

Chapter 26
Climate

ESMERALDA GRAPHITE PROJECT

aarc ENVIRONMENTAL SOLUTIONS
APEM Group

GRAPHINEX

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Glossary, acronyms and abbreviations

Acronym or Abbreviation	Meaning
AEP	Annual Exceedance Probability
BMP	Bushfire Management Plan
BOM	Bureau of Meteorology
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFF	Department of Agriculture, Fisheries and Forestry
DETSI	Department of the Environment, Tourism, Science and Innovation
EIS	Environmental Impact Statement
ERP	Emergency Response Plan
EV	Environmental Values
GABORA	Great Artesian Basin and Other Regional Aquifers
GHG	Greenhouse Gas
MIA	Mine infrastructure area
MLA	Mining Lease Application
NRM	Natural resource management
QLD	Queensland
ROM	Run-of-Mine
SSP	Shared Socio-economic Pathways
TOR	Terms of Reference
WMP	Water Management Plan
WQO	Water Quality Objectives

26 Climate

This chapter has been prepared in accordance with the EIS terms of reference (TOR). An assessment of the local and regional climate in the Project area, climate risks, and potential impacts on the Project, has been undertaken in accordance with the Queensland Government, Climate – EIS information guideline, ESR/2024/5298 (DETSI 2026). Mitigation and management measures relevant to identified risks and impacts are provided in Section 26.3. A reconciliation table of the chapter content against the EIS TOR is provided in Section 26.5.

Other assessments which relate to climate and have been detailed in separate EIS chapters include:

- Water management (Chapter 14, Water Resources);
- Flooding and Regulated Structures (Chapter 16);
- Air Quality (Chapter 23);
- Noise and vibration (Chapter 24); and
- Greenhouse Gas (Chapter 27).

26.1 Existing environment

The existing climate patterns in the broader Project area are presented in the following sections, including extreme climate events such as droughts, bushfires, flooding and tropical cyclones, in addition to long-term meteorological parameters of rainfall, evaporation, temperature, humidity and wind speeds.

Meteorological data has been extracted from Bureau of Meteorology (BOM) gauging stations for the above parameters and interpolated modelling sources have been used to inform the impact assessment.

The closest BOM weather stations to the Project are located at Croydon Township (site number 029012), approximately 70 km north of the Project, Georgetown Airport (site number 30124), and Georgetown Post Office (site number 030018) – both located approximately north-east 150 km from the Project. An additional BOM site, Esmeralda Station (site number 029016) is located approximately 30 km east of the Project, however this station only records rainfall data. A summary of these sources is presented in Table 26-1.

Table 26-1: Meteorological data sources

Database	Weather station	Purpose	Latitude	Longitude	Approximate distance to Project
Bureau of Meteorology	Croydon Township (029012)	All climate statistics	18.20° S	142.24° E	~70 km north
	Georgetown Airport (030124)	All climate statistics	18.30 °S	143.53 °E	~150 km north-east
	Georgetown Post Office (030018)	Wind	18.29° S	143.55° E	~150 km north-east
	Esmeralda Station (29016)	Rainfall	18.85° S	142.57° E	~30 km east

26.1.1 Local and regional climate

The Project is located in the Gulf Savannah region of northern Queensland. This region has a tropical savannah climate, characterised by a distinct wet season from November to April and a dry season from May to October (Gulf Savannah Development n.d.).

An overview of climate data from proximal BOM weather stations is provided in Table 26-2 and Table 26-3.

Table 26-2: Climate statistics for Croydon township and Georgetown airport

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Croydon Township (site number 029012)													
Mean rainfall (mm)	223.0	180.2	119.2	24.9	8.8	8.2	4.1	2.4	5.2	14.6	45.9	113.2	753.5
Highest rainfall (mm)	860.5	601.4	591.4	279.8	150.0	139.2	83.4	44.2	92.7	145.0	384.7	312.0	1,585.8
Lowest rainfall (mm)	49.4	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	225.4
Mean number of days of rain	13.0	12.2	8.3	2.1	1.0	1.0	0.6	0.4	0.6	1.8	4.6	8.2	53.8
Mean number of days of rain >10 mm	6.0	5.5	3.4	0.6	0.3	0.2	0.1	0.1	0.2	0.5	1.4	3.3	21.6
Mean number of days of rain >25 mm	2.8	2.2	1.5	0.3	0.1	0.1	0.0	0.0	0.1	0.2	0.5	1.4	9.2
Highest temperature (^{o}C)	42.8	41.2	39.7	38.0	36.8	35.2	35.4	37.2	39.4	42.2	43.9	43.3	43.9
Mean maximum temperature (^{o}C)	35.5	34.5	34.3	33.9	31.6	29.2	29.2	31.2	34.3	36.9	38.0	37.3	38.8
Lowest temperature (^{o}C)	17.0	17.2	13.9	11.5	6.0	3.9	2.6	5.2	7.0	11.1	16.7	15.0	2.6
Mean minimum temperature (^{o}C)	24.2	23.9	23.3	21.0	17.9	14.7	14.1	15.7	19.2	22.5	24.4	24.6	20.5
Mean daily evaporation (mm)	6.4	5.6	6.0	6.4	5.7	5.0	5.3	6.5	8.2	9.2	9.0	8.0	6.8
Mean 9am relative humidity (%)	70	75	67	57	54	53	51	45	44	44	51	60	56
Mean 3pm relative humidity (%)	50	54	47	36	34	32	29	25	23	25	30	37	35
Georgetown Airport (site number 30124)													
Mean rainfall (mm)	257.4	212.4	132.5	23.4	13.5	8.1	10.6	1.4	5.8	11.9	77.6	142.5	892.5
Highest rainfall (mm)	772.0	455.2	429.8	120.8	100.4	93.2	64.7	18.6	36.6	58.0	236.5	291.6	1572.4
Lowest rainfall (mm)	41.8	15.8	17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	7.2	458.8

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean number of days of rain	16.1	13.4	11.2	3.5	1.7	1.3	1.3	0.3	1.0	2.6	7.3	10.4	70.1
Mean number of days of rain >10 mm	7.0	6.0	3.6	0.8	0.5	0.3	0.3	0.0	0.2	0.5	2.2	3.9	25.3
Mean number of days of rain >25 mm	3.5	2.9	1.6	0.3	0.1	0.0	0.2	0.0	0.0	0.0	0.9	1.8	11.3
Highest temperature (°C)	40.9	40.0	39.1	38.9	36.3	34.5	34.7	36.9	38.7	41.6	42.3	43.1	43.1
Mean maximum temperature (°C)	33.9	33.4	33.5	32.9	30.4	28.9	28.8	30.5	33.7	36.4	36.9	36.3	33.0
Lowest temperature (°C)	17.8	15.2	14.7	9.6	4.3	1.5	-0.6	1.9	5.8	11.3	14.7	15.6	-0.6
Mean minimum temperature (°C)	23.4	22.9	22.0	19.6	16.7	14.0	13.2	13.7	17.1	20.5	22.9	23.7	19.1
Mean daily evaporation (mm)	7.0	6.3	6.2	6.3	5.6	4.9	5.2	6.5	8.1	9.8	9.9	8.3	7.0
Mean 9am relative humidity (%)	n/a												
Mean 3pm relative humidity (%)	n/a												

Table 26-3: Esmeralda Station rainfall statistics (1914-2025)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean rainfall (mm)	213.5	170.6	110.8	21.6	8.9	8.9	5.8	3.1	5.2	14.9	44.0	106.3
Highest rainfall (mm)	929.8	598.0	462.1	192.0	91.9	123.0	75.5	41.1	98.0	128.0	203.1	400.0
Lowest rainfall (mm)	24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

26.1.1.1 Rainfall and evaporation

Most rainfall in the region occurs during the summer wet season. Winter months are typically mild and dry (BOM 2025). This highly seasonal rainfall is typically associated with monsoonal, thunderstorm and cyclonic weather patterns often influenced by the El Niño Southern Oscillation (Department of Energy and Climate 2024). Figure 26-1 shows the average rainfall and evaporation for the nearest BOM stations.

The highest average monthly rainfall occurs in January, while the lowest average monthly rainfall occurs in August. This is consistent across all stations. The wet season for the region generally occurs from November to March/April, with rainfall during these months contributing approximately 70% to the region's annual total. While the three stations generally record similar average monthly rainfall, the Esmeralda Station (site number 29016) is the most relevant station given its close proximity to the Project.

Recent weather events from late 2025 to early 2026 such as Cyclone Koji and Cyclone Narelle indicate the region is susceptible to significant, rapid-onset flooding (Queensland Reconstruction Authority 2026). Flooding is discussed in detail in Chapter 16.

The dry season generally occurs from April/May to October, with monthly rainfall usually less than 20 mm. Average daily evaporation for both sites is very similar, with the lowest evaporation occurring over the dry winter months and the highest occurring prior to the wet season. Evaporation data is not available from Esmeralda Station (site number 29016).

