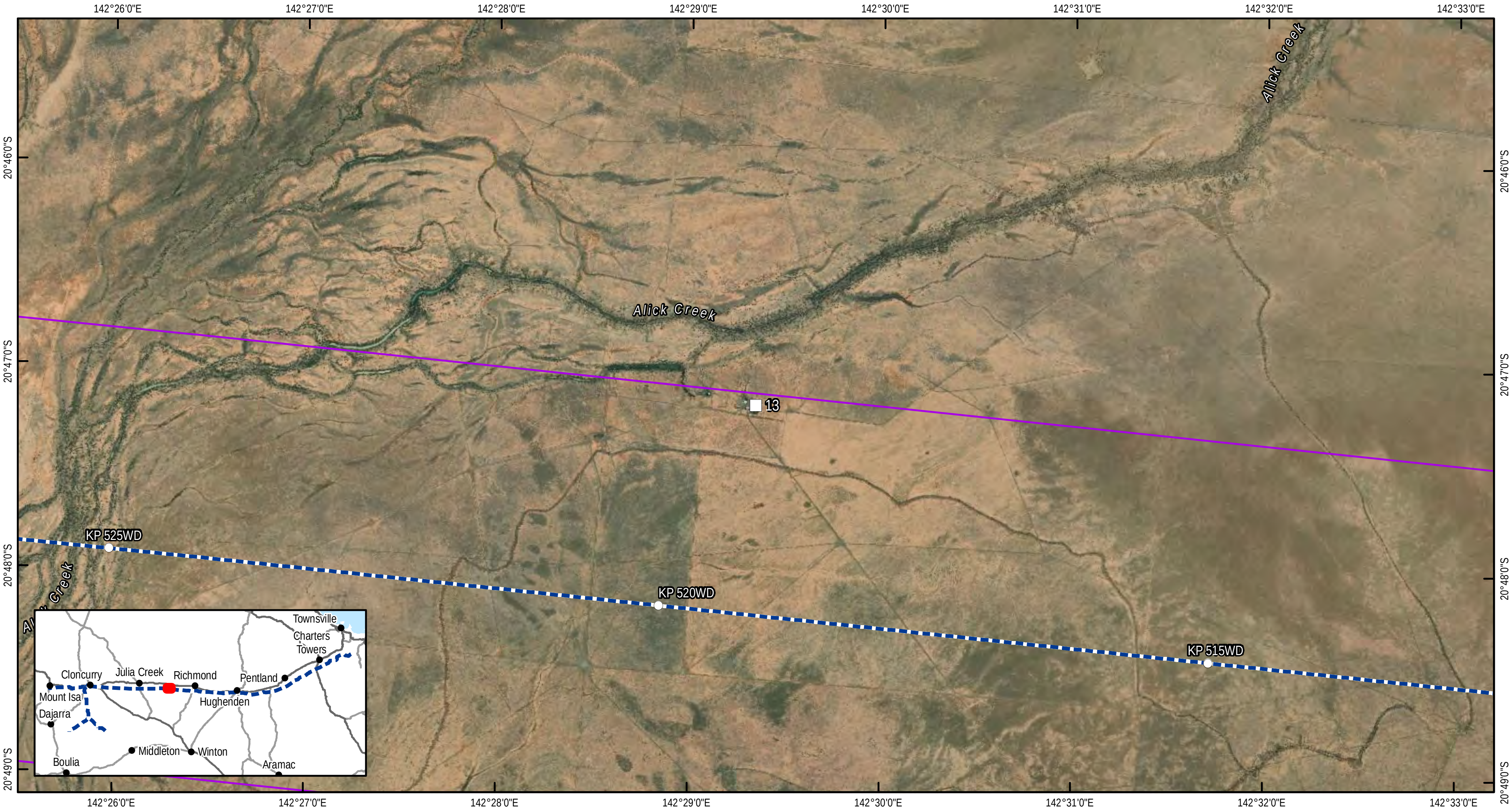

Legend

- Sensitive Receptor within 2km
- Kilometre Post
- CopperString Alignment
- 2 km buffer
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street

0 500 1,000 1,500
Metres
Coordinate System
GDA 1994 MGA Zone 54

Notes/Data Sources
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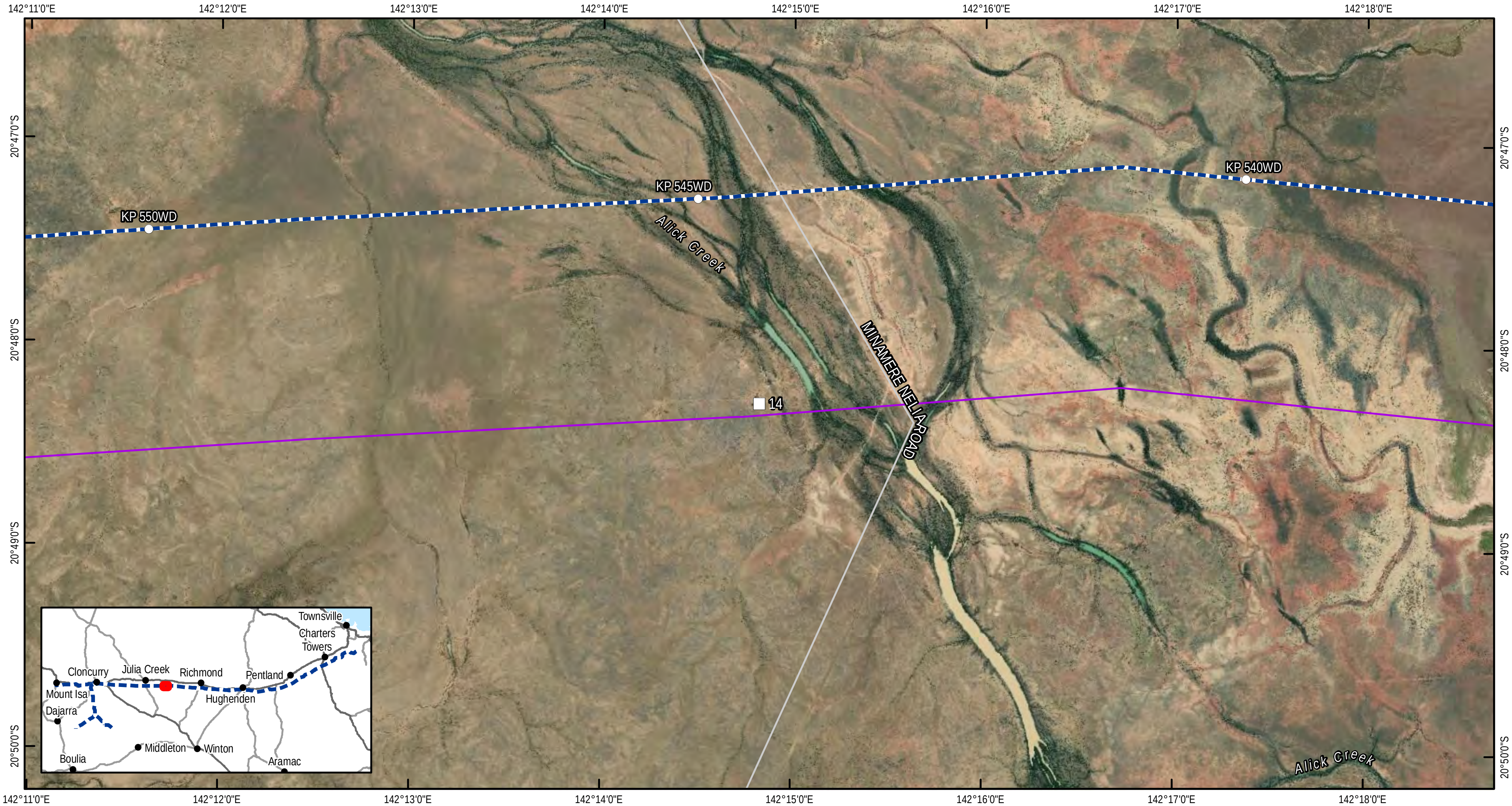
WKSP Sensitive_Receptors_RevE

CopperString 2.0 EIS

Figure **10-2**L - Sensitive receptors -Air **q**uality **a**ssessment

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

Sensitive Receptor within 2km	Railway
Kilometre Post	Highway
CopperString Alignment	Secondary Road
2 km buffer	Local Connector Road
	Street

0 500 1,000 1,500

Metres

Coordinate System
GDA 1994 MGA Zone 54

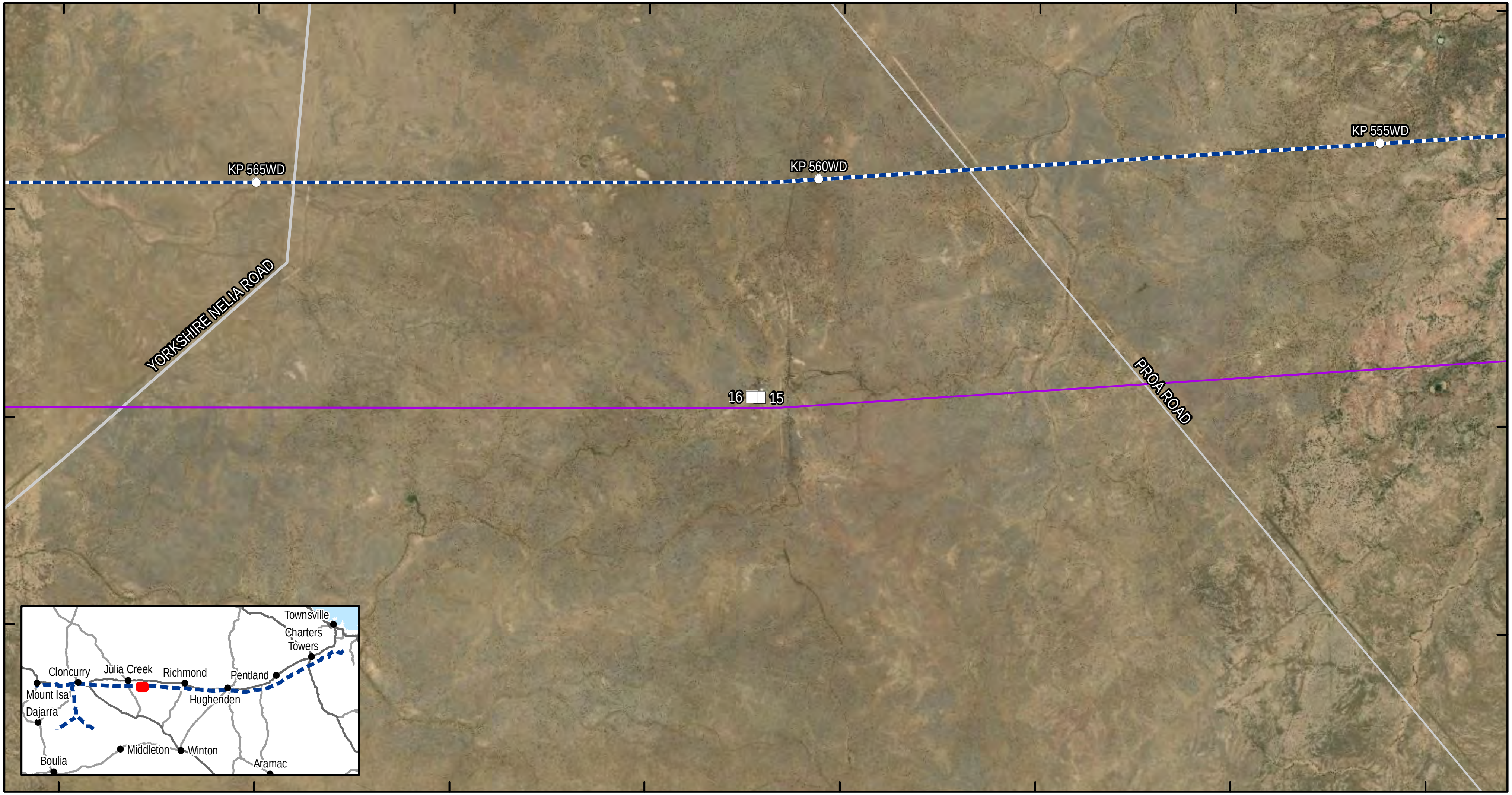
Notes/Data Sources
Original page size: A4 landscape

