

Chapter 29
Cumulative impact

ESMERALDA GRAPHITE PROJECT

aarc ENVIRONMENTAL SOLUTIONS
APEM Group

GRAPHINEX

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Glossary, acronyms and abbreviations

Acronym or Abbreviation	Meaning
ACCU	Australian Carbon Credit Units
AEP	Annual Exceedance Probability
AS	Australian Standard
BESS	Battery energy storage
BMP	Bushfire Management Plan
CHMP	Cultural Heritage Management Plan
DAF	Department of Agriculture and Fisheries
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DoEE	Department of the Environment and Energy
DPI	Department of Primary Industries
EF	Energy Factor
EIS	Environmental Impact Statement
EO Act	*Environmental Offsets Act 2014*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPP (Noise)	Environmental Protection (Noise) Policy 2019
ERA	Environmentally Relevant Activities
ESCP	Erosion and Sediment Control Plan
EV	Electric Vehicles
GHG	Greenhouse gas
GRF	Gilbert River Formation
HOFF	Hydrocarbons-off
HDPE	H
IBRA	Interim Biogeographic Regionalisation for Australia
IECA	International Erosion Control Association
KPI	Key Performance Indicator
KRA	Key Result Areas
LGA	Local Government Area
LOP	Life of Project
ML	Mining Lease

Acronym or Abbreviation	Meaning
MLA	Mining Lease Application
MSES	Matters of State Ecological Significance
MW	Megawatts
NEM	National Electricity Market
NMP	Noise Management Plan
NZS	New Zealand Standard
OCG	Office of the Coordinator General
PMLU	Post mining land use
PPA	Power purchase agreement
PPE	Personal protective equipment
PRCP	Progressive Rehabilitation and Closure Plan
PV	Photovoltaic
QEOP	Queensland Environmental Offset Policy
RE	Regional Ecosystem
RNTBC	Registered Native Title Body Corporate
SHMS	Safety and Health Management System
SIA	Social Impact Assessment
SIMP	Social Impact Management Plans
SPC	Soil Profile Class
STP	Sewage Treatment Plant
TBD	To be determined
TOR	Terms of Reference
VM Act	*Vegetation Management Act 1999*
WPMP	Weed and Pest Management Plan

29 Cumulative impact

29.1 Environmental objectives

This chapter summarises the impacts of the Project and presents a cumulative impact assessment on the relevant environmental values. That is, whether the combined effect of potential impacts of different components/aspects of the Project on the same environmental value (i.e. intra project cumulative impacts) or the impacts of other relevant projects acting in combination on the same environmental value (i.e. inter-project cumulative impacts) are greater than the individual impacts.

29.2 Existing environment

29.2.1 Relevant projects

There are several existing or planned resource projects and operations located within the Project region (Figure 29-1). Projects that may be considered relevant to this cumulative impact assessment include the:

- Croydon Gold Project (owned by Jubilee Metals) including several precious and base metals near term gold exploration and development projects;
- Vecco Critical Minerals Project (owned by Vecco Industrial Pty Ltd and currently subject to approvals);
- Saint Elmo Vanadium Project (owned by Multicom Resources Limited and currently at construction phase);
- Julia Creek Vanadium and Energy Project (owned by QEM Limited and currently subject to approvals); and
- Richmond-Julia Creek Vanadium Project (owned by Richmond Vanadium Technology Pty Ltd and currently subject to approvals).

None of these projects are operational at the time of preparation of this EIS.