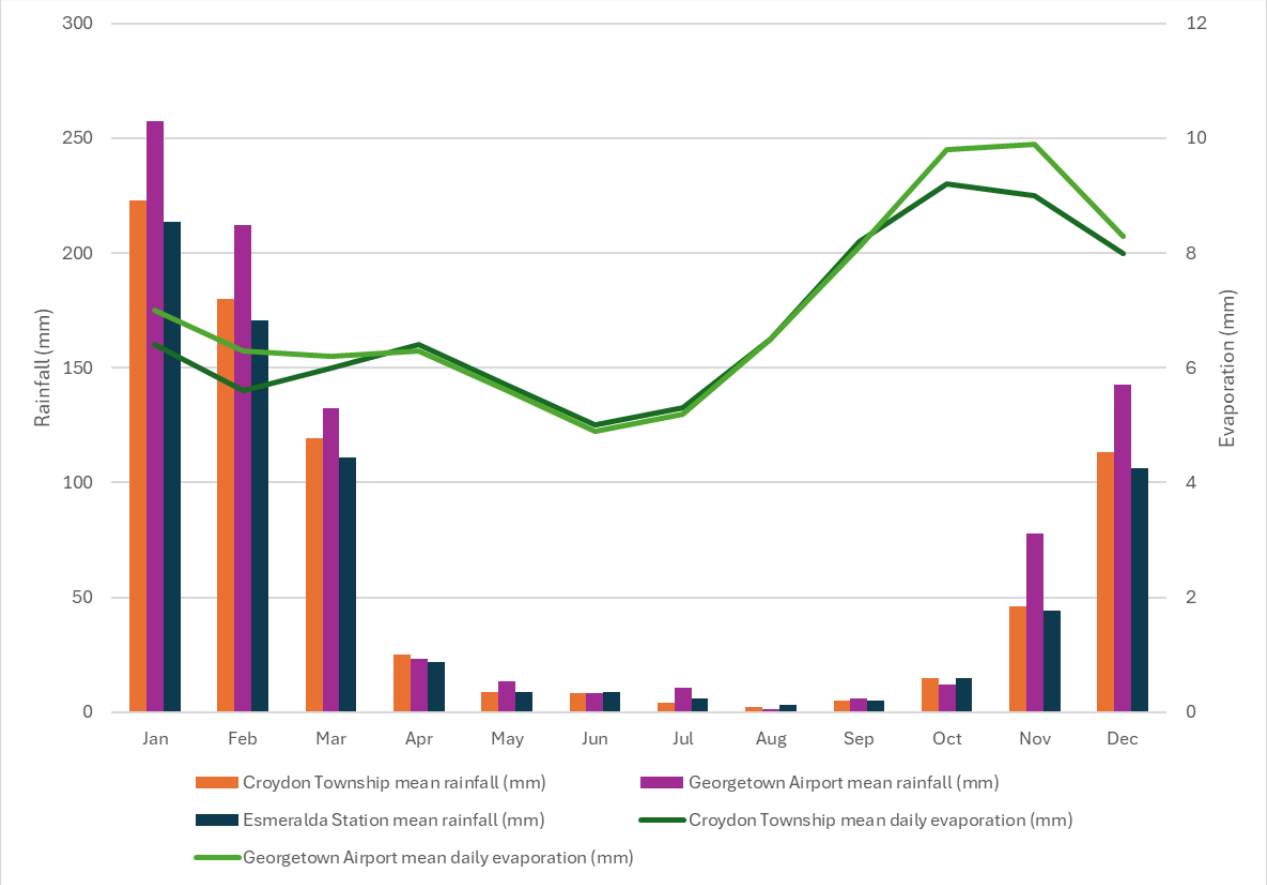


Figure 26-1: Mean rainfall and evaporation

26.1.1.2 Air temperature and humidity

Air temperature in the region is typical of a semi-arid climate. Climate data from the Croydon BOM station (029012) for the period of 1912-2014, and from Georgetown Airport (030124) for the period of 2005-2025, show that mean temperatures at the two sites are similar. The mean maximum temperature at Croydon occurs in November at 38.0°C and the mean minimum in July at 14.1°C (Figure 26-2). For Georgetown Airport, the mean maximum temperature occurs in November at 36.9°C, and the minimum occurs in July at 13.2°C (Figure 26-3).

Relative humidity is an indicator of the moisture content in air and is typically presented as a percentage of the total moisture that the air can contain at that temperature. Relative humidity at 9 am is consistently higher than at 3 pm due to air moisture decreasing throughout the day in response to increasing air temperature. Relative humidity in Croydon generally increases from November to January (during the onset of the wet season), peaking in February at 9am at 75%, before gradually declining through to September/October at 3pm at 23% (Table 26-2).

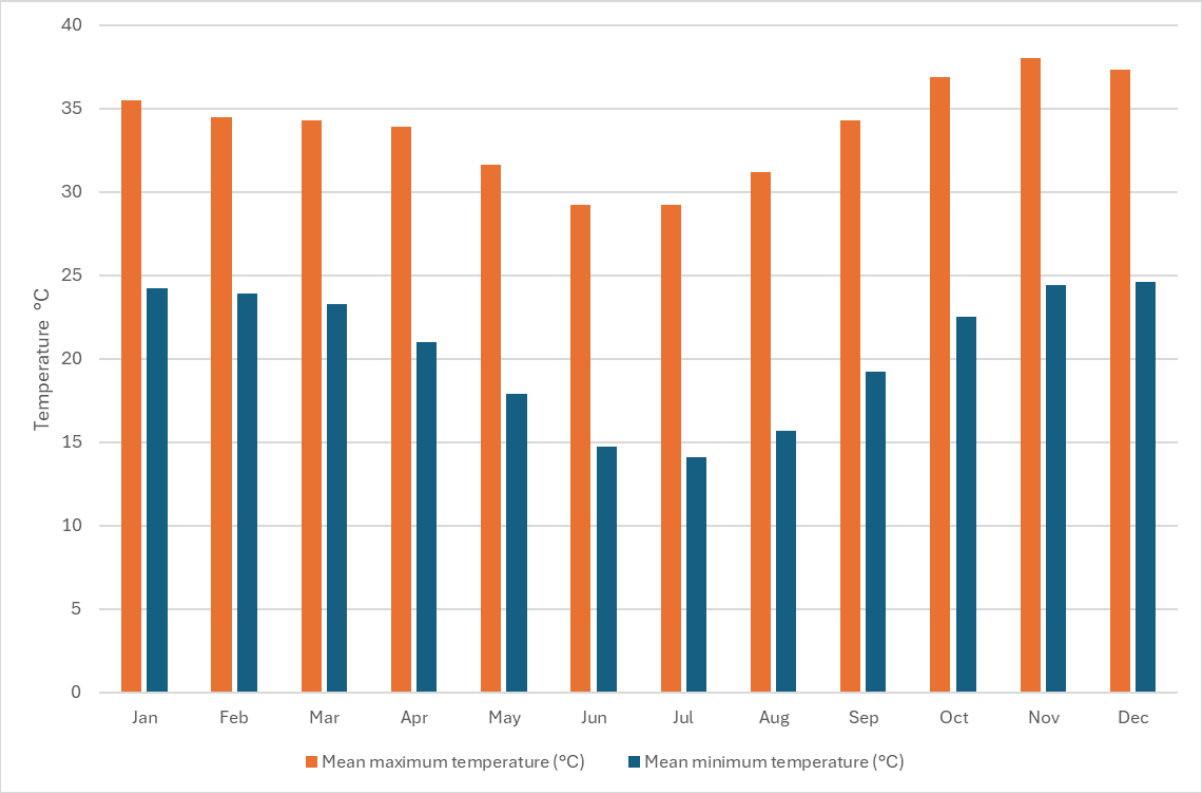


Figure 26-2: Monthly mean temperatures for Croydon (1912-2014)