WKSP Sensitive_Receptors_RevE

CopperString 2.0 EIS

Figure **10-2**M - Sensitive receptors -Air quality **a**ssessment

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

Sensitive Receptor within 2km

Kilometre Post

CopperString Alignment

2 km buffer

Railway

Highway

Secondary Road

Local Connector Road

Street

0 500 1,000 1,500

Metres

Coordinate System
GDA 1994 MGA Zone 54

Notes/Data Sources
Original page size: A4 landscape

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

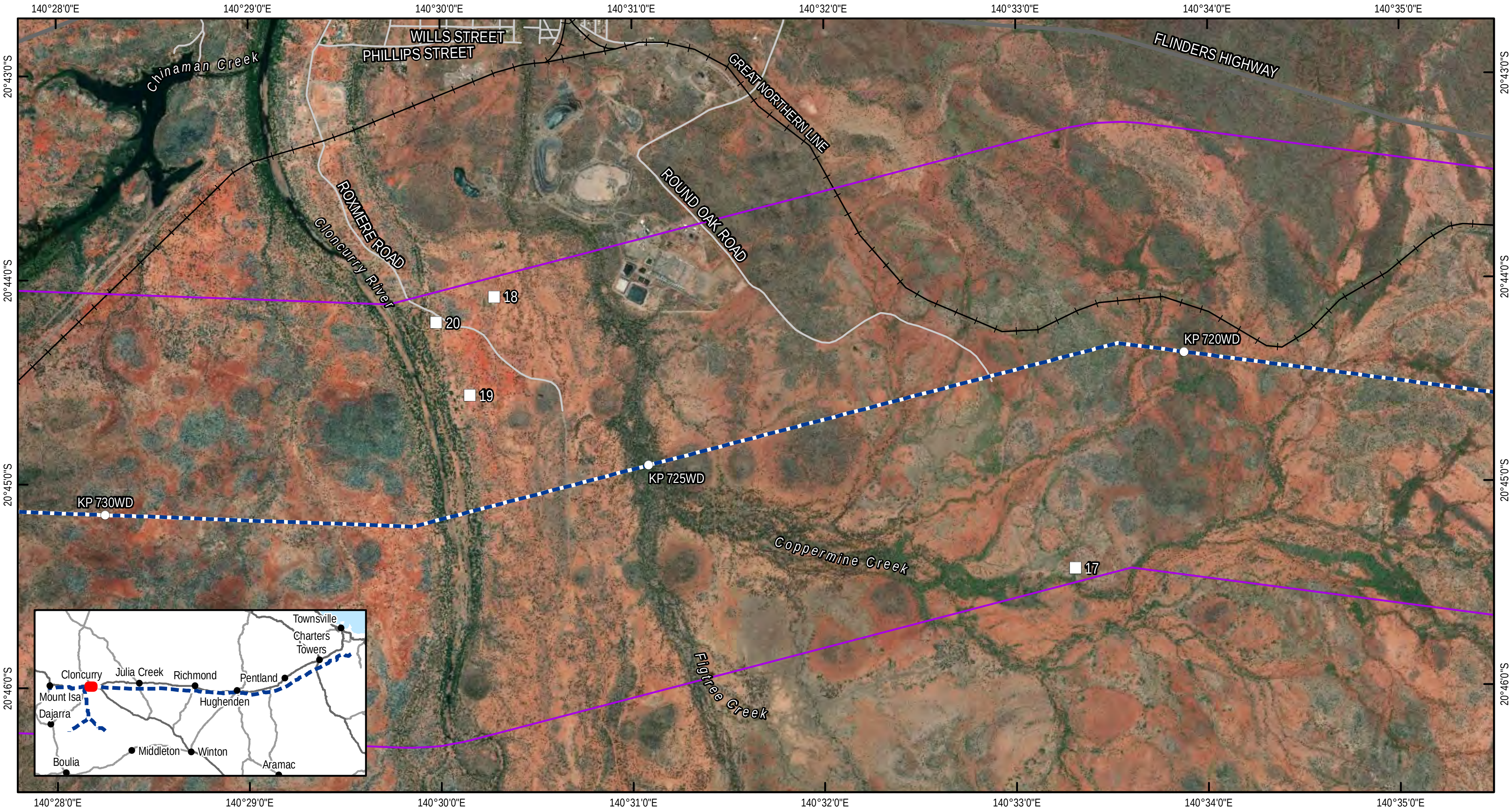
WKSP Sensitive_Receptors_RevE

CopperString 2.0 EIS

Figure **10-2**N - Sensitive receptors -Air **q**uality **a**ssessment

COPPERSTRING 2.0

BORN, BRED & OWNED IN NQ



Legend

- Sensitive Receptor within 2km
- Kilometre Post
- CopperString Alignment
- 2 km buffer
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street

0 500 1,000 1,500

Metres

Coordinate System
GDA 1994 MGA Zone 54

Notes/Data Sources
Original page size: A4 landscape

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Disclaimer
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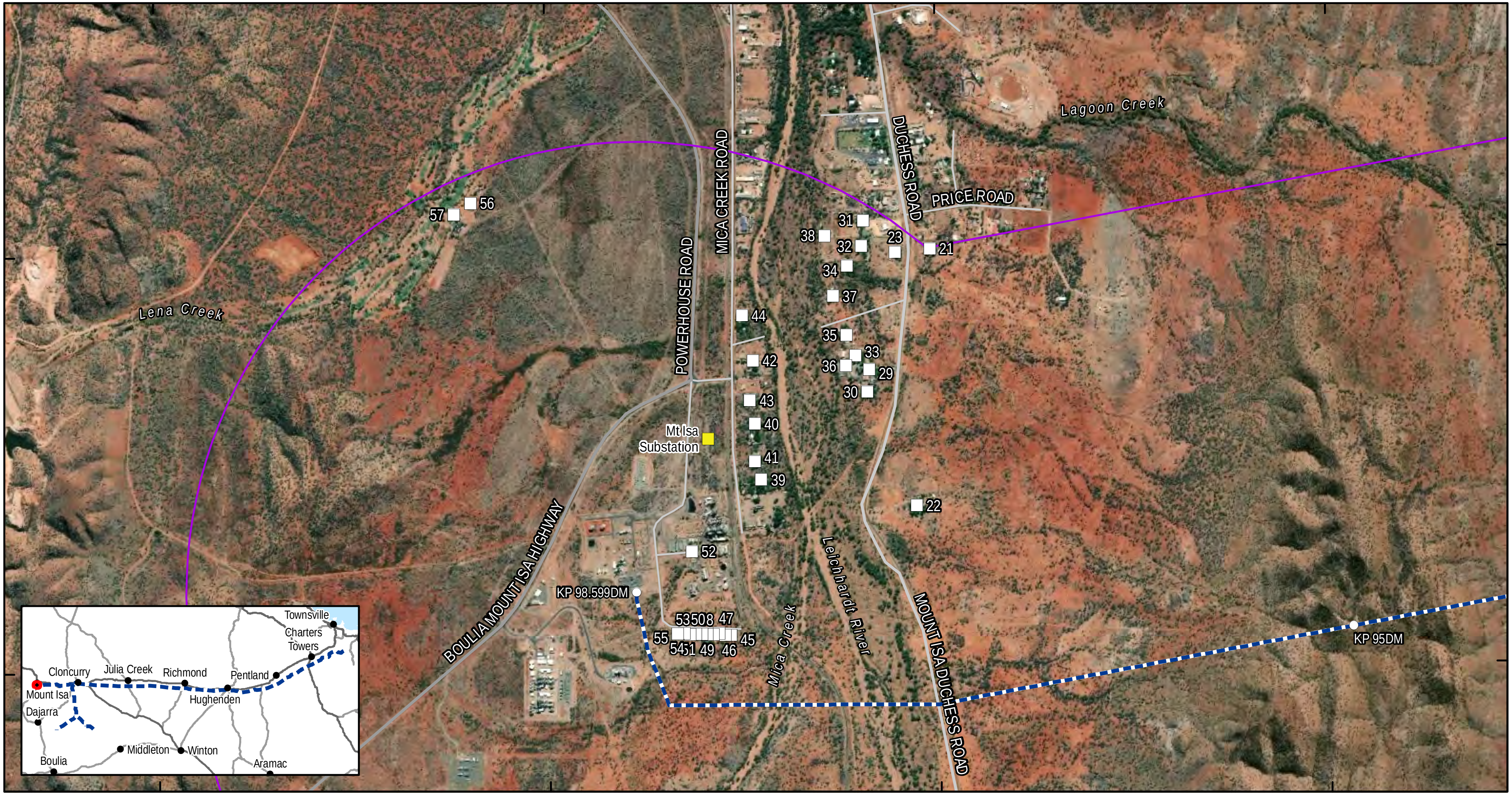
WKSP Sensitive_Receptors_RevE

CopperString 2.0 EIS

Figure **10-2**O - Sensitive receptors -Air **q**uality **a**ssessment

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- Sensitive Receptor within 2km
- Proposed Substation
- Kilometre Post
- CopperString Alignment
- 2 km buffer
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street

0 250 500 750

Metres

Coordinate System
GDA 1994 MGA Zone 54

Notes/Data Sources
Original page size: A4 landscape
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© Commonwealth of Australia (Geoscience Australia) 2020
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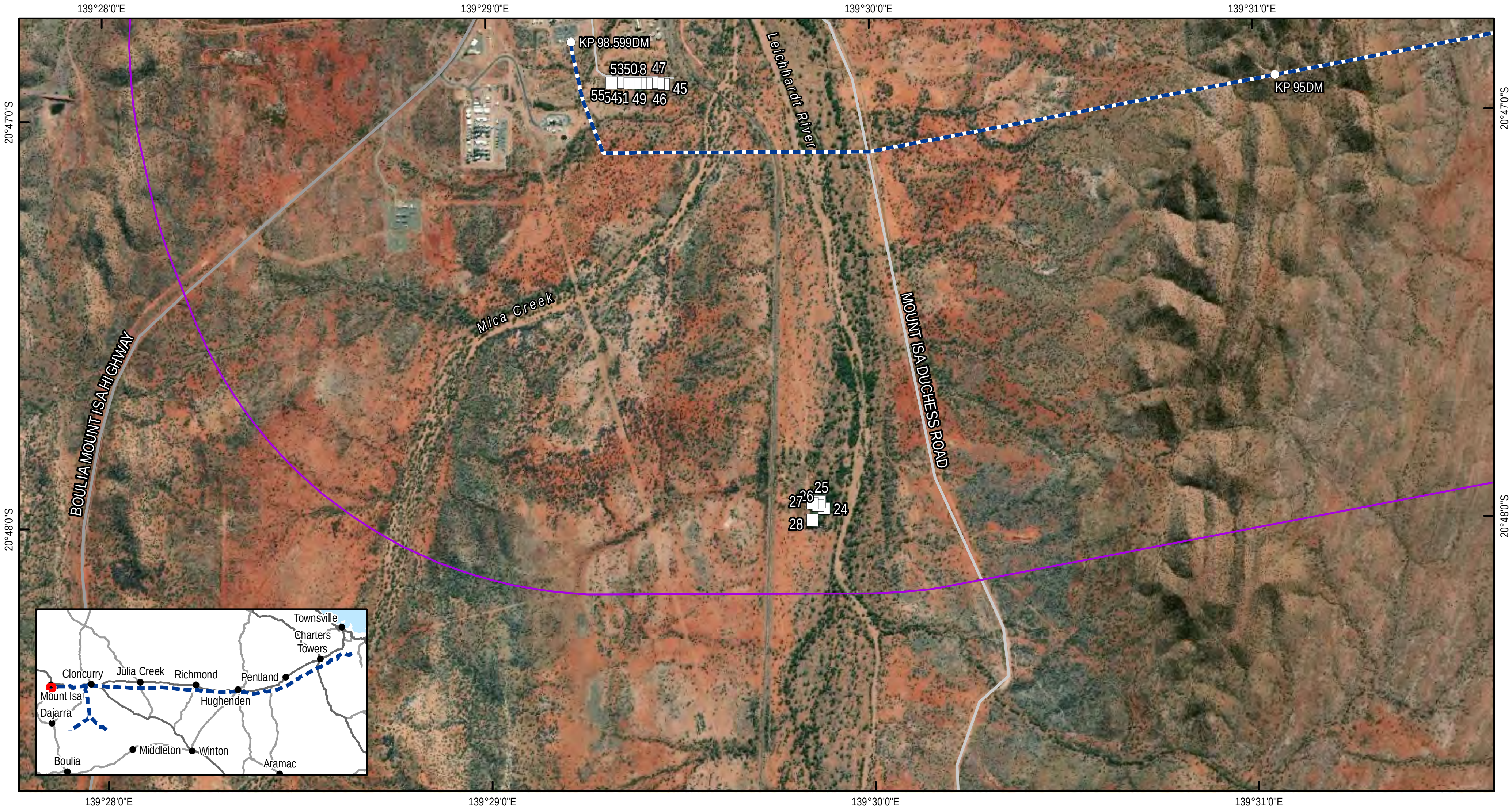
WKSP Sensitive_Receptors_RevE

CopperString 2.0 EIS

Figure **10-2**P - Sensitive receptors -Air **q**uality **a**ssessment

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ



Legend

- Sensitive Receptor within 2km
- Kilometre Post
- CopperString Alignment
- 2 km buffer
- Railway
- Highway
- Secondary Road
- Local Connector Road
- Street

0 250 500 750
Metres
Coordinate System
GDA 1994 MGA Zone 54

Notes/Data Sources
Original page size: A4 landscape
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WKSP Sensitive_Receptors_RevE

CopperString 2.0 EIS

Figure **10-2**Q - Sensitive receptors -Air **q**uality **a**ssessment

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ

1.3.3 Meteorological regions

Data from eight Bureau of Meteorology (BoM) weather stations, located within proximity to the corridor selection were assessed to obtain a baseline for existing meteorology. These stations were chosen as relevant to the study area based on their location and are described in Table 10-5, and shown in Figure 10-3. Measurements from these stations are used to describe the existing environment in Sections 10.3.4 to 10.3.5.

Table 10-5 BoM weather stations

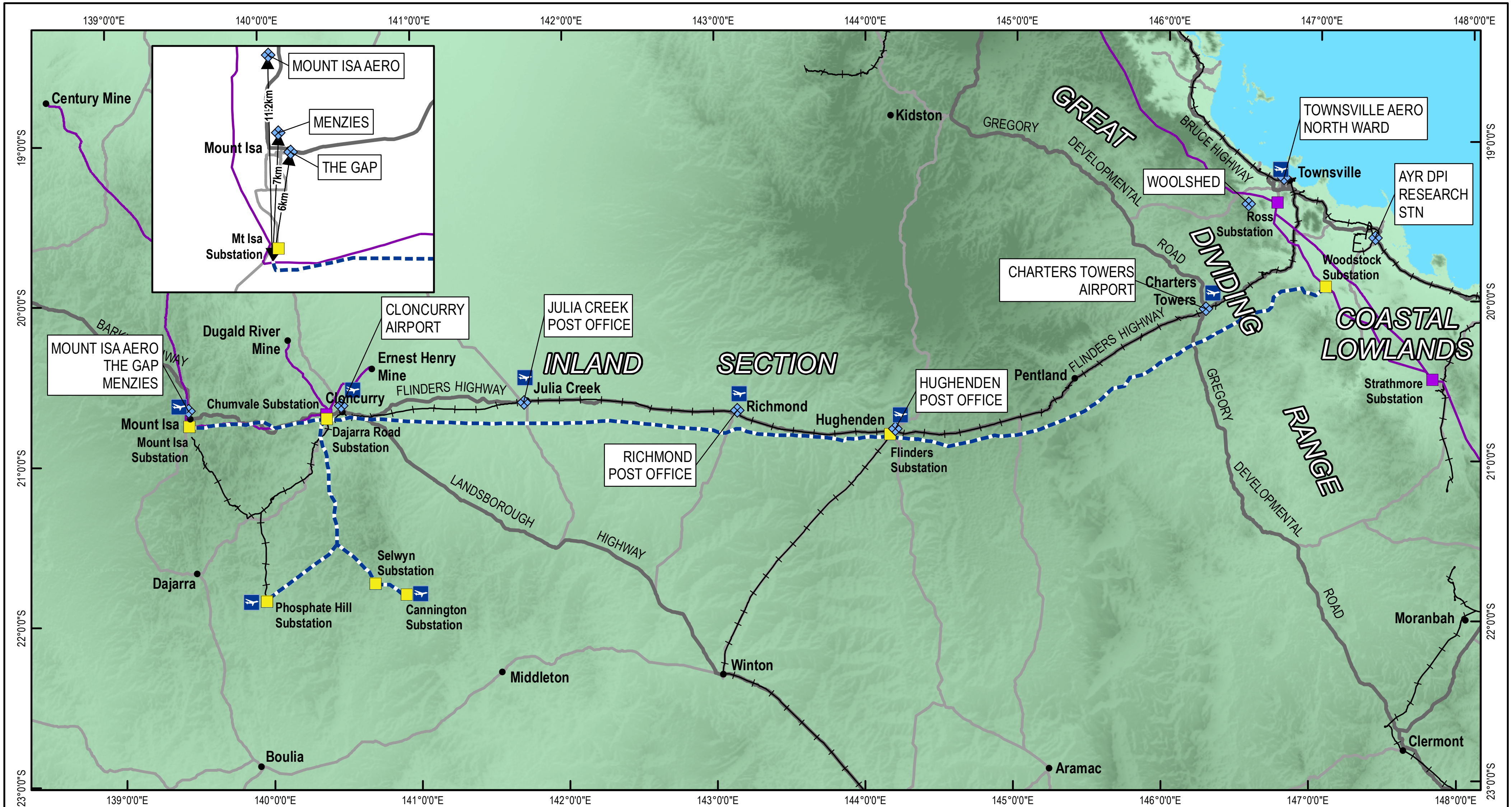
BoM weather station	Description	Observations commenced	Coordinates (GDA94 Zones 54-55) (m)			Elevation (m above sea level)
			Zone	Easting	Northing	
33002	Ayr DPI Research Centre	1951	55	147.38	-19.62	17
32040	Townsville Aero	1940		146.77	-19.25	4
33307	Woolshed	1998		146.54	-19.42	556
34084	Charters Towers Airport	1942		146.27	-20.05	290
30024[1]	Hughenden Post Office	1884		144.20	-20.84	324
30045	Richmond Post Office	1889	54	143.14	-20.73	211
29025[2]	Julia Creek Post Office	1912		141.75	-20.66	123
29141	Cloncurry Airport	1978		140.51	-20.67	186
29127	Mount Isa Aero	1966		139.49	-20.68	340