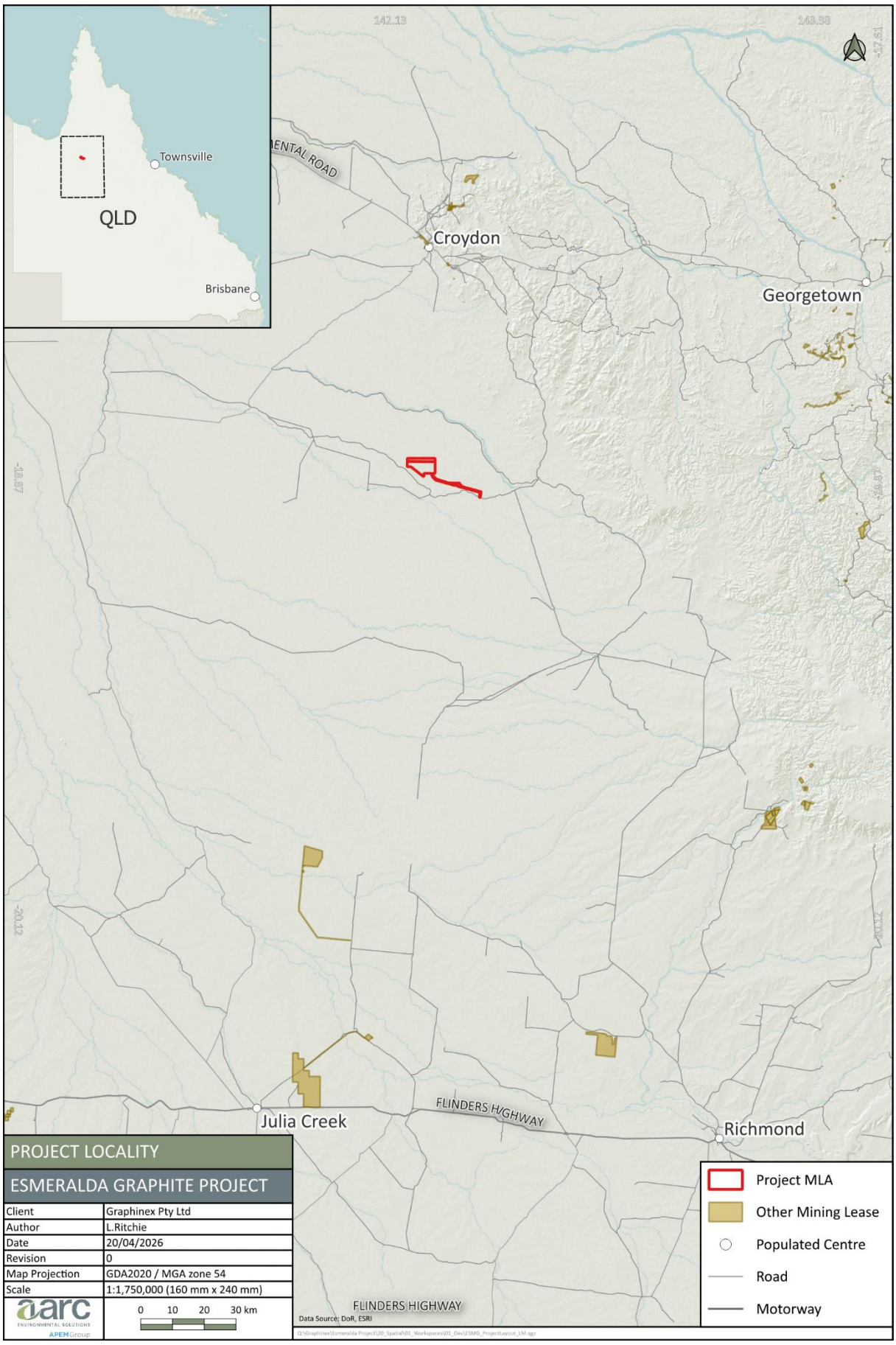


Figure 29-1: Other mining leases

29.3 Potential impacts

Potential impacts by the Project will occur across all phases of the Project life, with varying degrees of likelihood, intensity, duration, magnitude, and extent. This includes during construction, operation, and decommissioning and rehabilitation.

A summary table of environmental values which may be affected by cumulative impacts is provided in Table 29-1. The risk of cumulative impact presented is determined in consideration of proposed mitigation and management measures relevant to identified potential impacts on each environmental value.

Risk of cumulative impact has been assessed as either low, or minor for all environmental values. Low risk includes where no inter- or intra-project actions are likely to cumulatively impact environmental values. Minor risk identifies some potential for cumulative impacts, but with proposed mitigation and management measures it is expected that these impacts would be contained and not significant.