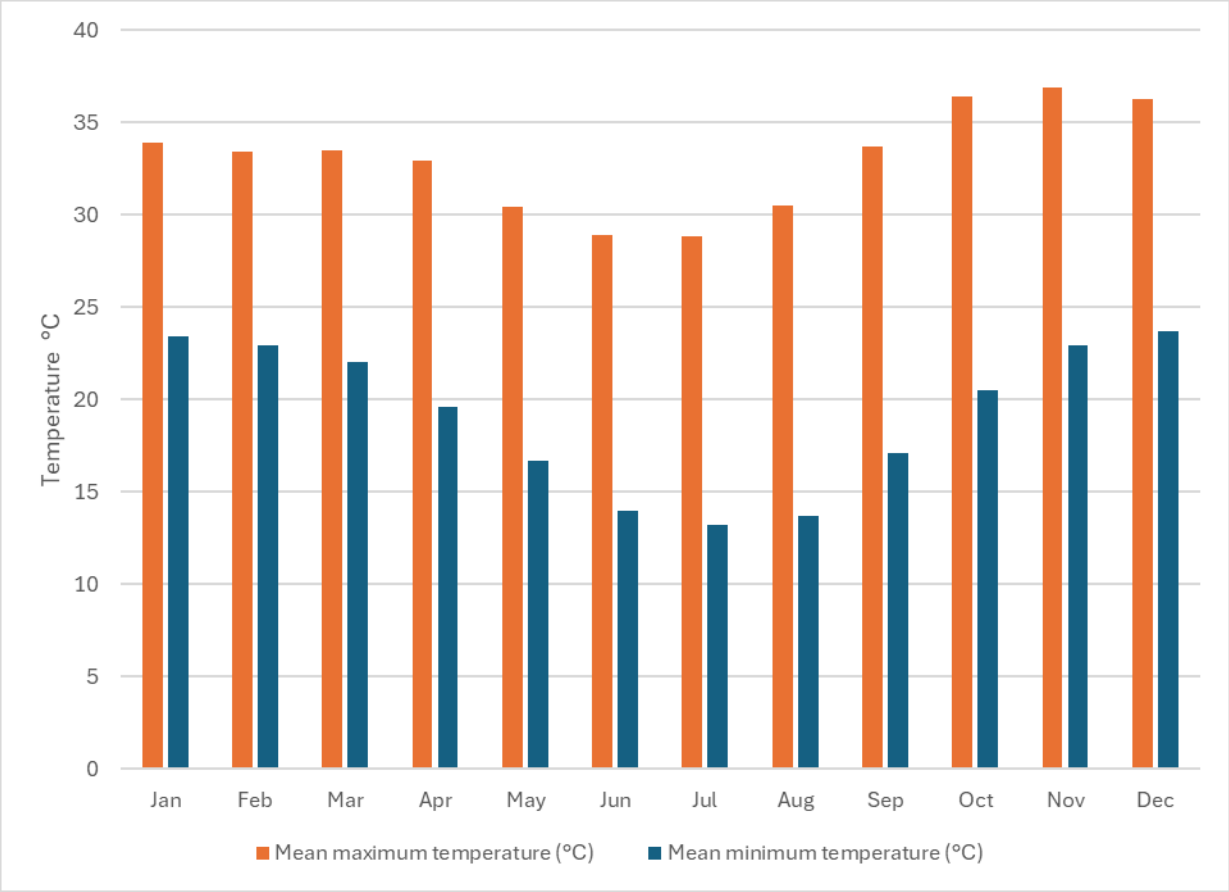


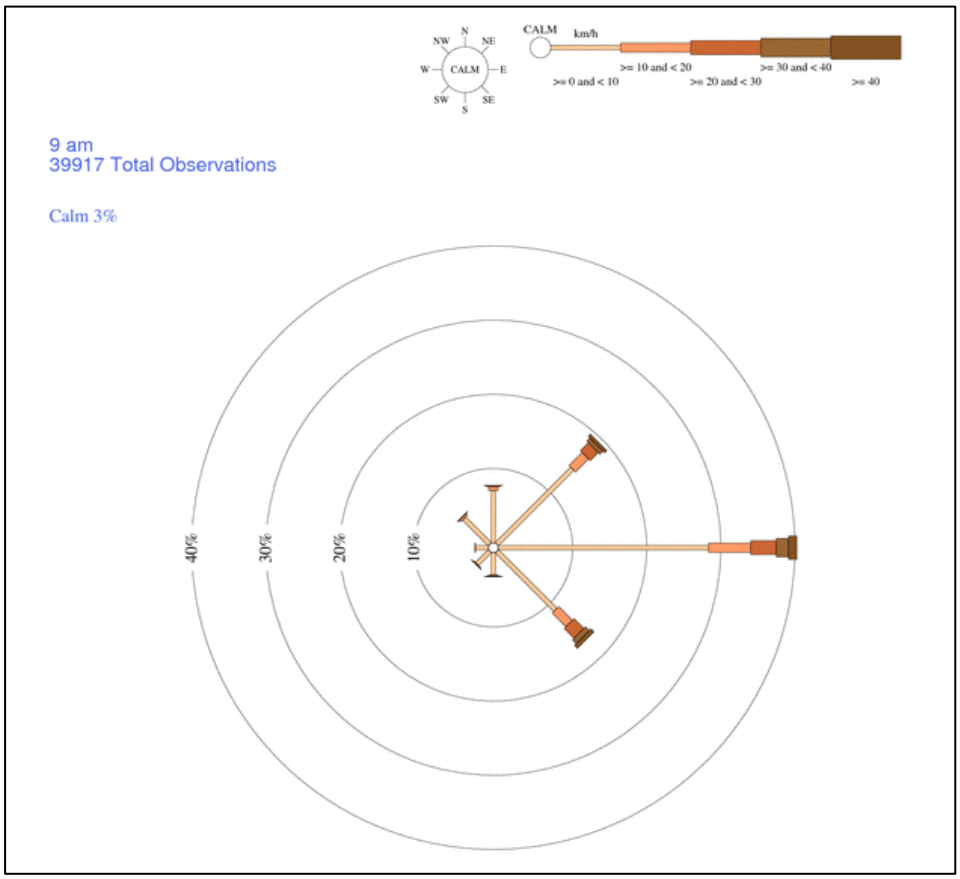
Figure 26-3: Monthly mean temperatures for Georgetown Airport (2005-2025)

26.1.1.3 Wind speed and direction

Wind speed and direction data for the period of 1894-2007 is available from the Bureau BOM weather station at Georgetown post office (029012) and from Croydon Township station (029012) for the period of 1962-2010. Historical wind rose data from Georgetown post office weather station is presented in Figure 26-4. In the morning, the prevailing winds are easterly and, in the afternoon, the wind direction transitions to an even more east south-easterly and south south-westerly direction. The mean annual wind speed is 9.8 km/hr at 9 am and 8.0 km/hr at 3 pm.

For Croydon township, the mean annual 9am wind speed is 10.3 km/hr, prevailing from the south and east, and 7.8 km/hr for 3pm, prevailing predominantly from the east -as presented in Figure 26-5. Conditions at the Project site are anticipated to be similar to the conditions experienced at both Georgetown and Croydon which have a similar surrounding environment.

The Project site falls within the Wind Region A (Non-cyclonic) as described by the Australian Institute for Disaster Resilience. Although categorised as non-cyclonic, these inland areas may experience high winds from cyclonic activity as the cyclone decays and moves further inland or south (Sexton *et al*. 2023).



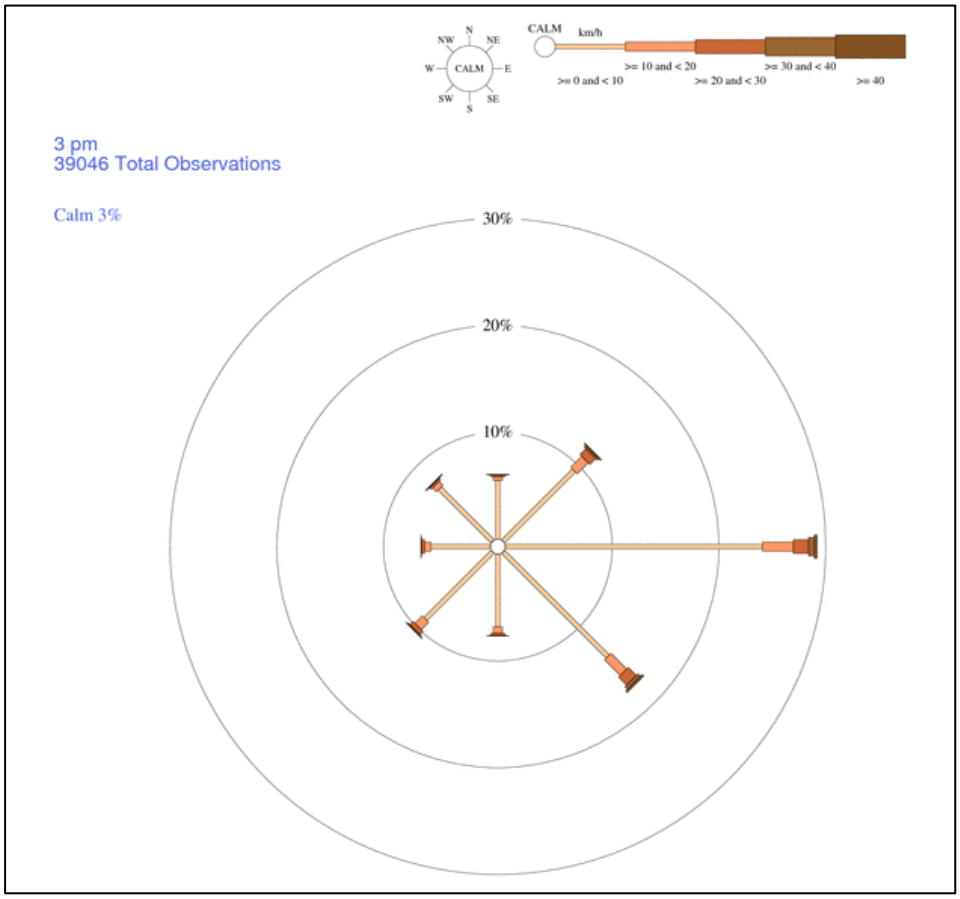
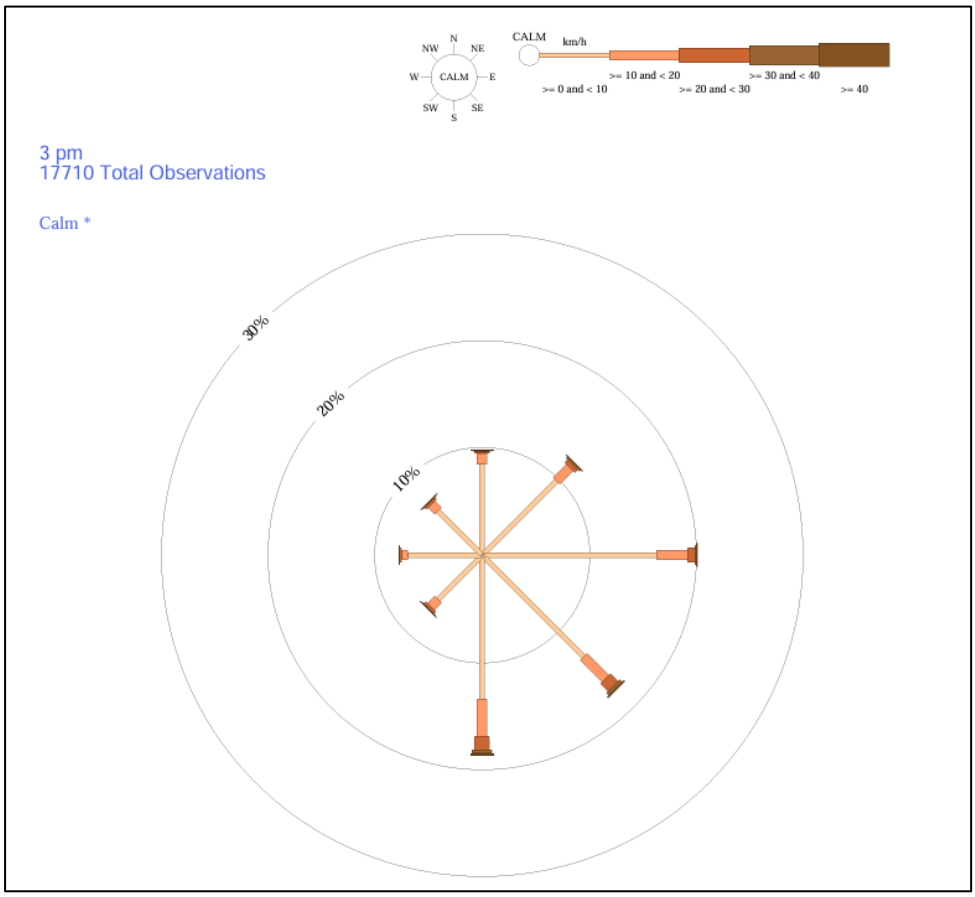