1. Data available to 2001
2. Data available to 2011

The corridor selection traverses a number of meteorological regions including the:

- Coastal Lowlands, which encompasses the western most corridor section and includes the Woodstock Substation and surrounding land towards the coast.
- Great Dividing Range, which encompasses the majority of the Renewable Energy Hub including, from east to west, the Charters Towers South Controlled Environment Vault (CEV), Pentland South CEV, Warreah South CEV and Flinders Substation. The Kennedy Connection is located at the intersection of the Great Dividing Range meteorological region and the Flinders River Catchment meteorological region described below.
- Flinders River Catchment, encompassing the CopperString Core including, from the east, Barabon CEV, Nonda CEV, Gilliat CEV and Dajarra Road Substation. To the west, the Kennedy Connection sits at the intersection of the Great Dividing Range meteorological region.
- North West Highlands Bioregion, encompassing from north to south, Mount Isa Augmentation, Southern Connection, Cannington Connection and Phosphate Hill Connection.

These areas have been defined to assist in the description of the meteorological parameters described below that may affect sensitive receptors as a result of the Project (see Figure 10-3).



Legend

- Airfield
- Weather Station
- Proposed Substation
- Existing Substation
- CopperString Corridor
- Existing Transmission Line (>= 220kV)
- Railway
- Highway
- Secondary Road

0 20 40 60 80 100
Kilometres
Coordinate System
MGA1994 Zone 54\55

Notes/Data Sources
Original page size: A4 landscape

WKSP Weather_Stations_RevC

CopperString 2.0 EIS

Figure 10-3 - BoM weather stations

COPPERSTRING 2.0
BORN, BRED & OWNED IN NQ

Coastal Lowlands

The Coastal Lowlands section of the Project lies between the Woodstock Substation in the east and the Great Dividing Range. The meteorology of this section of the corridor selection is characterised by data from the Townsville Aero BoM station and the Ayr Department of Primary Industries Research Centre station (Figure 10-3). These BoM stations can provide an understanding of the influence of the ocean on the meteorology along the corridor.

The meteorology of the Coastal Lowlands is tropical. Summers are generally hot, wet and humid with afternoon sea breezes. South-east trade winds characterise the winter months with fine weather and relatively cooler nights.

Humid weather, as is experienced in summer in the Coastal Lowlands meteorological region, can cause agglomeration of ultrafine particles in the atmosphere and lead to the formation of haze, however a high level or particulate matter in the atmosphere is required for this to occur, and is therefore unlikely given the relatively low population density of this region compared to Beijing, for example. Coastal breezes experienced in this meteorological region may assist in dispersing airborne particulate matter and gaseous emissions.

Great Dividing Range

Westward from the Coastal Lowlands, the corridor selection rises in elevation and crosses the Great Dividing Range. The influence of the elevated range on meteorology is characterised by data from the Woolshed and Charters Towers Aero BoM stations. The western margin of the Great Dividing Range is represented by the Hughenden Post Office BoM station (Figure 10-3).

The meteorology of the Great Dividing Range is similar to the Coastal Lowlands, although the elevation (>500 metres at Woolshed BoM station) results in reduced temperature and high relative humidity. North-easterly to south-easterly winds dominate the wind profile of the Great Dividing Range meteorological region.

Reduced temperatures compared to those experienced in the Coastal Lowlands meteorological region, coupled with the location further in land result in slightly reduced wind speeds. Lower wind speeds have a reduced ability to entrain larger particles into the air column and therefore results in lower dispersion of particulate matter.

Flinders River Catchment

This region is characterised by undulating plains within the Flinders River Catchment and may experience seasonal flooding. The meteorology is reflected in data recorded at Hughenden Post Office BoM station in the east, Richmond and Julia Creek Post Office BoM stations in the middle section of the region and Cloncurry Aero BoM station in the west (Figure 10-3).

Generally, the inland sections are characterised by hotter maximum temperatures, lower relative humidity and reduced rainfall comparative to the Coastal lowlands. During the summer months, the temperature can exceed 40°C on a number of days. Similarly, the Great Dividing Range meteorological region, north-easterly to south-easterly winds dominate the wind profile of the Flinders River Catchment. Wind speeds are variable across the four BoM stations, demonstrating the influence of local topography and land use on small scale meteorological systems.

North West Highlands Bioregion

The Mount Isa section consists of rugged hills and undulating valleys. The meteorology is represented by the monitoring records from the Mount Isa Aero BoM station. This meteorological region commences west of Cloncurry and extends across the remainder of the proposed corridor section from Dajarra Road to Mount Isa.

The North West Highlands Bioregion has a higher elevation than the Flinders River Catchment, which tends to slightly reduce maximum temperatures.

Further inland, the ocean cannot regulate diurnal temperature profiles, and dispersion is encouraged as a result of differences in temperature and pressure. The topography of the region also influences wind speed, causing strong downhill gusts.

10.3.4 Wind speed and direction

Wind speed and direction have been captured by data recorded at the nine BoM stations described above. These are provided by BoM in the form of mean 9:00 am and 3:00 pm wind speed versus wind direction plots, known as wind roses. The annual wind roses are shown below for the eight BoM stations and a summary description of the prevailing winds is provided for each.

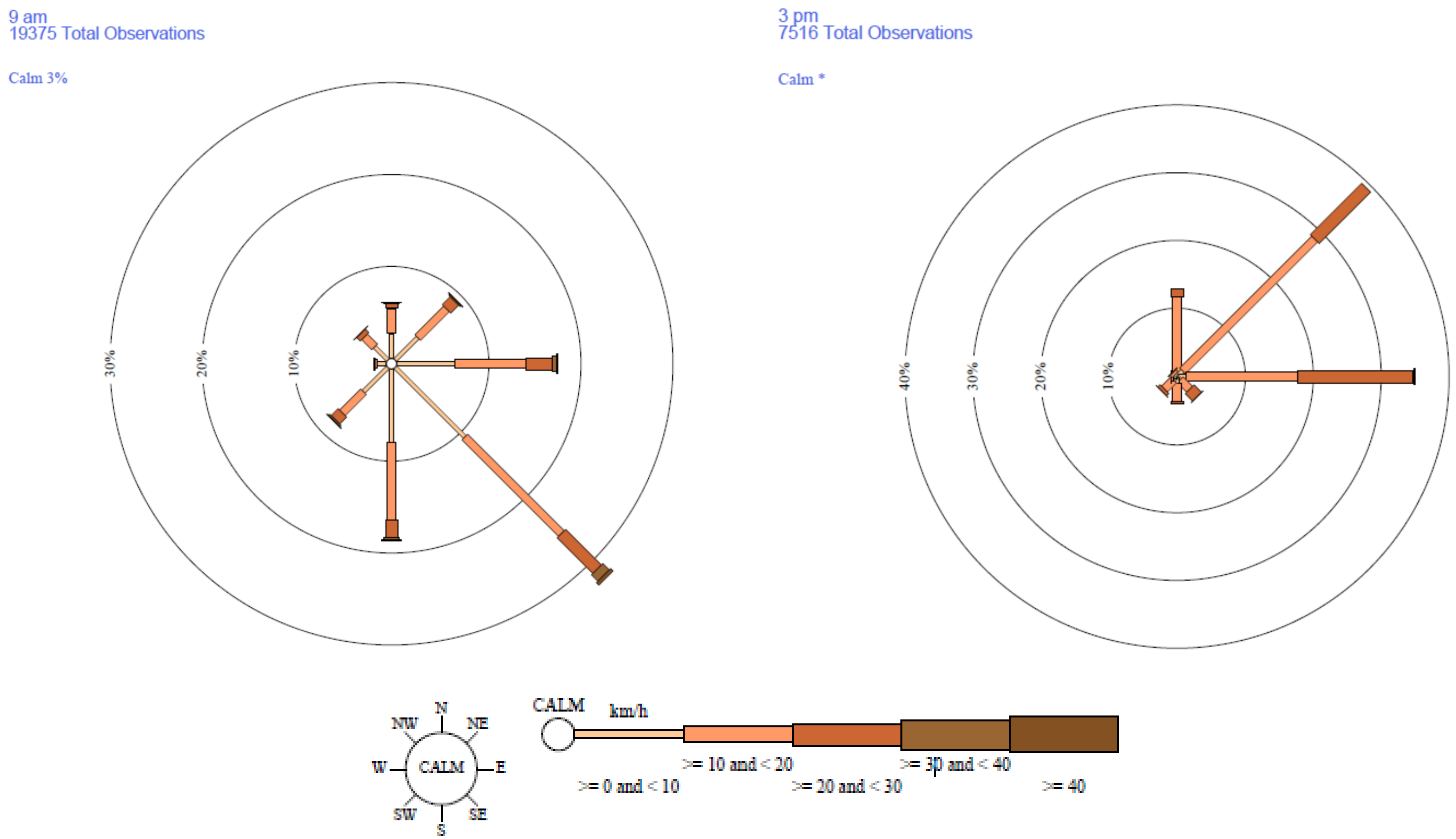


Figure 10-4 Ayr Research Station BoM station wind roses

Further from the corridor selection, the Ayr Research Station BoM Station provides an understanding of the basline wind profile of the Coastal Lowlands. However, local winds recorded at the station are unlikely to affect the dispersion of pollutants associated with the Project. The mean 9:00 am Ayr Research Station wind rose shows a predominant south-easterly wind.The mean 3:00 pm Ayr Research Station wind rose shows two wind components from the north-east and easterly directions. hese winds are unlikely to affect the dispersion of pollutants associated with the Project at the sensitive receptor locations (residential receptors 1 to 3).

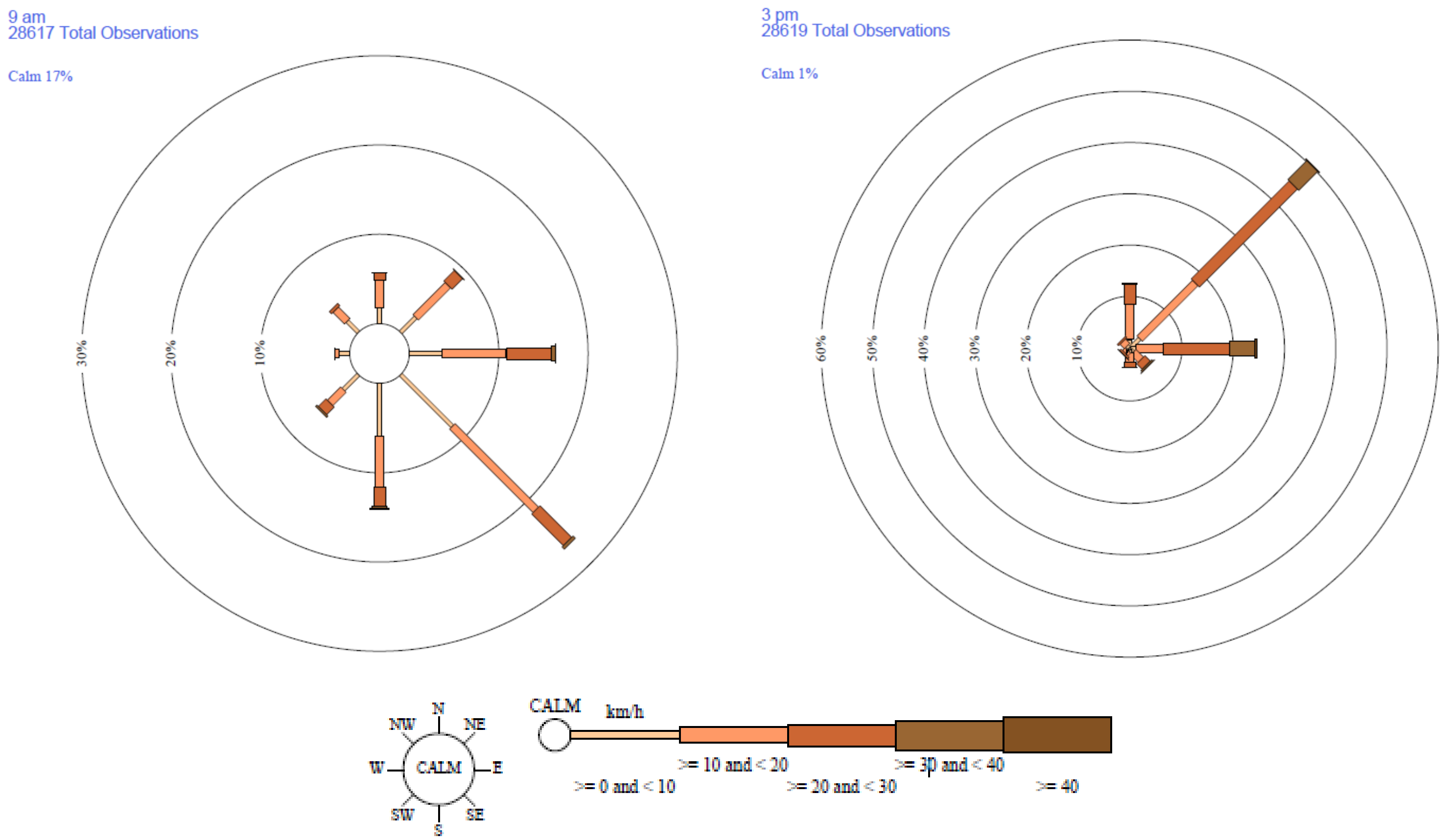


Figure 10-5 Townsville Aero BoM station wind roses

Further from the selection corridor, the Townsville Aero BoM Station provides an understanding of the basline wind profile of the Coastal Lowlands. However, local winds recorded at the station are unlikely to affect the dispersion of pollutants associated with the Project. The mean 9:00 am Townsville wind rose shows a dominant south-easterly wind and the mean 3:00 pm Townsville wind rose shows a dominant north-easterly wind. Similar to the Ayr Research Station, these winds are unlikely to affect the dispersion of pollutants associated with the Project at the sensitive receptor locations (residential receptors 1 to 3).