Table 29-1: Summary of potential cumulatively affected environmental values

Environmental value	Duration/Project phase	Risk of cumulative impact
Land	Construction, operation, rehabilitation	Low
Infrastructure and resources	Construction, operation	Low
Terrestrial and aquatic ecology	Construction, operation, rehabilitation	Low
Matters of State Environmental Significance	Construction, operation	Low
Water	Construction, operation, rehabilitation	Low
Air quality	Construction, operation	Low
Greenhouse gas and climate change	Construction, operation	Minor
Noise and vibration	Construction, operation	Low
Public health and safety	Construction, operation	Low
Social	Construction, operation	Minor
Economic	Construction, operation	Minor
Transport	Construction, operation	Low
Cultural	Construction, operation, rehabilitation	Low

29.4 Cumulative impact assessment

29.4.1 Land

The Project's potential impact on land environmental values is detailed in Chapter 10, Land – geology, geomorphology, topography and soils.

29.4.1.1 Potential impacts

Surrounding land uses in the Project area are predominantly cattle grazing and mining. The Project will add to the relative proportion of mining as a land use. However, given the distances of the Project from other mining projects in the region, with the closest project being approximately 70 km away (the Croydon Gold Mine), the

cumulative impact is not expected to be significant. Impacts will occur from Project commencement until rehabilitation and site surrender.

29.4.1.2 Mitigation, management and monitoring

Land contamination

Potential land contamination will be mitigated and managed by implementing the following:

- An Erosion and Sediment Control Plan (ESCP) for all stages of mining activities on site to minimise erosion and release of sediment to receiving waters and contamination of stormwater.
- Ensuring all hazardous chemicals, corrosive substances, toxic substances, gases and dangerous goods are stored and handled in accordance with the current Australian standard, where such is applicable.
- Minimising the potential for contamination of land and waters by diverting stormwater around contaminated areas and facilities used for the storage of chemicals and flammable or combustible liquids.
- Treating sewage effluent on-site, within a STP at the on-site accommodation facility towards the eastern boundary of the Project MLA. The STP is designed to treat 100% of potable water throughput of the accommodation camp for the Project. Treated effluent generated by the STP will be managed via land application through irrigation.
- Irrigation water will be applied to land as a means of disposing of STP effluent. The irrigation system will be operated using a simple fixed daily design irrigation rate of no more than 3.5 mm/day to dispose a conservative volume of 40 m^3 per day of secondary treated effluent. Modelling (Stantec 2024) indicates that the rate and area of irrigation will result in no nutrient leaching, waterlogging, runoff or overflow issues arising.
- If any unexpected contamination due to prior land uses is identified, work will cease in that area and appropriate actions taken to delineate the contaminated area. If required, further investigation and/or remediation works will be undertaken.
- The Project will progressively rehabilitate the land, with the objectives of restoring land capability and connectivity. Rehabilitation will aim to re-establish contiguous grazing areas and minimise long-term fragmentation of grazing land. Access to infrastructure will be reinstated where practicable.

At mine closure, the Project will remediate any land contamination, including spills or seepage from mine affected water storage, and all disturbed areas (except for retained infrastructure) will be rehabilitated and returned to the Project site to the pre-existing land use of low intensity cattle grazing on native vegetation, in line with the Progressive Rehabilitation and Closure Plan (PRCP). Thus, no intra-project cumulative impacts are expected.

Soils

Any potential cumulative soil impacts that may arise from the Project will be avoided, minimised, or mitigated with appropriate soil stripping, stockpiling, placement, and amelioration practices. Such soil handling practices will vary based on the characteristics of the soil profile class (SPCs) in the Project area and hence, will be specific to each SPC. However, soil management practice will generally follow the recommendations made by GT Environmental (2026), including the following:

- stockpile locations will be placed in areas outside the mining activities, as close to the area to be rehabilitated where possible and away from watercourse and tributaries;
- any known overland flow, watercourse and tributaries around the stockpiles will be diverted or have appropriate measures in place to prevent erosion;
- locations are to be designated off limits by remaining grazing stock, machinery, and vehicles;
- stockpile locations will be placed against existing vegetated areas to function as a buffer, or adjacent to any rise in landscape to provide protection from wind erosion, where possible;