Figure 26-4: Wind speed and direction at Georgetown, Qld at 9 am and 3 pm



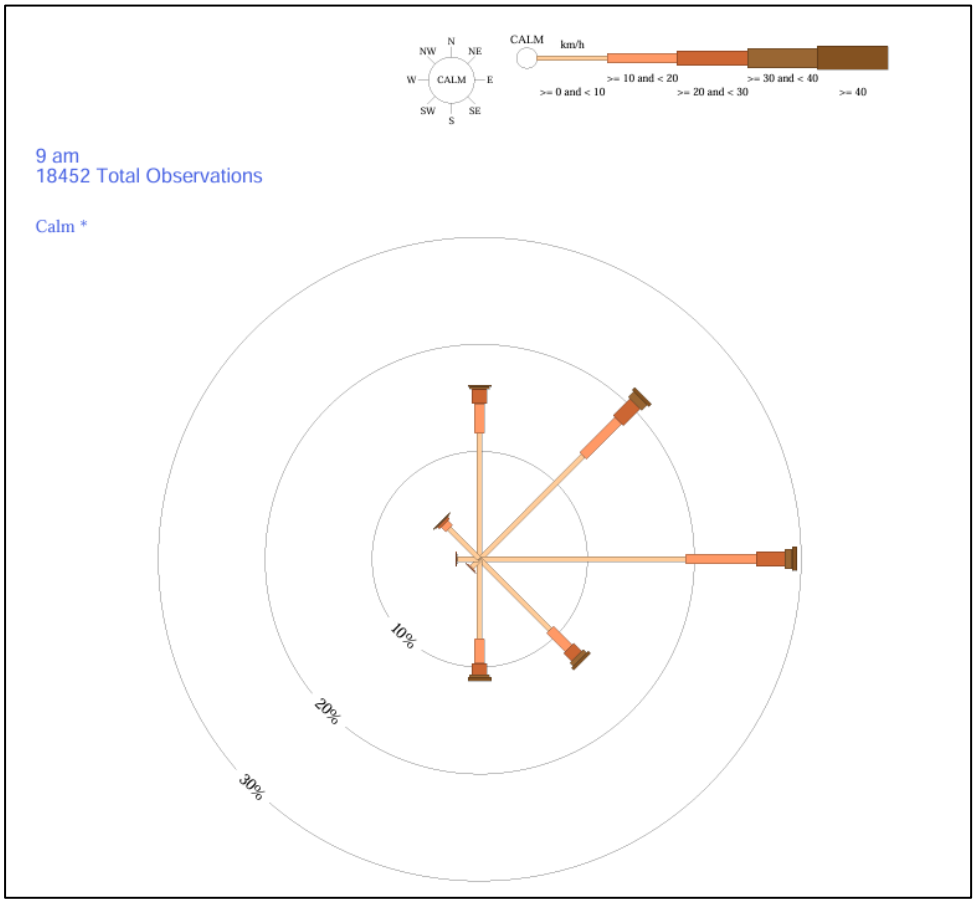


Figure 26-5: Winds speed and direction at Croydon, Qld, at 9 am and 3 pm

26.1.1.4 Bushfires

The Historical Bushfire Boundaries Dataset (version 2) has been reviewed to assess historical bushfire occurrences in the broader Project region. The dataset represents the aggregation of jurisdictional supplied burnt areas polygons that date from the early 1900s through to 2023.

The dataset was produced as a collaborative partnership between:

- Australian Climate Service
- CSIRO (NBIC)
- Geoscience Australia; and
- Emergency Management Spatial Information Network (EMSINA).

It is noted that the information within this dataset is reflective of the data supplied by participating authoritative agencies. It may, or may not, represent all fire history within that jurisdiction.

Bushfires in the Project region have been mapped in orange in Figure 26-6. Details of the mapped bushfire events are presented in Table 26-4. Events have spatial overlap, and therefore transparency has been used to indicate more events (darker orange), and fewer events (lighter orange). Prescribed burns are also included in the database but have not been reflected in Figure 26-6 as these are considered controlled events. None of the mapped bushfire events are within 30 km of the Project. The closest, Entrona/NP/W/2018/001, was approximately 38 km north-east from the nearest point of the Project access road. This was also the largest event at approximately 69,593 ha impacted.

Table 26-4: Bushfire history

Event name	Ignition date	Extinguish date	Area (ha)
Entrona/NP/W/2017/001	21/04/2017	27/04/2017	443
Littleton North/NP/W/2016/001	20/10/2016	28/11/2016	58,120
Littleton National Park/NP/W/2020/002	30/11/2020	10/12/2020	25,826
Littleton National Park/NP/W/2016/003	7/12/2016	11/12/2016	5,519
Inorunie/NP/W/2017/002	21/04/2017	21/09/2017	0
Littleton National Park/NP/W/2023/001	27/09/2023	2/10/2023	12,606
Littleton National Park/NP/W/2016/002	7/12/2016	11/12/2016	2,045
Littleton National Park/NP/W/2017/001	6/11/2017	12/11/2017	29,018
Littleton National Park/NP/W/2021/002	21/11/2021	26/11/2021	13,453
Entrona/NP/W/2018/001	3/11/2018	4/11/2018	69,593
Inorunie/NP/W/2017/001	21/04/2017	27/04/2017	11,558
Littleton National Park/NP/W/2019/004	16/12/2019	27/12/2019	16,004

Event name	Ignition date	Extinguish date	Area (ha)
Littleton National Park/NP/W/2019/002	30/09/2019	5/10/2019	20,571
Littleton National Park/NP/W/2022/001	1/11/2022	12/11/2022	16,117
Littleton National Park/NP/W/2021/001	5/11/2021	10/11/2021	33,223
Littleton National Park/NP/W/2019/001	26/12/2018	28/12/2018	10,052
Littleton National Park/NP/W/2020/001	23/10/2020	4/11/2020	247
Littleton National Park/NP/W/2016/001	12/11/2016	18/11/2016	11,392
Littleton National Park/NP/W/2018/001	21/02/2018	22/02/2018	182
Fire Advice/2015/461	17/11/2015	30/11/2015	44,402
Littleton National Park/NP/W/2022/002	16/11/2022	22/11/2022	22,798