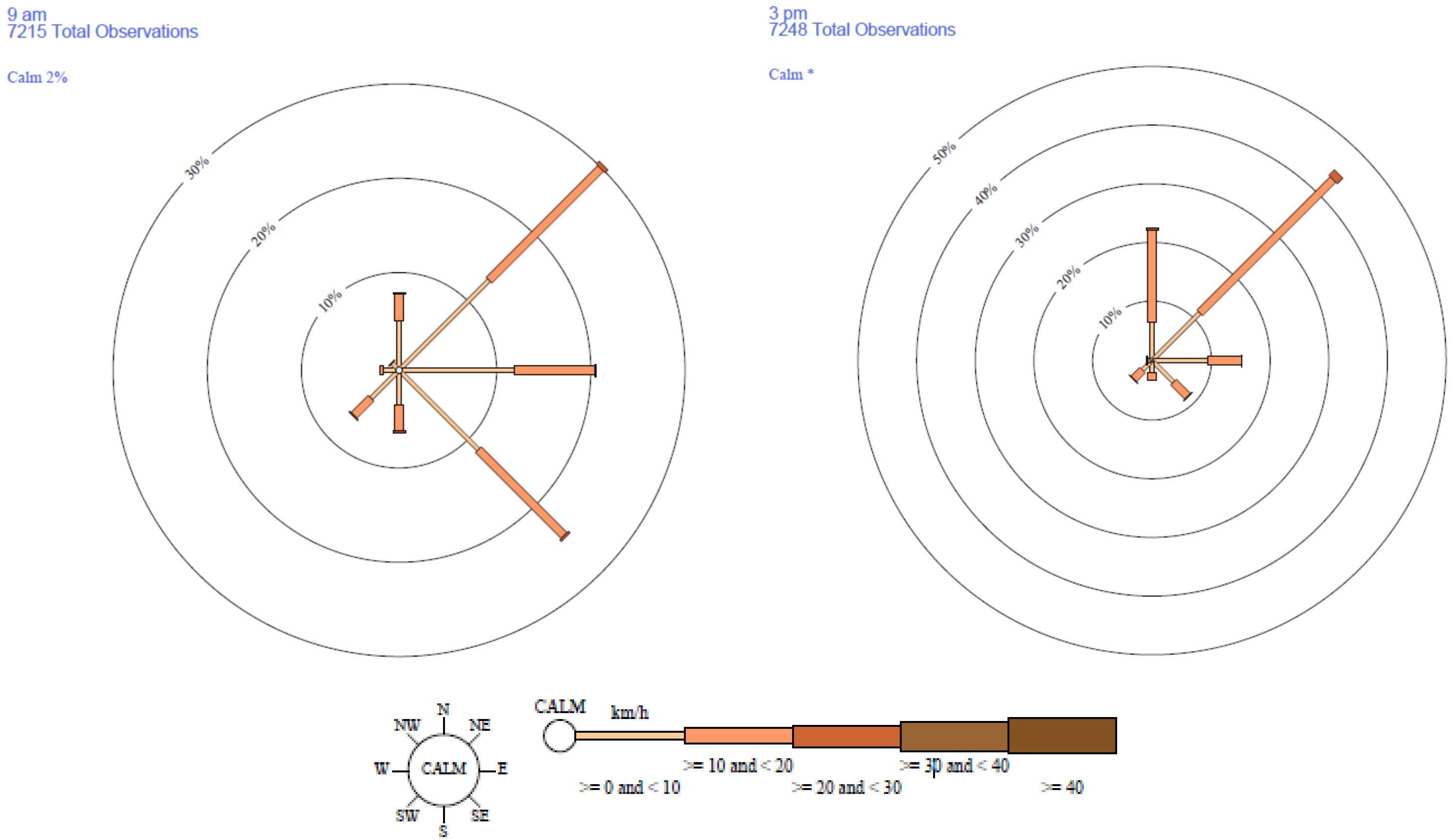


Figure 10-6 Woolshed BoM station wind roses

The mean 9:00 am Woolshed wind rose shows a dominant north-easterly wind, with secondary south-east and easterly wind components. The mean 3:00 pm Woolshed wind rose shows a predominant north-easterly wind. The north-easterly winds may carry air pollutants such as construction dust associated with the Project to the nearby sensitive receptors along the corridor selection (residential receptors 1 to 3). However, as the Woolshed station is within close proximity to the coast, wind speeds are likley to rapidly decrease further inland where the sensitive receptors (1 to 3) reside and therefore have lower potential to carry airborne particles of dust long distances.

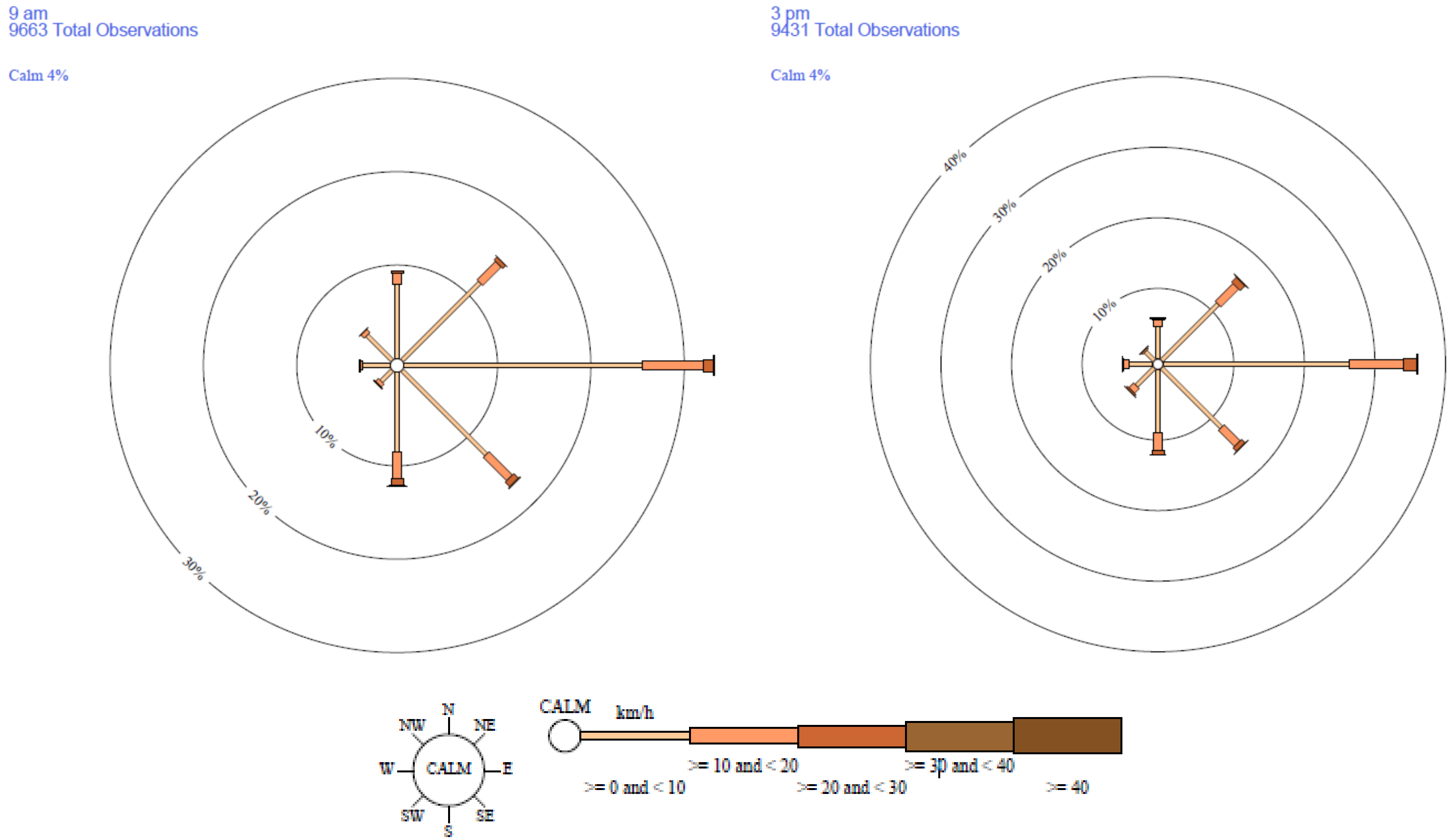


Figure 10-7 Charters Towers Airport BoM station wind roses

The Charters Towers mean 9:00 am wind rose and mean 3:00 pm wind rose both show a dominant easterly wind. The nearby sensitive receptors (4 to 6) are situated north-west of the corridor selection (residential receptors 4 to 6). Therefore, the predominant strong easterly winds, and secondary south-easterly winds may carry air pollutants associated with the Project to the sensitive receptors.

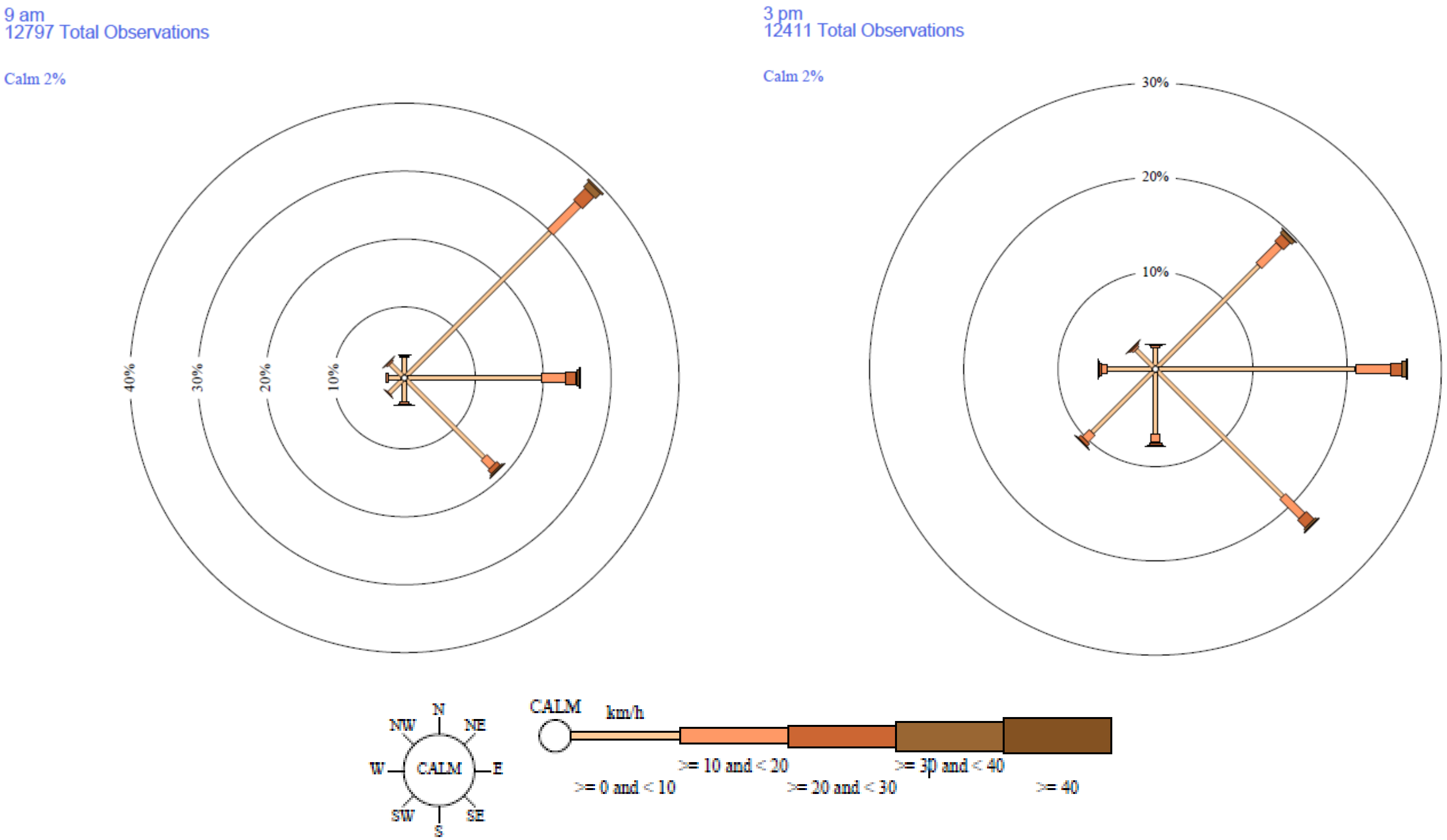


Figure 10-8 Hughenden Post Office BoM station wind roses

The mean 9:00 am Hughenden Post Office wind rose shows a dominant north-easterly wind. The nearby sensitive receptors are south of the corridor selection (residential receptors 7 and 8). Therefore, the dominant north-easterly wind may carry air pollutants associated with the Project towards the sensitive receptors. The mean 3:00 pm Hughenden Post Office wind rose shows three wind components: north-easterly, easterly and south-easterly. The north-easterly wind in the afternoon may carry air pollutants associated with the Project towards the sensitive receptors (7 and 8). It is noteworthy that wind speeds above 20 km/hr occur less than 10 percent of the time in each direction, reducing the ability of the wind to carry larger particulates far from the source.