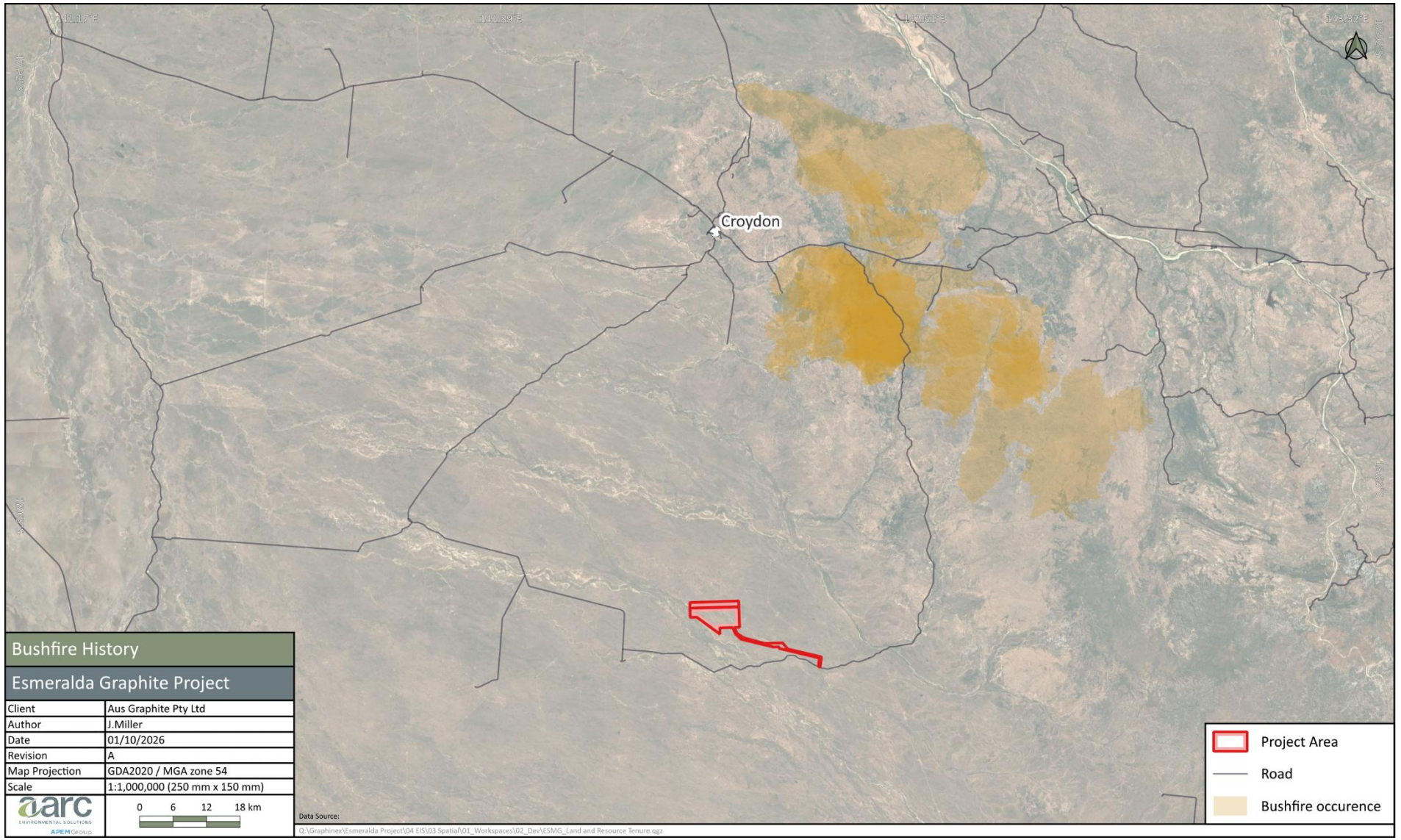


Figure 26-6: Regional bushfire history

26.1.1.5 Surface water

The Project is flanked by the Warrigal Creek main channel immediately south of the MLA, the Yappar River further north-east, and the Borer and Clara Rivers south of Warrigal Creek. A minor unnamed tributary also flows immediately north of the proposed pit. The surface topography is generally flat, which results in overland flow interactions between the major waterways during significant flood events. The surface topography in the vicinity of the Project area slopes northwest at an average grade of 0.2%.

Flooding at the Project location is dominated by breakout flooding from the northern banks of Warrigal Creek and the Borer River which are influenced by flooding interactions with other major waterways, influenced by the flat terrain (Figure 26-7).

Significant rainfall events have been recorded at the Yappar River Gauging Station (29154) in January 2009, January 2021 and December-January 2025/26. The most recent event was caused by a tropical low tracking south from the Gulf Coast in late December 2025, resulting in a period of heavy rainfall. In January 2026 the remanent moisture interacted with a monsoon low and an embedded trough over western Queensland (BOM 2024). Over an 11-day period, significant widespread rainfall was recorded, with peak daily rainfall totals occurring on different days across the catchment. The rainfall data shows considerable spatial variation in rainfall during the event, with larger rainfall totals up to ~ 700mm recorded at the downstream extent of the catchment.

Satellite imagery (Sentinel-2 L2A) of the Norman River was captured on the 8th of January during the 2026 flood event. The peak maximum flood extent at the MLAs is unavailable due to high cloud cover; however, the MODIS Corrected Reflectance imagery (12th January 2026) captured flooding at the MLAs. Sentinel-2 L2A imagery illustrates the breakout flooding from the Warrigal Creek and Yappar Rivers downstream of the site.

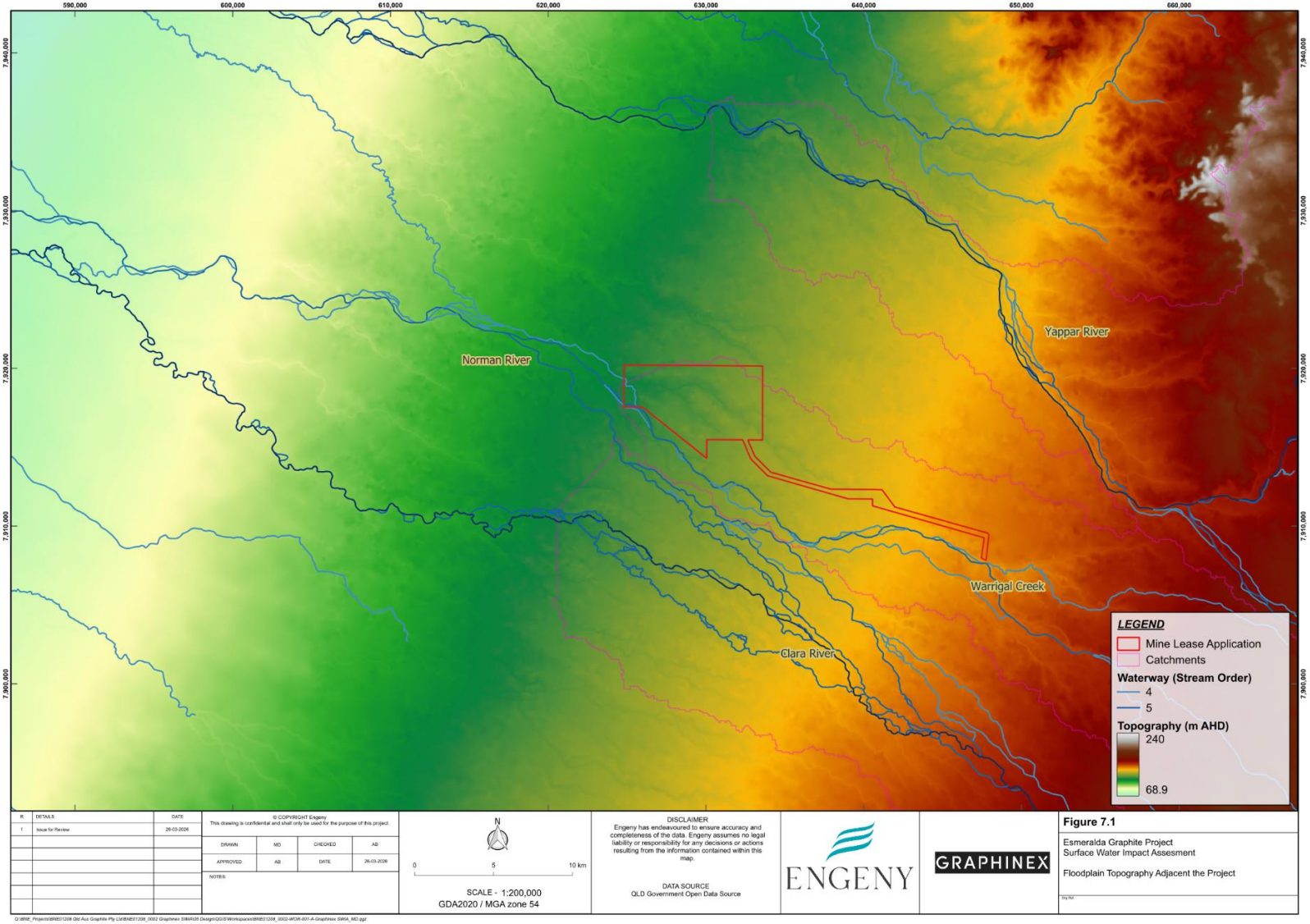


Figure 26-7: Floodplain topography of the Project

26.2 Impact assessment

The interactions between climate and the Project are assessed in the following sections. Potential impacts of the Project to the environment could be influenced by the existing climate. In addition, climate change could potentially magnify these potential impacts. This section describes the climate patterns that are relevant to Project's environmental impact assessment and discusses the related impacts.