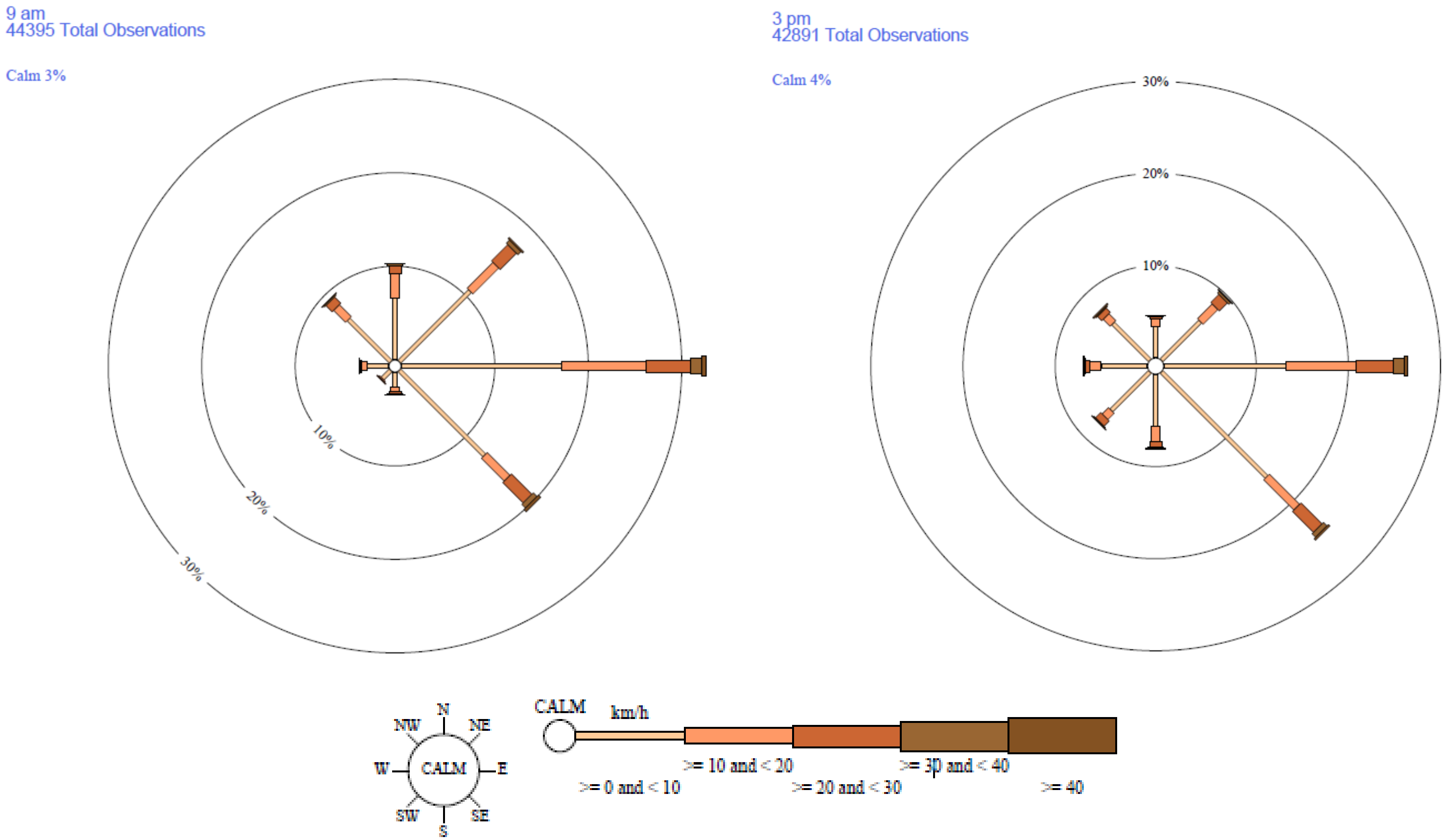


Figure 10-9 Richmond Post Office BoM station wind roses

The mean 9:00 am Richmond Post Office wind rose shows a predominant easterly wind, with secondary north-east and south-easterly components. Nearby sensitive receptors north or south of the corridor selection (residential receptors 9 to 13) may be affected by the dispersion of pollutants associated with the Project depending on the north or south component of the wind.The 3:00 pm Richmond Post Office wind rose shows a dominant easterly component and a south-easterly component. The south-easterly winds may carry air pollutants from the Project towards the sensitive receptors located north of the corridor selection (residential receptors 10, 11 and 13).

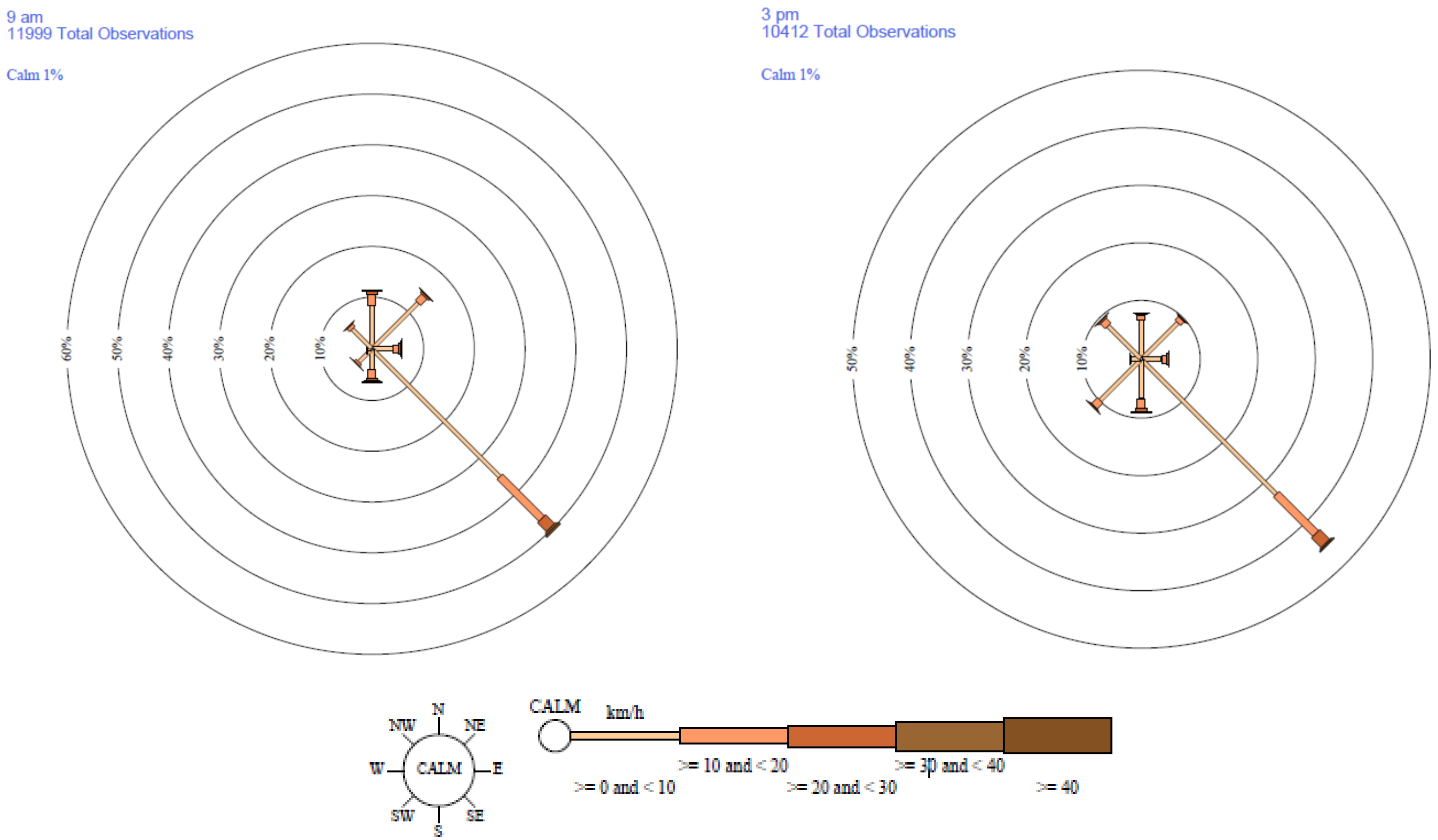


Figure 10-10 Julia Creek Post Office BoM station wind roses

The mean 9:00 am and 3.00 pm Julia Creek Post Office wind roses both show a predominant south- wind.north-westerlywesterlyThe nearby sensitive receptors are south of the corridor selection (residential receptors 14 to 16), and therefore it is unlikley that the sensitive receptors will be affected by dispersion of pollutants associated with the Project.

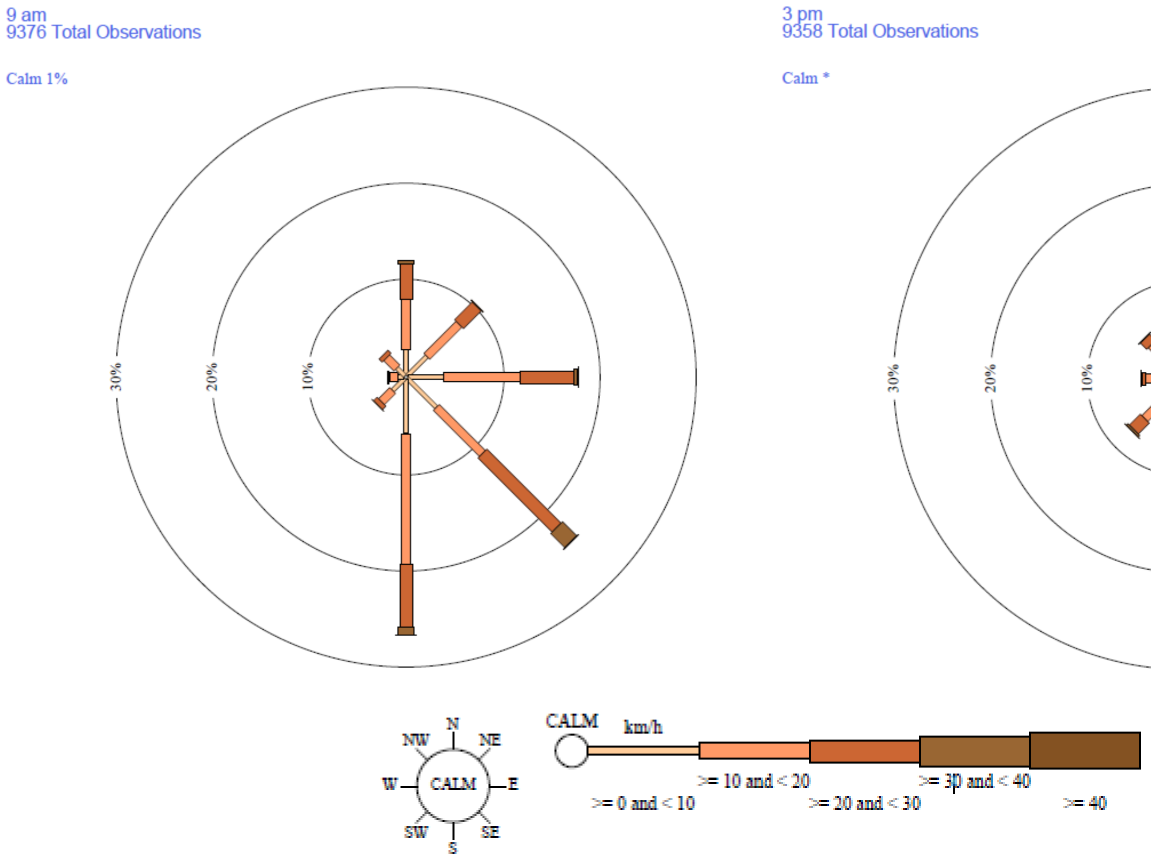


Figure 10-11 Cloncurry Airport BoM station wind roses

The mean 9:00 am wind rose shows variable winds from westerly directions, with a dominant southerly component. Similarly, the mean 3:00 pm wind rose shows variable winds from the west and south, with a predominant south-westerly component. As the proposed corridor selection is south of the sensitive receptors (residential receptors 18 to 20), the southerly winds may carry air pollutants associated with the Project towards these sensitive receptors. Residential receptor number 17 is unlikely to be affected as it is situated south of the corridor selection.