26.2.1 Extreme weather events and climate change

According to the BOM and CSIRO climate change projection tool (BOM and CSIRO n.d.), the Project is located within the Monsoonal North-East sub-cluster, which comprises the Northern and Southern Gulf in addition to the Burdekin NRM regions in northern QLD. This subcluster region covers savannah woodland and rainforest areas in the Mitchell, Gilbert, Norman and Staaten River catchments which flow into the Gulf of Carpentaria. The Monsoonal North-East sub-cluster experiences pronounced wet and dry seasons. Climate predictions for this sub-cluster include:

- very high confidence that average temperatures will increase in all seasons;
- very high confidence that hot days and warm spells will increase;
- high confidence that intensity of extreme rainfall events will increase; and
- medium confidence that fewer cyclones will occur, however they will be more intense.

Predictions of future climatic conditions are inherently uncertain, and dependent on many factors. As such, impacts on the Project may be more or less severe than predicted, and will require adaptive mitigation and management strategies such that evolving conditions can be suitably addressed.

26.2.1.1 Heatwaves

The Project is within an area that periodically experiences heatwave conditions. Heatwaves are defined by the BOM as a time when the maximum and minimum temperatures are unusually hot over three-day period, including a high overnight temperature (BOM 2026). The maximum temperature recorded in Croydon was 43.9 °C in November 1965. Historical temperatures have been consistently above 30 °C degrees across all months, with many of these months experiencing consecutive days above 35 °C. Historical data from the Croydon Shire Local Government Area shows that for the period of 1951-2016, the average number of heatwaves per year was 1.4 showing that the region has a history of consistently experiencing heatwaves (Trancoso et al. 2020).

Temperatures and rainfall in the Project area are extreme. Projected temperature increases in the Project area and surrounding areas involves an increased average temperature and incidence of hot days, as well as more frequent and intense heatwaves (Figure 26-8).

Heatwaves have the potential to disrupt the Project through direct health and safety impacts on staff and additional stress on Project infrastructure, including increased water requirements. The safety and hazard implications for the Project and regional community in general are related to the potential increase in the frequency and intensity of natural hazards, including bushfires and flooding. Climate change is discussed in further detail in Chapter 23, Air Quality. Climate change considerations of assessment of potential flooding impacts are detailed in Chapter 14, Water resources.

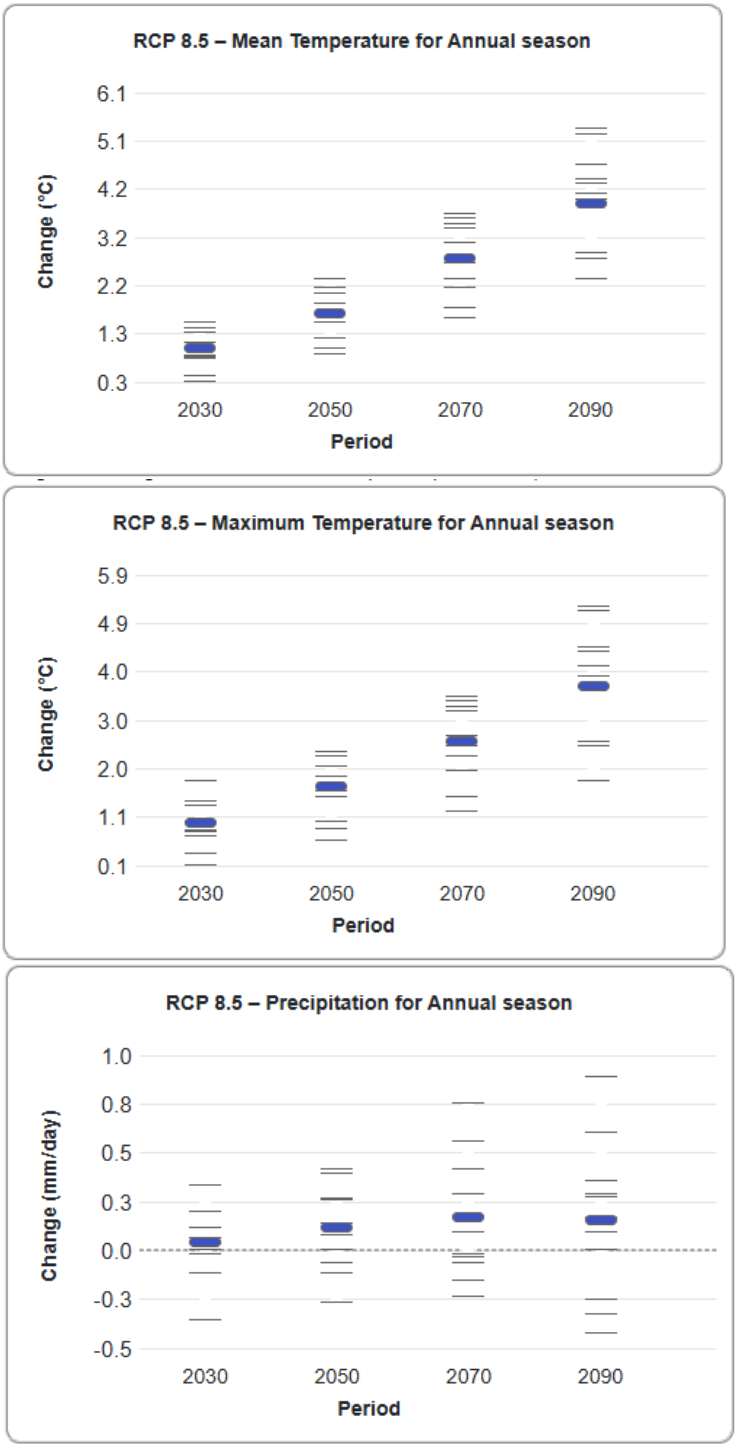


Figure 26-8: Climate predictions for Croydon Shire (Queensland Government 2024)

26.2.1.2 Drought

The Project is located in a generally arid region, with seasonal summer rainfall typically less than 350 mm and comparatively dry winters (BOM 2025). Average rainfall projections are unreliable for the Monsoonal Northeast sub cluster due to the natural climate variability of tropical processes; however, drought will continue to be a feature of the region with uncertain climate change implications (BOM & CSIRO n.d.). Highly variable rainfall, as demonstrated in Figure 26-9, is likely to continue.

According to the Gulf Hinterland Regional Drought Resilience Plan 2024-2030 (DAFF 2024) the Croydon Shire has been 'drought declared' for 0-5% of all years from 1964-2024. Despite this low percentage, the Shire was recently 'drought declared' for the period of November 2013 to December 2016 associated with consecutive years of low rainfall, as shown in Figure 26-9.

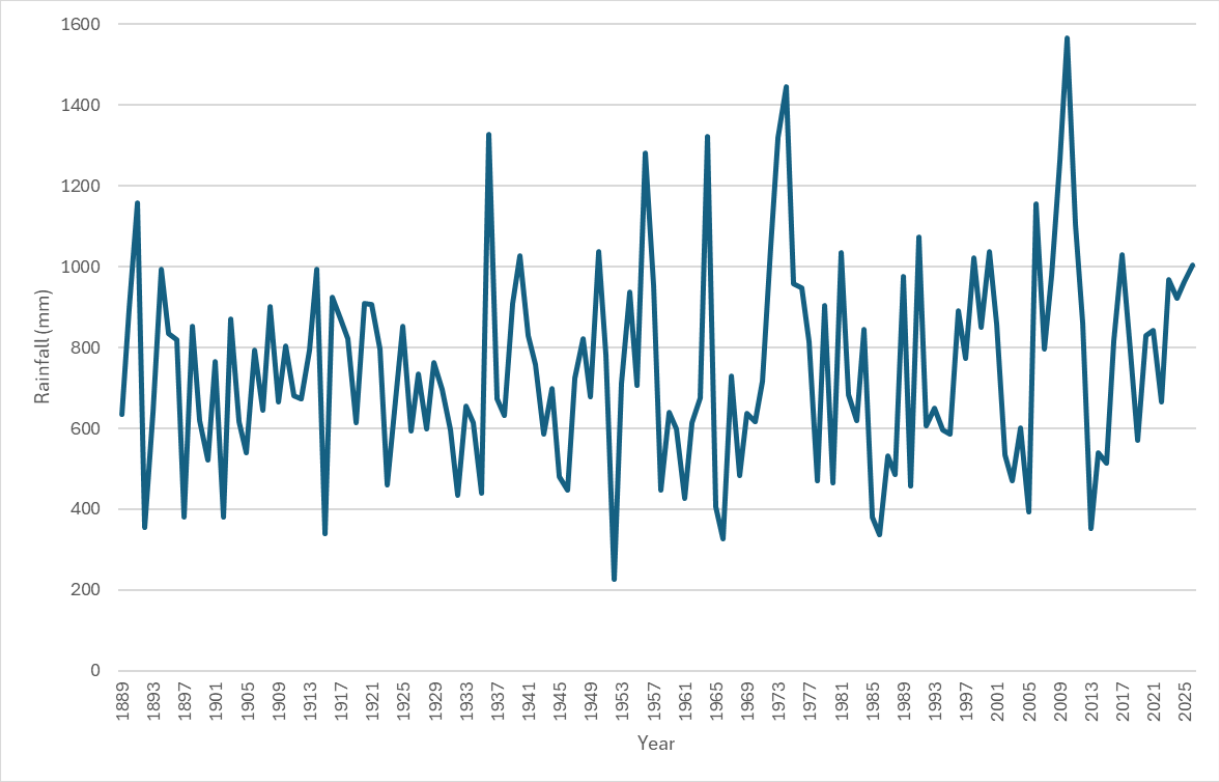


Figure 26-9: Croydon Township yearly rainfall (1889-2025)

26.2.1.3 Water security

The main water source for the Project will be groundwater. Groundwater abstraction from the underlying aquifer, the Gilbert River Formation is discussed in Chapter 14, Water Resources. As groundwater recharge occurs during the wet season at a rate of 1.25% to 2.5% of annual rainfall, pro-longed periods of drought may impact the underlying groundwater resource. However, groundwater modelling has not identified a shortfall as occurring for the life of the Project.