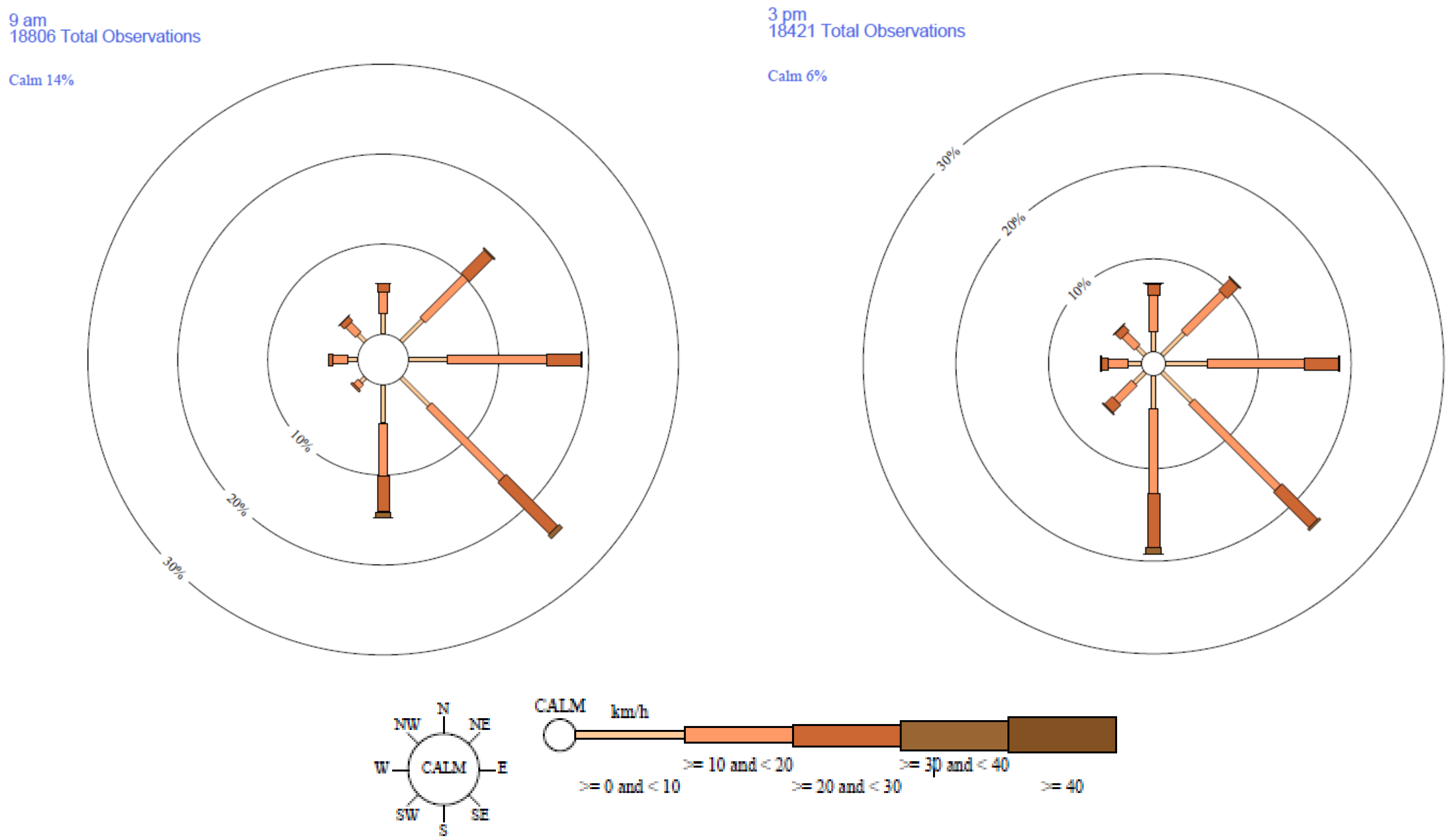


Figure 10-12 Mount Isa Aero BoM station wind roses

The mean 9:00 am wind rose shows variable winds from easterly directions and the south, with a predominant south-easterly component. Similarly, the mean 3:00 pm wind rose shows variable winds from the west and south, with a predominant south-easterly component. As the proposed corridor selection is south of the sensitive receptors (residential receptors 21 to 51 and 53 to 56), the southerly winds may carry air pollutants associated with the Project towards the sensitive receptors.

10.3.5 Rainfall

Queensland's sub-tropical climate sees two seasons – the wet season from October to May and a relatively dry season through the middle of the year. Figure 10-13 graphically describes monthly average rainfall recorded at the eight BoM stations. Rainfall peaks at most BoM stations in January or February and is relatively low from April to September, before increasing again in October.

During the wet season, dust impacts from construction of the Project may be mitigated by the natural wetting of open areas or other dust sources from seasonal rain. During the dry season however, mitigation measures may be required in order to reduce dust impacts associated with construction of the Project.

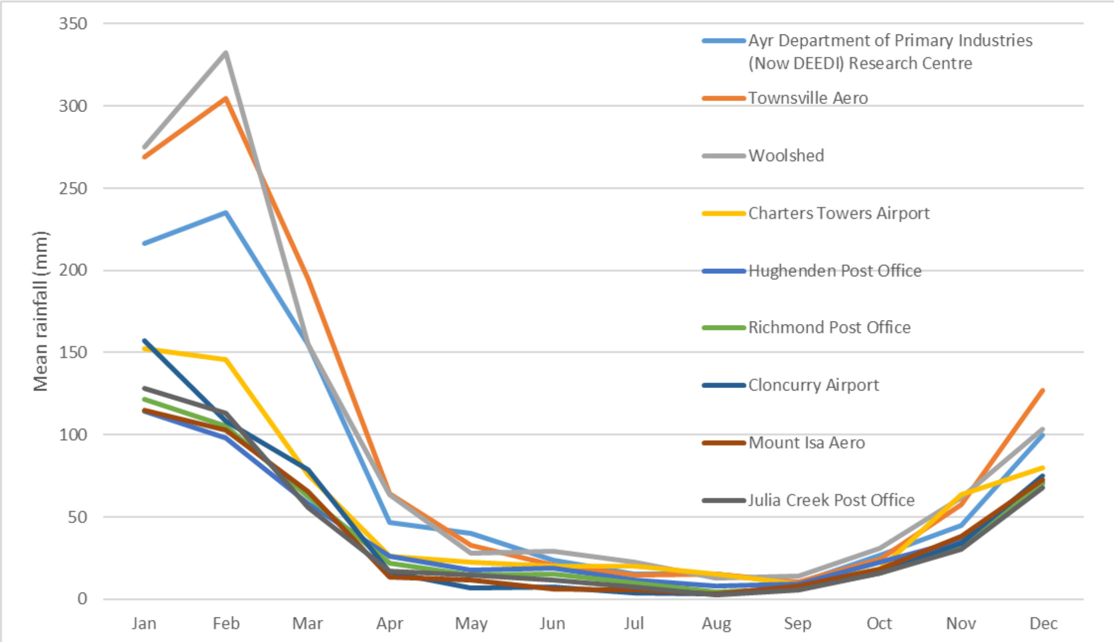


Figure 10-13 Average monthly rainfall recorded at BoM stations

10.3.6 Background air quality

The Queensland Government carry out ambient air monitoring across the state with a network of ambient air quality monitoring stations (AAQMS) installed in various locations in south-east Queensland, south-west Queensland, Gladstone, central Queensland, Townsville and Mount Isa. The locations of the AAQMS were reviewed and it was determined that ambient air quality monitoring along the majority of the corridor selection is not available. However, two AAQMS were found to reside within proximity of the Mount Isa Augmentation corridor section and are therefore considered relevant for the characterisation of existing background air quality of the corridor section.

Maximum monthly running averages were assessed from these AAQMS to gauge the general air quality of the Mount Isa Augmentation corridor section. Data from the network were available from the year 2016, however individual sites were commissioned at different times and periods of no data were also observed, and hence the datasets were not continuous. However, the results presented here are considered generally representative of maximum air quality conditions of the area. Charts showing the maximum monthly running average for each pollutant recorded at each AAQMS are shown below.

Additional monitoring data was determined not to be required due to the existing land uses in across the Project and the temporary localised nature of any potential Project construction related impacts.

Mount Isa AAQMS

The two Mount Isa AAQMS are Menzies (2000-2020) and The Gap (from 2009).

PM_{10}

PM_{10} is monitored at The Gap AAQMS only. Figures for PM_{10} data are shown In Figure 10-14 and Figure 10-15.

Available data for The Gap AAQMS show PM_{10} concentrations are sometimes below the 24-hour EPP (Air) criterion of 50 μg/m^3 with exceptions to this occurring in August-November 2018, and January-April and August-September 2019.

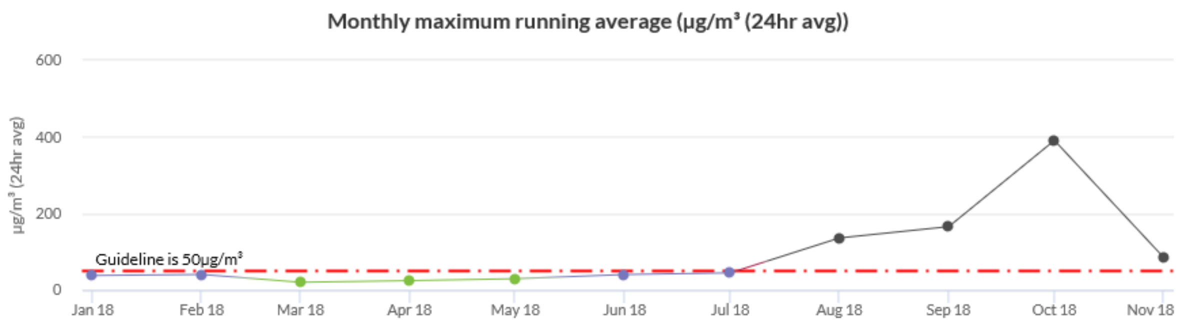


Figure 10-14 PM_{10} The Gap, Mount Isa year 2018

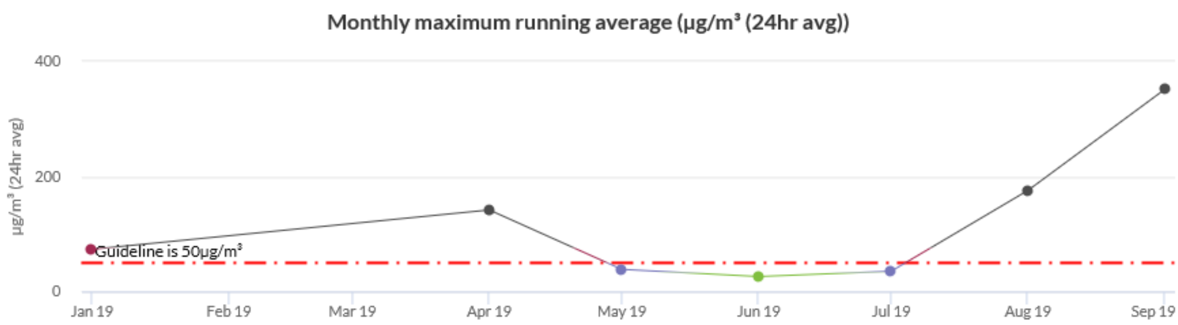


Figure 10-15 PM_{10} The Gap, Mount Isa year 2019

Sulphur dioxide

SO_2 is monitored at both Mount Isa AAQMS and are shown in Figure 10-16 and Figure 10-17 for Menzies and Figure 10-18 and Figure 10-19 for The Gap.

Available data for Menzies AAQMS show SO_2 concentrations are generally above the 1-hour EPP (Air) criterion of 250 μg/m^3. Concentrations were recorded below the criteria in March-June 2018 and April-May, July, and September 2019.

Available data for The Gap AAQMS show SO_2 concentrations are sometimes below the 1-hour EPP (Air) criterion of 570 μg/m^3. Concentrations were recorded above the criteria in January, July-August and October-November in 2018, and January, April, June and August-September 2019.

As the population density and land use of Mount Isa differs to the rest of the corridor selection, the air quality presented here cannot be used to represent the air quality of the entire project. As population density is extremely low along the majority of the corridor selection in comparison to Mount Isa, it is expected that concentrations of PM_{10}, SO_2 and other airborne pollutants across the majority of the corridor selection are low.

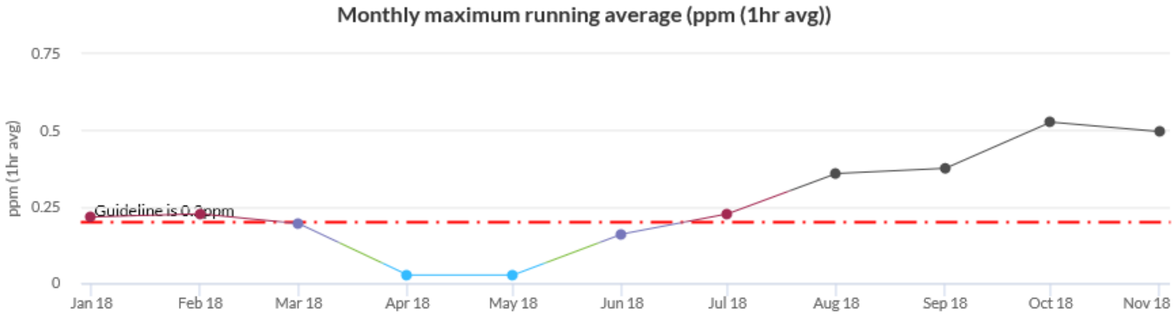


Figure 10-16 SO_2 Menzies, Mount Isa year 2018

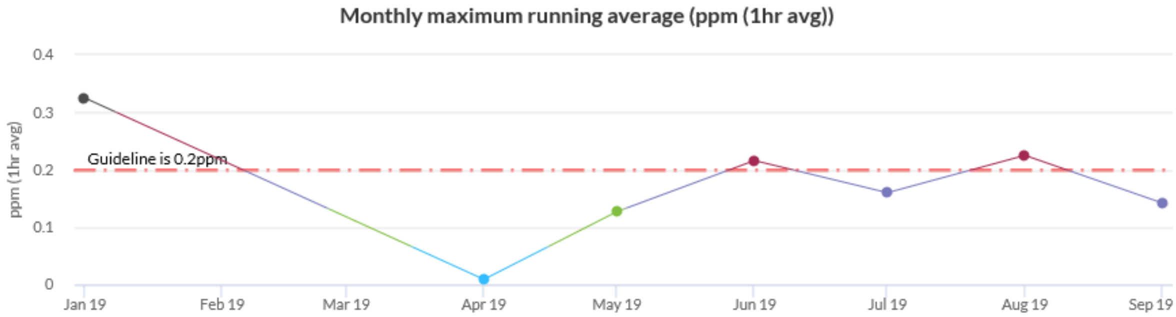


Figure 10-17 SO_2 Menzies, Mount Isa year 2019

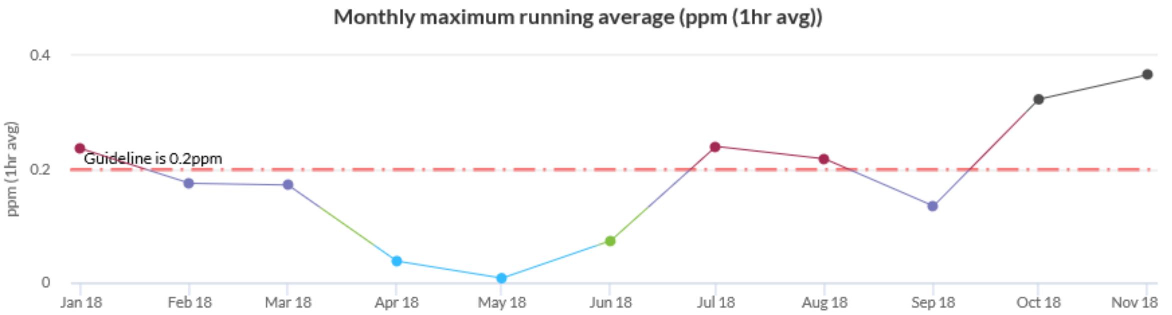


Figure 10-18 SO_2 The Gap, Mount Isa year 2018

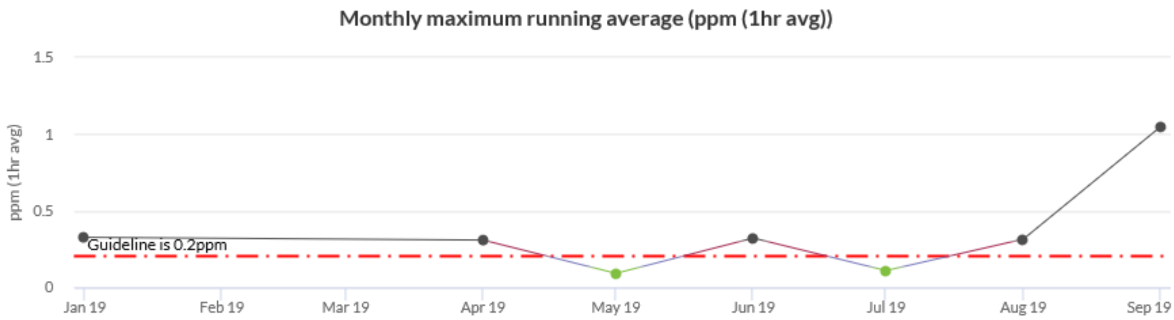


Figure 10-19 SO_2 The Gap, Mount Isa year 2019

10.3.7 Recommendations

Based on the review of the existing environment (Section 10.3), no significant risk areas have been identified associated with the Project in terms of air quality. The background air quality in Mount Isa occasionally experiences elevated levels of SO_2 and PM_{10}. As the population density and land use of Mount Isa differs to the rest of the corridor selection, the air quality presented here cannot be used to represent the air quality of the entire project. As population density is extremely low along the majority of the corridor selection in comparison to Mount Isa, it is expected that concentrations of PM_{10}, SO_2 and other airborne pollutants across the majority of the corridor selection, do not experience elevated levels of pollutants.

The following sections review the likely construction and operational emissions associated with the Project and include mitigation and management measures for the protection of air quality values.

10.4 Impact assessment and mitigation measures

10.4.1 Design response

Overall design responses include routine measures to reduce impacts to air quality. The following responses are recommended to protect the environmental values of air.

- As far as is practicable, construction access to the corridor selection will utilise existing roads and access tracks as agreed with the landowner.
- As far as is practicable, construction access routes which have to accommodate medium to high frequency vehicle traffic, will be controlled in accordance with the Field Development Plan and local council standards for roads or as agreed with the landowner where required on private property.
- Vegetation clearing for construction will be undertaken to minimise excessive ground disturbance and kept to the minimum extent possible in accordance with the Field Development Plan. The height and position of transmission towers will be specifically designed to respond to the six general landscape types which occur across the study area. The landscape types are based on remnant broad vegetation groups (BVG) mapped and other features such as watercourses.
- Where vegetation clearing is required for temporary infrastructure the cleared areas will be rehabilitated as required in line with the Field Development Plan.

The Project involves two distinct phases which may result in emissions to air. These are:

- Construction of the transmission line, substations and related infrastructure including commissioning.
- Operation of the transmission line, including upset conditions, maintenance, repair and decommissioning.

The following sections outline common air pollutants associated with construction and operation of the Project.

10.4.2 Construction

Several different air pollutants may be released during construction of the Project and associated infrastructure. These include dust emissions (particulate matter) and gaseous emissions from operating equipment and vehicles (nitrogen oxides, sulphur oxides, carbon monoxide, exhaust particulates, some trace substances including unburnt hydrocarbons).

These emissions come from several sources. Particulate (dust) emissions are the main pollutant of concern and can be either fugitive or point source-related.

- Fugitive dust can be generated mechanically, by disturbance of the ground through excavating, dozing, loading and unloading of material, or as wheel-generated dust from vehicles travelling on unsealed roads and temporary access tracks along the corridor selection. Windblown eroded dust is another source of fugitive dust emissions, and this can be from un-stabilised stockpiles of material, bare or exposed ground or from uncovered truck loads.
- Point sources of particulates include exhaust from combustion engines such as generators, transport vehicles and excavation equipment.

Gaseous emissions (such as NO_2 and SO_2) are associated with combustion engines in the form of diesel generators or motor vehicles and are either point sources or transient in nature. Gaseous emissions are expected to be minor and confined to emissions from vehicle exhaust.

The following sections examine potential air emissions associated with the construction of different Project components.

Impacts to environmental values

The impacts outlined Table 10-6 to the environmental values described in the EPP (Air).

Table 10-6 Impacts to environmental values

Environmental value	Impacts to environmental values
The qualities of the air environment that are conducive to protecting the health and biodiversity of ecosystems	Temporary localised impacts associated with dust generated by construction activities and traversing access tracks. Construction activities to be undertaken during daylight hours wherever possible.
The qualities of the air environment that are conducive to human health and wellbeing	Temporary localised impacts associated with dust generated by construction activities and traversing access tracks.
The qualities of the air environment that are conducive to protecting the aesthetics of the environment, including the appearance of buildings, structures and other property	Temporary localised impacts associated with dust generated by construction activities and traversing access tracks.
The qualities of the air environment that are conducive to protecting agricultural use of the environment	Temporary localised impacts associated with dust generated by construction activities and traversing access tracks. Land holders will be kept informed of activities on their properties.

Access roads

The construction of access tracks associated with the Project may require the following activities that have potential to adversely affect the local air quality:

- Vegetation clearing of dense woody vegetation. This would involve bulldozing and broad acre mulching and hand clearing methods (chainsaws and similar).

- Where clearing is unavoidable in areas of sparse woody vegetation or environmentally sensitive areas, vegetation clearing or trimming will be conducted by hand methods. There is a commitment to consider the landscape types mapped during the design stage to reduce clearing to a minimum as far as is practicable, which will mitigate associated emissions to air.
- Fugitive dust emissions generated from driving vehicles along access tracks. Tracks along the corridor selection will be predominantly established following the compaction of the surface from construction vehicles which will be restricted to a designated right of way.

Transmission line

The construction of the transmission line component of the Project would require the following activities that have potential to adversely affect the local air quality.

- Vegetation clearing along the corridor selection – this would involve bulldozing and broad acre mulching and hand clearing methods (chainsaws and similar). Where clearing is unavoidable in areas of sparse woody vegetation or environmentally sensitive areas, vegetation clearing or trimming will be conducted by hand methods. There is a commitment to consider the landscape types mapped during the design stage to reduce clearing to a minimum as far as is practicable, which will mitigate associated emissions to air.
- Construction of access roads – the Project will utilise the existing road network as far as practicable, although some new tracks will be required to provide access for construction and maintenance teams. Tracks along the corridor selection will be predominantly established following the compaction of the surface from construction vehicles which will be restricted to a designated right of way. Tracks that are not required for future maintenance access and will be rehabilitated to minimise wind-blown dust. Watering of access roads near homesteads and sensitive receptors during construction periods will minimise dust and nuisance air emissions from vehicular movement. Speed restrictions will also be enforced on access tracks.
  Due to the rural nature of the Project, there is likely to be a significant buffer between the location of access tracks and the closest sensitive receptors, which moderates the risk of impact.
- Earthworks for the installation of towers – clearing of vegetation will occur immediately before foundation works begin. The foundation works for each tower site will be completed in approximately two to five days. The installation of foundations will occur in a process of excavation or boring, forming and pouring of concrete.
  Concrete will be brought to each site from concrete batching plants within the local area. These plants may be existing plants providing concrete under contract or be mobile and temporary established for the duration of the construction period in a particular construction laydown / work area.
  It is expected that up to three bores per day per rig will be completed. The duration of particulate emissions from site preparation will be minor and the emissions from concrete batching plants are discussed below.
- Erection of the towers – materials will be brought to site as prefabricated components and assembled into sections at the site. Following assembly, the towers sections will be erected using a work crew with site cranes. Emissions from erection of the towers are expected to be minor.
- Stringing the line – a helicopter will be used to fly the draw line from tower to tower along the line. The draw line is then detached from the helicopter and attached to the headboard used to connect the conductors and allow them to be pulled into place from the winching

station. The air emissions associated stringing the line will be resultant of exhaust emissions from the helicopter and line winching equipment.

Substation sites

The construction of substations as part of the Project is expected to occur over 18-24 months. The following activities required as part of construction of the substations have the potential to adversely affect local air quality.

- Vegetation clearing. Substation sites have generally been selected in pre-disturbed areas where minimal vegetation clearing is required. Appropriate measures will be taken to minimise disturbance as much as possible. The offsite air quality impacts are expected to be minor.
- Earthworks/civil works to ensure there is the correct platform for substation foundations including rainfall runoff and treatment areas. It is expected that the earth and civil works will have the greatest impact on air quality.
- Construction of foundations, cable ways, bunds and similar infrastructure. This is not expected to contribute significantly to air emissions.
- Construction of buildings (such as site offices and switch rooms). This is expected to have a minor impact to local air quality only.
- Construction of other structures and installation of electrical equipment. This is expected to have a minor impact to local air quality only.

CEV sites

The construction of CEVs as part of the Project is expected to occur over a relatively short time period. The following activities required as part of construction of the CEV sites have the potential to adversely affect local air quality.

- Vegetation clearing. CEV sites will be located approximately every 80 km to 120 km.. Appropriate measures will be taken to minimise disturbance as much as possible. The offsite air quality impacts are expected to be minor.
- Earthworks/civil works to ensure there is the correct platform for CEV hut foundations, and associated solar PV system. It is expected that the earth and civil works will have the greatest impact on air quality.
- Construction of foundations, cable ways, bunds and similar infrastructure. This is not expected to contribute significantly to air emissions.
- Installation of buildings (such as site offices and switch rooms). This is expected to have a minor impact to local air quality only.
- Construction of other structures and installation of electrical equipment. This is expected to have a minor impact to local air quality only.

Concrete production

The Project will require large quantities of concrete for tower and substation foundations and other concrete works within the substations. This concrete will be obtained from a series of concrete batching plants along the transmission line. Concrete has a limited travel life and needs to be locally available. Where feasible, concrete will be sourced from existing concrete batching plants. Additionally, where this is not possible, mobile and temporary batching plants will be developed next to operating batching plants in major locations to minimise environmental impact, or within construction laydown areas in remote construction locations that are beyond the travel life perimeter of the concrete. The locations of these batching plants are currently unknown and will be determined following further assessment by the Construction contractor.

Concrete batching plants can release particulate matter from several sources within the plant. The most significant source of fugitive emissions is materials handling (e.g. delivery of cement, gravel or sand) and concrete batching involving raw materials unloading. Other potential emission sources include wind erosion on stockpiles and motor vehicle movement on unpaved roads.

Buffer distances published by the Environmental Protection Authority Victoria recommend that concrete batching plants should have a minimum buffer of 100 m to sensitive receptors to protect values of the air environment (EPA Victoria 2013). Concrete batching plant locations will be finalised during the detailed design of the Project and where itinerant plants are proposed they will incorporate the 100 m buffer distance (or maximum distance recommended in any other chapter of this document) into the siting study.

Additionally, it should be noted that concrete products will only be required during construction and will be relocated as the construction schedule progresses. Concrete production will not be required during the operational phases of the Project.

A summary of potential air quality impacts associated with construction of the Project, including unmitigated and mitigated risk ratings is provided in Section 10.4.4.

10.4.3 Operation

Upon completion of construction of the transmission lines and associated infrastructure, emissions of air pollutants are expected to reduce. This is because excavation of the site and movement of materials will cease, reducing dust emissions. Therefore, air emissions during operational phases of the Project are expected to be minor.

Sources of air pollutants that will remain include some dust from open area sources associated with vegetation management. Some areas of revegetation will reduce the open area sources of dust from the construction phase. Some exhaust emissions will be generated during surveying and treating vegetation as part of vegetation management. Vegetation treatment will be triggered by ROAMES style aerial surveys that may be conducted several times per year in some areas as prescribed under the Field Development Plan.

Vehicle travel will be required to conduct routine inspection and maintenance activities several times per month. Inspections of the transmission network components will also be conducted to ensure no atypical wear, corrosion or damage has occurred to the transmission components. In addition to vehicle exhaust, there is potential for dust emissions from these vehicles travelling on any remaining unpaved roads, however, this is expected to be very minor. For tower mounted equipment inspection will be conducted by helicopter.

Point sources to remain (although expected to be reduced) include exhaust from service vehicles, which includes particulate matter as well as gaseous emissions.

Substations will not release emissions to air during operation, however backup diesel generators located at substations and CEVs will require routine testing and prolonged use during power outages, resulting in some gas and particulate emissions.

Upset conditions

Upset conditions include a failure, breakdown or malfunction of equipment. Upset conditions have the potential to cause excess emissions. The quantity of emissions during upset conditions would depend on the nature of the failure/malfunction of equipment. Although considered “abnormal operation’, due to the scale of the project, upset conditions are expected to occur on a regular basis due to lightning strike and other faults, which will require response by road vehicles, generators and/or helicopters. However, it is not expected that responses to upset conditions would cause significant adverse impact to nearby sensitive receptors.

A summary of potential air quality impacts associated with operation of the Project is provided in Section 10.4.4.