The Project will utilise associated water from an aquifer managed under the Great Artesian Basin and Other Regional Aquifers (GABORA) Water Plan as part of the Project water supply. Climactic periods such as drought may potentially place limitations to available water resources. The potential impact of the Project activities on groundwater drawdown has been extracted from the numerical groundwater model (Appendix L, Groundwater Impact Assessment). The Proponent will work with any affected landholders and negotiate appropriate agreements to mitigate risk to water users (Chapter 14, Water resources).

26.2.1.4 Bushfire

The Project area is described by the Queensland Fire and Emergency Service as an area that could be at risk of a dangerous fire. This means that the area shows potential for a bushfire to take hold, spread and do damage, if one started in the area. This description is based on local conditions such as vegetation type, topography and other indicators (Queensland Fire Department n.d.).

Bushfire predictions are typically based primarily on fuel availability, which is influenced by rainfall. A combination of higher rainfalls and fewer low temperature burns can create conditions where high fuel loads exist, means the risk of wildfires is higher. Changes to fire frequency will also influence the severity of bush fires. However, it is predicted that when fire events occur less frequently, they will be more extreme. More extreme climate would exacerbate these conditions.

The Project and surrounding areas are located in the Grazing Lands subregion of the Northern Gulf NRM region, which is subject to large, infrequent bushfires. Fire in the Northern Gulf grazing lands is infrequent because intensive grazing practices reduce the fuel load. Some graziers prefer to maintain grassland for feed rather than conduct low temperature burns or maintain fire breaks. Whilst these methods preserve pasture for stock, this can contribute to woodland thickening which generate higher fuel loads for wildfires (Northern Gulf Resource Management Group 2015).

Climate change predictions project increases in average temperatures, hot days and warm spells. Low humidity levels of 35% annual average 3 pm relative humidity for Croydon Township are forecast to continue. Longer dry, hot periods may further influence bushfire patterns.

The mine infrastructure area (MIA), including the accommodation camps and hazardous materials storage areas, are intended to be located within areas that will be cleared of vegetation as a bushfire risk mitigation measure. Buffers between vegetation and infrastructure will be maintained to ensure that all facilities are protected from radiant, bushfire heat. The on-site availability of firefighting equipment, water trucks and earth moving machinery will contribute to bushfire control on-site, and bushfire management will be addressed in the Emergency Response Plan (ERP) to be prepared for the Project.

26.2.1.5 Cyclone and severe wind hazard

As the Project is located inland within a non-cyclonic wind region (Sexton et al. 2023), it is less vulnerable to tropical cyclones than areas closer to the coast. However, this region may experience indirect impacts from cyclones such as significant rainfall and flooding from decaying cyclones and tropical lows as evidenced by significant cyclone events.

There is a history of extreme storms in the region (Croydon Shire Council 2025). Severe storm events with damaging winds and heavy rain occur frequently in the locality of the Project. These events along with lightning strikes can cause localised power outages, disruptions to transport or communications, and damage to property or personnel health and safety.

26.2.1.6 Discharge to air

Dust and particulate emissions from the Project may spread in the atmosphere. The severity of impact from these emissions are influenced by weather and climate conditions, including wind, temperature inversions, and atmospheric pressure.

CALPUFF dispersion model (version 7.2.1) has been used to quantify the incremental change in air pollutants and dust associated with the Project. CALPUFF is an advanced non-steady-state air quality modelling system that is approved by DETSI for dispersion modelling. The TAPM/CALMET models were used to simulate meteorological conditions in the region around the project site, in consideration of the existing environment as detailed in Section 26.1 The data generated by these models was used as inputs for the dispersion model to account for all weather conditions likely to be experienced in the region during a typical year. The modelling has been used to predict maximum ground-level concentrations and deposition rates of dust across a cartesian grid of the Project region and at the locations of the identified sensitive receptors. Ground-level concentrations of dust and key exhaust pollutants, and dust deposition rates associated with the Project have been predicted at the sensitive receptors through this process.

Ambient background dust levels have been added to the incremental model predictions to obtain an estimate of the potential cumulative impact of the project, with existing natural and anthropogenic sources of dust. Air pollutant levels have been assessed by comparing the predicted concentrations and dust deposition rates with the relevant air quality objectives at sensitive locations.

Results of the Air Quality Assessment (Appendix A) demonstrated that predicted ground-level concentrations of all air pollutants and dust deposition rates due to the Project with ambient background levels included are predicted to comply with the relevant air quality objectives at all sensitive receptors.

26.2.1.7 Noise

Noise emissions from the Project may be influenced by climatic conditions.

Noise modelling has been undertaken by AARC (Appendix I) using SoundPLAN (version 9.1). The noise modelling program considers the mine and local topography, noise levels and locations of equipment, distance attenuation, ground and air absorption, natural and artificial barriers, and meteorological effects. Predictions under different meteorological conditions and a single typical worst-case meteorological condition were generated using CONCAWE and ISO 9613-2:2024 (ISO 9613) algorithms, respectively.

As the propagation of noise in the outdoor environment can be influenced by local meteorological conditions either in isolation or as a combined weather condition, the SoundPLAN model uses CONCAWE and ISO 9613 algorithms to predict noise levels under five combinations of meteorological conditions, considering temperature, relative humidity, wind speed, wind direction and Pasquill Stability Class.

As shown in Table 26-5, the standard meteorological conditions used for noise modelling are calm (nil wind), downwind, and day and night conditions. Each meteorological condition listed is of what would be expected to be prevalent in a rural location, and it is expected that higher noise levels will be predicted under night and/or downwind conditions.

Table 26-5: Noise modelling meteorological conditions

Meteorological parameter	CONCAWE algorithm				ISO 9613-2:2024 algorithm
	Calm – day conditions (experienced in the day, evening and night)	Downwind-day conditions (experienced in the day, evening and night)	Calm – night conditions (mostly experienced in the evening and night)	Downwind-night conditions (mostly experienced in the evening and night)	Downwind conditions (mostly experienced in the evening and night)
Temperature (°C)	25	25	10	10	10
Relative Humidity (%)	40	40	70	70	70
Wind Speed (m/s)	Nil	2	Nil	2	ISO 9613
Wind direction	NA	Towards receivers	NA	Towards receivers	Towards receivers
Pasquill Stability Class	D (neutral conditions)	D (neutral conditions)	F (moderately stable condition, which is typical of a moderate temperature inversion)	F (moderately stable condition, which is typical of a moderate temperature inversion)	NA (Moderate temperature inversion)

The results of noise impact modelling, in consideration of varying (and worst-case) climate conditions, indicates that the Project is compliant with the EPP (Noise) acoustic quality objectives and background creep

requirements. The predicted A-weighted noise levels at residential sensitive receptors are under the acoustic quality objectives, where the daytime noise limit is at 40 dBA and the night-time limit is at 35 dBA.

26.2.1.8 Flooding

The Project is located within the Norman River Catchment area, which drains north to the Gulf of Carpentaria. The Norman River Basin has a total catchment of 49,000 km^2 with the main rivers being the Norman River, Clara River and Yappar River. The Project is within an area that is prone to flooding. It is located immediately north of Warrigal Creek and the Borer River and has an unnamed waterway (stream order 3) flowing through the northern extent of the MLA. Topography surrounding the Project area is very flat which results in widespread flooding with interactions between the major waterways during significant flood events.

Access to the Project may be restricted in extreme flood events. The existence of the Project has the potential to impact flooding risk through the modification of drainage pathways on the Project area. This flooding risk is discussed in Chapter 16, Flooding and Regulated Structures.

Flooding has been assessed and is included in Chapter 16, Flooding and Regulated Structures. The peak flood maps for the 1% AEP and is provided in the assessment and shows that in extreme events, the area surrounding the Project will be flooded. A summary of flood modelling for two climate scenarios is provided below.

Engeny (2026) developed a simulation of the Existing Case Flood for two future climate change scenarios to assess change in flooding (afflux and velocity) and determine the potential flooding impacts from different SSP emission pathways:

- Median Emission Pathway Projection (SSP2-4.5 2090).
- High Emission Pathway Projection (SSP5-8.5 2090).