10.4.4 Summary of potential mitigation and management measures

Table 10-7 outlines routine emission management measures to be used during construction and operation activities to minimise emissions to air as far as practicable. Management and mitigation measures will be incorporated and detailed into future construction environmental management plans to be prepared by the Construction Contractor. Further details on proposed monitoring and reporting are contained in section 10.4.5 and Table 10-10

Table 10-7 Recommended emission management measures for construction and operation phases

Source/activity	Project phase	Mitigation method	Person responsible
Unpaved roads	Construction	The total length of new access tracks will be minimised as far as is practicable.	Project management
	Construction	Watering of access roads as required near homesteads or sensitive receptors in order to reduce wheel-generated and wind-blown dust.	Allocated staff members
	Construction and operation	Speed restrictions to reduce wheel-generated dust.	All staff members
	Construction and operation	Disturbed areas no longer required for access roads and construction staging areas will be restored as per the Field Development Plan.	Project management
Vehicle movement (exhaust emissions)	Construction and operation	Keep vehicles in good working order and operate according to manufacturer's instructions to avoid excessive vehicle exhaust	All staff members
Vegetation clearing	Construction	Hand clearing will be undertaken where necessary to reduce excessive ground disturbance during clearing of vegetation.	Allocated staff members
	Construction and Operation	Rehabilitation of construction sites will occur progressively as the construction process advances to minimise wind-blown dust.	Project management
Open areas/remaining un-vegetated areas	Construction and operation	Keep remaining vegetated areas to a minimum as far as is practicable to reduce risk of wind-blown dust	Project management

Source/activity	Project phase	Mitigation method	Person responsible
Transporting materials	Construction	Trucks carrying construction material will be covered to avoid sources of nuisance dust.	All staff members
Material stockpiles	Construction	Any stockpiled material will be sprayed with water carts to reduce wind-blown dust. Where stockpiled material will be untouched for more than several weeks, it will be stabilised using a stabilising agent.	Allocated staff members
Upset conditions (generator and response vehicle exhaust)	Operation	Maintain maintenance and routine inspection schedule as part of preventative maintenance	Allocated staff members
General	Construction and operation	Education - All employees are educated regarding dust management onsite, including reporting and best dust management practices.	Project management
General	Construction	Meteorological conditions - Work will occur with consideration to wind and weather forecasts and dust alerts from the BoM.	Project management
General	Construction and operation	Complaints register - A register of community complaints will be maintained. Complaints will be investigated and mitigation measures taken where necessary.	Project management

A summary of potential air quality impacts associated with the construction and operation of the Project and an estimation of their unmitigated and mitigated risk of impact is provided in Table 10-8 and Table 10-9.

Table 10-8 Potential air quality impacts associated with the construction phase

Construction activities	Associated potential impacts	Unmitigated risk rating	Mitigated risk rating
Vegetation clearing	Dust generation in the form of mechanically generated dust (excavators etc.) and wind-blown dust (from resultant cleared areas)	Moderate	Low
Vehicle movement on unpaved access roads	Dust emissions generated from vehicle wheels on unpaved roads.	Moderate	Low
Earthworks for the installation of towers and substation sites	Mechanically generated dust emissions	Moderate	Moderate[1]
Erection of the towers	Air emissions associated with erection of the towers will be limited to vehicle exhaust and crane exhaust	Low	Low[1]

Construction activities	Associated potential impacts	Unmitigated risk rating	Mitigated risk rating
Stringing the line	Air emissions associated with stringing the line will be limited to vehicle exhaust, helicopter exhaust and winch exhaust	Low	Low[1]
Construction of buildings and other infrastructure	Construction of buildings and other infrastructure will not inherently contribute to air emissions. Associated activates such as excavation/earthworks and vehicle emissions are more likely to contribute to air emissions.	Low	Low/Negligible
Concrete batching	Materials handling (e.g. delivery of cement, gravel or sand, loading/unloading of raw materials) has the potential to generate airborne dust	Moderate	Low
1. No specific mitigation measures recommended. Best practice methods should be adopted such as limiting speeds, covering loads etc.			

Table 10-9 Potential air quality impacts associated with the operational phase

Operational activities	Associated potential impacts	Unmitigated risk rating	Mitigated risk rating
Remaining un-vegetated areas	Wind-blown dust associated with un-vegetated areas necessary for operation/maintenance	Low	Low
Vehicle movement	Both wheel-generated dust and emissions from vehicle exhaust associated with operational and maintenance staff	Low	Low
Upset conditions	Reduced efficiency of pollution mitigation equipment resulting in emissions to air (dust or gas emissions)	Low	Low

1.4.4 Monitoring and reporting

PM_{10} monitoring will be undertaken using appropriate ambient air quality monitors if requested by landowners in the event of a complaint. Air quality will be monitored against the dust deposition goal of 120 mg/m^2/day averaged over a month as outlined in Table 10-2. Should air quality complaints be received, an investigation into the cause of the complaint will be undertaken and suitable dust control measures as described in Table 10-7 will be implemented.

Table 10-10 provides recommended monitoring and reporting methods to assist in managing emission associated with the construction phase of the Project.

Table 10-10 Management response to trigger levels

Monitor	Description	Report	Action/response	Responsibility
Meteorological forecast	Monitor meteorological forecasts to determine the likelihood of adverse wind conditions	Report any adverse wind conditions in a site log book. This allows for possible complaints to be investigated and checked against meteorological conditions that may have caused the dust event.	If adverse wind conditions are forecast (strong winds in the direction of nearby sensitive receptors) that could result in a high dust event, review operations schedule and postpone work if required, until such time that meteorological conditions are permitting.	Site management
Visual inspection for nuisance dust	Carry out visual inspections for nuisance dust during high dust-generating activities (e.g. excavating)	Visual assessment of wind speed and direction during the shift to enable high wind warnings to be issue if required. Report any adverse wind conditions in a site log book This will allow investigation into possible dust complaints.	If nuisance dust is observed when working near a residential receptor implement additional dust mitigation measures or reduce dust generating activities.	Site management
Dust complaints	Maintain a dust complaint register	Record the name/contact details (including address) of the complainant, as well as all details of the dust event (date, time, meteorological conditions (if know))	Carry out investigation into the cause of the dust event including reference to site log book. and nuisance dust log book. Contact the complainant to discuss cause of event and implement dust control as required.	Site management

10.5 Greenhouse gas assessment

A Greenhouse gas (GHG) Assessment has been undertaken and is provided in Volume 3 Appendix T Greenhouse gas assessment. This assessment includes the following:

- Characterisation of GHG emission sources from the Project and an estimation of expected Scope 1 (direct) and Scope 2 (energy indirect) GHG emissions in accordance with the *National Greenhouse and Energy Reporting Act 2007* (NGER Act), considering both the construction and operation of the Project.
- Comparison of total GHG emissions between the Project and State emissions.
- Provides a high level summary of GHG abatement opportunities and measures for the Project.

10.5.1 Methodology

The GHG emission quantities and sources were estimated based on activity data representative of the proposed activities, and in reference to the following documents:

- Greenhouse Gas Protocol, the World Resources Institute/ World Business Council for Sustainable Development (WRI/WBCSD 2004).
- *National Greenhouse Accounts Factors* (2020), Commonwealth Department of Environment and Energy. This determination deals with Scope 1 and Scope 2 emissions.
- *National Greenhouse and Energy Reporting Regulations 2008*, under the NGER Act, Australian Government. These outline the detailed reporting requirements under the NGER framework and provide a basis for estimating emissions.
- *NGER (Measurement) Determination 2008* (as amended) under subsection 10(3) of the NGER Act, Australian Government.

The GHG emissions considered for this assessment are consistent with the characterisation of GHGs as outlined in the Greenhouse Gas Protocol (WRI/WBCSD 2004), which establishes an international standard for reporting of greenhouse gas emissions. The GHG Protocol has been adopted by the International Organisation for Standardisation (ISO 14064-2).

The GHG Protocol defines three emissions 'Scopes' for greenhouse gas accounting and reporting purposes. This GHG assessment boundary focuses on direct (Scope 1) and indirect (Scope 2) emissions associated with the Project. Scope 3 emissions were identified; however, they were not subject to assessment.

Scope 1 emissions are direct greenhouse gas emissions from operations or activities exclusively from within the physical boundary of the Project.

Scope 2 emissions are indirect emissions emitted from the use of purchased or acquired electricity brought into the Project boundary.

Emissions within Scope 3 are indirect emissions from sources not owned or controlled by the Project. Scope 3 emissions were not subject to assessment under the ToR for the Project.

10.5.2 Emissions summary

The Scope 1 and 2 greenhouse gas emissions sources from the Project included in this inventory are:

- Land use change (Scope 1)
- Diesel combustion in mobile engines (Scope 1)
- Diesel combustion for stationary engines (i.e. generators) (Scope 1)

- Aviation fuel combustion in mobile engines (Scope 1)
- Use of synthetic gases in electrical components (Scope 1); and
- Consumption of purchased electricity, including transmission losses around the network (Scope 2).

The GHG emissions inventory is prepared on the basis of knowledge of the Project design, construction and operations current at the time of assessment. Emission sources and estimated emissions calculated in this assessment are outlined in Table 10-11. The projected average annual emissions are presented as well as the total greenhouse gas emissions over the construction and operational phases of the Project.

The average annual GHG emissions equate to 151,079 tCO_2-e per year (excluding Scope 3 emissions) during construction and 211,722 tCO_2-e per year during operation (excluding Scope 3 emissions).

Table 10-11 Greenhouse gas emissions by source during construction and operation for the AC Scenario

Activity	Average annual GHG emissions by source		Total GHG emissions by source	
	Construction	Operation	Construction	Operation
Scope 1				
Land clearing	143,764	-	431,293	
Diesel combustion in mobile engines	3,804	179	11,413	8,071
Diesel combustion in stationary engines	2,529	13	7,587	574
Aviation fuel in mobile engines	948	26	2,843	1,183
Gas insulated electrical components (SF_6)	-	314	-	14,118
Scope 2				
Electricity consumed	34	486	102	21,870
Transmission losses (AC)	-	210,704	-	9,481,695
Total	**151,079**	**211,722**	**453,238**	**9,527,510**

Total Scope 1 and Scope 2 GHG emissions calculated over the life of the Project (3 years construction and 45 years operation) is calculated to 9,980,748 tCO_2-e. The GHG intensity is equal to 0.60 tCO_2-e per GWh.

10.5.3 Emission comparison

The National Greenhouse Gas Inventory (DISER 2020) was used to present Project emissions in comparison to Australian and Queensland emissions.

Australia's net greenhouse gas emissions across all sector totalled 537 million tonnes (Mt) CO_2- e in 2018 (DISER 2020). The direct (Scope 1) GHG emissions for public electricity and heat production totalled 183.2 Mt CO_2-e, with total indirect (Scope 2) emissions from the generation of purchased electricity totalled 21 Mt CO_2-e.

In Queensland, total annual emissions equated to 171 $MtCO_2$-e in 2018 (DISER 2020).

Total annual direct (Scope 1) GHG emissions contributed 52.9 Mt CO_2-e (28.3%) to the total 183 .2 MtCO2-e annual emissions of Australia related to public electricity and heat production. Total annual indirect (Scope 2) emissions related to the generation of purchased electricity contributed 6.2 MtCO_2-e (29.5%) to the total annual GHG emissions in Australia.

Within the context of Queensland emissions relating to public electricity and heat production, the Scope 1 and 2 emissions from the Project equate to an increase in emissions of 0.36%. At a national level, the Project contributes an increase of 0.10% for emissions relating to public electricity, heat production and generation of purchased electricity.

10.5.4 Mitigation measures

This section describes the mitigation measures to reduce the potential impacts of greenhouse gas emissions from the construction and operation of the Project.

An energy conservation and GHG management plan for the construction and operation of the Project should be prepared to develop strategies to reduce GHG emissions in line with Australia's commitments under the Kyoto Protocol and the State and Commonwealth aspirations. The objectives of the plan should be:

- Reduce greenhouse gas emissions associated with the Project and all relevant emissions sources.
- Incorporate energy efficiency initiatives into Project design, procurement, engineering, construction and operation.
- Integrate greenhouse gas management and energy efficiency initiatives into business decision making at all stages of the Project.
- Provide consistent and accurate reports on greenhouse gas emission levels in compliance with relevant legislation.

Fuel combustion

The following mitigation measures should be considered for implementation to reduce the production of greenhouse gas emissions due to fuel combustion.

- Design a construction works program to minimise haul distances between construction sites and laydown areas.
- Planning activities to minimise vehicle kilometres travelled during construction and operation.
- Maintain construction equipment and vehicles in good working order to maximise fuel efficiency.
- Use appropriately-sized equipment for construction activities.
- Minimise waste from construction (therefore minimising transport of waste).
- Alternative fuel types and motive technologies may also be considered to mitigate greenhouse gas emissions from construction and operation of the Project should they be readily available.

Electricity consumption

The design and construction of accommodation and office buildings will consider energy efficient and passive design features, including air conditioning, lighting, low-flow fitting and solar power.

Gas-insulated electrical components

Detailed design of the Project will endeavour to use SF_6 only where alternatives are not available. To do this, the Proponent will undertake a review of technology used in all aspects of the Project e.g. investigate oil-filled transformers as an alternative insulation solution and restricting the use of SF_6 to switchgear components.

Methods for further mitigating SF_6 gas emissions rely on appropriate selection of gasket types and best practice leakage detection monitoring during operation, maintenance, and end of life dismantling procedures. The management of the end of life gas-insulated equipment will follow industry best practice guidelines i.e. recycling SF_6 gas or safe disposal if contamination due to arc switching is high.

Offsets

The following offset (abatement) strategies are proposed for the Project where in line with State and Commonwealth legislation and policy:

- Produce a GHG Offset Plan that provides an offset for the Scope 1 and Scope 2 greenhouse gas emission generated during the construction and operation of the Project.
- Options to be considered include the use of GreenPower sources from a renewable source or contributions to another credited offset program.
- The Proposed offset strategy will depend on Federal and State climate change policy current at the time the Project is approved.

10.6 Conclusion

The assessment of air quality indicated that the Project may be constructed and operated without significant impact on sensitive receptors, as long as appropriate routine management practices are implemented and siting studies for consolidated construction actives (such as at laydown areas) are completed.

The placement of concrete batching plants at laydown areas by the Construction contractor, should consider the proximity of sensitive receptors and ensure that adequate buffer distances are maintained, or other air quality mitigation measures are adopted during strong wind conditions.

Construction activities have the greatest potential for impact, although impacts from construction will be of a short-term duration at any individual location. Operation is not expected to result in any impacts on the environmental values of receptors near the corridor selection or substations.

During the operational phase of the Project, a reduction in overall gaseous and particulate emissions associated with power generation is anticipated, due to the connection opportunities to the North Queensland Clean Energy Hub. The Project may also provide additional connection opportunities for renewable electricity generation projects within the region.

Decommissioning would be expected to be similar to construction of the transmission line and substations. Routine mitigation activities to reduce the impact of dust and air emissions during demolition/disassembly would apply where dust emissions are expected to occur.

Commitments to manage potential air quality and greenhouse gas impacts include:

- Development of air quality and stockpile management procedures within the Environmental Management Plan
- Undertake progressive rehabilitation and stabilisation of disturbed areas in accordance with a rehabilitation plan.

- Maintain a complaints register for the management and tracking of complaints
- Development of a Greenhouse gas Offset Plan
- Construction program will consider haul distances and use of appropriately sized equipment.

No cumulative air quality impacts are anticipated as a result of the Project.