Flood modelling results for the median and high emission paths for 2090 have been compared to the current day scenario (2030) model results to calculate resulting change in flood height (afflux). These results show the incremental change in existing flooding conditions due to potential future climate scenarios. It is noted the current day modelling was used to assess the operational phase flooding impacts and the high emission pathway projection was used to assess the closure phase flooding impacts for the Project.

Climate change and uplift factors have been applied in accordance with the site-specific duration dependant estimates for rates of change (%/C), and loss scaling ratios.

The flood impact assessment results show the following:

- Increase in flood levels from climate change was most pronounced in the upstream major waterways where flooding is more contained to the main river channels and decreases downstream where there is significant breakout flooding.
- The SSP2-4.5 pathway for 2090 results in an increase in depth across the floodplain. Breakout flooding towards the MLA has increased by up to 0.33 m, in the 0.1% AEP event and 0.37 m in the 1% AEP event. Flooding at the MLA increases by 0.18 m in both the 0.1% and 1% AEP events. Minimal changes to flood velocity were modelled for this scenario.
- The SSP5-8.5 pathway for 2090 results in an increase in depth across the floodplain. Breakout flooding towards the MLA has a modelled afflux of up to 0.75 m in the 0.1% AEP event and 0.82 m in the 1% AEP event. Flooding at the MLA increases by 0.45 m in both the 0.1% and 1% AEP events.
- Flood velocity afflux in the SSP5-8.5 pathway was minor, modelled at 0.15 – 0.35 m/s for the 0.1% and 1% AEP events.

26.3 Mitigation measures

The following sections describe the mitigation measures and strategies to minimise climate change impacts to the Project and post mine land uses for the Project and surrounds. These activities are designed in accordance with the hierarchy of control where negative impacts are avoided where possible and mitigated if they cannot be avoided.

These mitigation measures are detailed throughout the EIS and are in the form of various management plans. The mitigation measures relevant to climate are summarised in the following sections.

It is anticipated that all mitigation measures proposed will be enacted where relevant across all Project phases, including construction, operation, and decommissioning and rehabilitation. It is acknowledged that unabated climate change will worsen climate conditions and severe weather – including cyclones, bushfires and drought. The management plans developed for the Project will include regular reviews that facilitate revision as necessary to adapt to climate change.

26.3.1 Water management plan

It is recognised that the Project area is an area subject to periods of high rainfall and regional flooding. Risks associated with water are managed through a Water Management Plan (WMP). The WMP is described in detail in Chapter 14, Water Resources. The WMP will be prepared for the Project and will provide a structure for achieving water quality objectives (WQOs) to protect environmental values (EVs) including the management controls proposed to reduce risks to an acceptable level.

The WMP will address climate risks by;

- diverting clean water around mine infrastructure and disturbed land through diversion drains to reduce external catchment area reporting to the mining pit and site storages and reduce impacts of flooding;
- containing of mine affected water in dedicated storages for reuse in the Project to reduce risk of water scarcity during drought periods, and sized to reduce the potential for release during high rainfall events;
- utilising dedicated processing pond for recirculation of water used in various stages of the processing circuit to eliminate interactions with flood water during high rainfall periods;
- decanting tailings water to minimise water stored on the tailings beach and maximising reuse in the plant;
- developing an on-site raw water storage (Raw Water Dam) to supply raw water demands and reduce water supply requirements;
- capturing sediment water in sediment basins and other sediment control infrastructure to minimise contaminants leaving site during rainfall periods;
- preferentially re-using mine affected water and sediment water captured by the Project to supply operational water demands; and
- progressively rehabilitating/stabilising waste rock dumps, topsoil stockpiles, and mine infrastructure areas to reduce the generation of sediment water.

In addition to the above management strategies, the Project will develop a flood levee around key project infrastructure including the open-cut pit, and processing plant, to prevent infrastructure and site damage from flooding events. This is detailed further in Chapter 16, Flooding and Regulated Structures.

26.3.2 Emergency response plan

An emergency response plan (ERP), discussed in Chapter 22, Hazards, Health and Safety, will respond to all emergencies including those that relate to climate conditions such as bushfire or flooding. The focus of the ERP will be on worker's safety. The ERP will be prepared for all phases of the Project and will cover the following key elements:

- severe injury or illness;
- vehicle/machinery collision;
- vehicle collision;
- chemical/fuel spill;
- heatwaves or high temperatures;
- flooding or cyclones; and
- fire or bushfires.

The ERP will also manage the Project operating under climate related disruptions in the broader region that will include mine accommodation, evacuation requirements, and interactions with local communities and emergency services during natural disasters.

26.3.2.1 Bushfire management plan

The ERP will include a bushfire management plan (BMP) subordinate plan which will outline the roles and responsibilities in the event of a bushfire and the training and resources required to perform duties involved in the response. The BMP will be developed upon approval of the Project.

The BMP section of the ERP will include the following information to mitigate the risk of bushfires:

- a bushfire hazard analysis and risk assessment for the approaching season;
- fire regimes for vegetation communities;
- detailed bushfire mitigation strategies;
- assessment of risk associated with the Project access and road network;
- identification of fire management zones;
- identification of existing and proposed firebreaks and fire management lines; and
- assessment of any proposed vegetation clearings for fire control.

26.3.3 Surface water management infrastructure

The Project will be designed to withstand the existing and potential climactic conditions for the location. A flood protection levee is proposed to protect operational areas from flood ingress up to 0.1% AEP. Additionally, the stream order 3 waterway that currently intercepts the proposed pit location is proposed to be permanently diverted to prevent inundation of the pit during all phases of the Project life including post closure. Details of surface water infrastructure design is provided in Chapter 14, Water resources.

26.3.4 Greenhouse gas emissions

The Project will produce up to 3.5 Mtpa of Run-of-Mine (ROM) ore over an operational mine life of approximately 53 years. Mining is via conventional truck and excavator methods to a depth of 250 m below ground level. Graphite ore (~6% total graphite) will be trucked to the onsite mineral processing plant for stockpiling and concentration via conventional flotation methods. These activities involve the use of various fuels and processes which produce GHG emissions that contribute to climate change. Emission generation is detailed further in Chapter 27, Greenhouse gas.

A Decarbonisation Plan with management controls to abate GHG emissions is detailed in Chapter 27, Greenhouse Gas, and includes practical measures that adhere to the mitigation hierarchy, including;

- Avoidance - where possible through strategic and operational planning decisions that consider opportunities to avoid GHG generation e.g. power infrastructure optimisation and solar
- Reduction - of GHG emissions where possible by materially changing energy process inputs where practical;
- Substituting - lower emission plant and equipment where possible; and
- Offsetting - in accordance with Safeguard requirements where required.

26.4 Effectiveness of risk controls

The Project will incorporate a comprehensive set of risk controls that will be managed in a risk database. Key controls will be reviewed on a regular basis in accordance with a risk review audit schedule. Critical controls to manage risks with higher risk ratings will be reviewed more regularly and reported to senior management on their effectiveness. The accountability for key risk controls will be assigned to senior roles to ensure they remain a priority.

26.5 TOR Reconciliation table

Terms of reference - Content requirements of the EIS		EIS Section
Section 26 - Climate		
26.1	The following guidance is relevant for the assessment of climate: (a) Queensland Government, Climate – EIS information guideline, ESR/2024/5298.	
Climate - Existing environment		
26.2	Describe the existing climate in accordance with the Climate – EIS information guideline. The description should include, but not be limited to: (a) the local and regional climate relevant to the project, with regard to its seasons and its susceptibility to extreme events such as droughts, cyclones, flooding and bushfires (b) rainfall patterns (including magnitude and seasonal variability of rainfall) (c) overland flow paths (d) air temperature, evaporation, humidity, wind (direction and speed), atmospheric pressure and any other special factors (e.g. temperature inversions) that may affect the management of the project.	Section 26.1.1
Climate - Impact assessment		
26.3	Conduct an assessment in accordance with the Climate – EIS information guideline.	Section 26.2
26.4	Describe the project area's climate patterns that are relevant to the environmental impact assessment, particularly the project's discharges to water and air, and propagation of noise. Climate information is to be presented in a statistical form including long-term averages and extreme values reflecting extreme weather events (e.g. droughts, floods and bushfires), as necessary. It should also be illustrated by bar charts, wind rose diagrams, or other relevant graphic means as necessary.	Section 26.2
26.5	Assess the project's vulnerabilities to projected climate change (e.g. changing patterns of temperature, rainfall, hydrology and extreme weather events). In the assessment of climate hazards and risks, reference relevant climate projection data (e.g. Queensland Future Climate high-resolution climate projection data) and employ appropriate risk assessment methodology.	Section 26.2
Climate - Mitigation measures		
26.6	Describe the adaptation strategies and/or activities designed to minimise climate change impacts to the project, subsequent land uses on that site (e.g. rehabilitation projects) and surrounding land uses. Adaptation activities must be designed to avoid perverse outcomes, such as increased emissions of GHGs, temperature rise, an increase in frequency and intensity of severe weather events, or maladaptive outcomes for surrounding land uses.	Section 26.3