- ripping, seeding and/or adding amelioration treatments will occur during operation to minimise compaction and surface structure degradation;
- the surface of the stockpile will be flat;
- adequate erosion and sediment control including but not limited to sediment fencing, shall be placed on the down slope area of stockpiles;
- the installation of plastic lined catch drains or runoff areas along the surface edge of waste or elevated landforms may assist in minimising surface runoff on batter slopes;
- stockpiles will have a maximum height of 3.0 m, preferably 2.0 m with a batter recommended no steeper than 3 h: 1 v (horizontal run to vertical rise). Stockpiles required to be more than 3.0 m in height shall require additional erosion and sediment controls and ideally be temporary stored;
- covering of the stockpiles with grasses or groundcover species appropriate to the nominated PMLU would minimise erosion and soil loss, minimise the establishment of weeds, assist in maintaining organic matter, nutrients and microbial activity and rejuvenate native vegetation through existing seedbank;
- stockpiles which are scheduled to be stored over a long term period i.e. not utilised within a short term period of stripping to replacement of soil resources, shall be reviewed and soil turned and mixed, into order to engage deeper stockpile soils, spread biological aspects of existing growth medium and existing vegetation (now organic matter). This will reduce the situation of stockpile soil being unbalanced with surface soils retaining their health (biological, physical and chemical) with deeper soils becoming weathered and transitioning to less healthy, potentially subsoil resources;
- an inspection of the stockpiles will occur once they are completed with scheduled ongoing maintenance either as required or recommended every six months if no scheduling has been considered.

29.4.2 Infrastructure and resources

The Project's potential impact on infrastructure and resources is detailed in Chapter 4, Project description.

29.4.2.1 Potential impacts

The Project will utilise existing infrastructure including roads, airports, port, and waste management facilities. Usage of infrastructure proposed to be utilised will be within existing capacity, or with minor improvements such as to the local road network. This is detailed further in Section 29.4.12. Electricity will be generated on-site, and the Project will not be connected to the regional electricity grid and will not utilise existing energy infrastructure.

Similarly, the Project will not be connected to the regional water supply infrastructure and network which services the township of Croydon. Supply of processing water will be from recycled sources on the mine site, including pit dewatering groundwater abstracted to enable the mining operations and process water returned from the tailings.

The Project will not be connected to a regional sewage system. An on-site sewage treatment plant will be constructed, while a primary sewage treatment process will be installed during the construction phase.

If other regional projects are successfully developed – then it is expected that each project will have a varying degree of additional impact on regional infrastructure. This may include heavy vehicle traffic and demand for regional airports.

Given that the Project will utilise the existing infrastructure with existing capacity and be disconnected from the regional water and electricity supplies - and has captured the closest other regional mining project (Croydon Gold Project) as part of impact assessments - inter- and intra-project cumulative impacts of the Project regarding infrastructure and resources in the region are not expected to be significant.

29.4.2.2 Mitigation, management and monitoring

Impacts to infrastructure and resources are mitigated predominantly through inherent Project design features, including developing a secure water supply, and on-site electricity solution which ensure the Project is not reliant on the regional electricity grid or regional water networks.

The Project will develop on-site accommodation, which will minimise impacts on the sparse available housing in the region and supporting infrastructure.

The Project use of existing capacity in airports, road networks, and potentially the rail and port network, determine that additional mitigation measures are not required.

29.4.3 Terrestrial and aquatic ecology

The Project's potential impact on ecological environmental values is detailed in Chapter 18, Flora and fauna.

29.4.3.1 Potential impacts

The cumulative impact assessment has considered the habitat and species occurring (species diversity, abundance and dynamics), patterns of species distribution (the communities and ecosystem present that encompass all species), broad habitat types (the ecological niches for the range of species present) and ecosystem processes.

The Project is located within the Gulf Plains Bioregion, a national classification system that identifies geographically distinct areas based on common ecological characteristics. This bioregion, which covers 21,910,942 ha, is then classified into more homogeneous and localised subregions, including the Claraville Plains subregion, where the Project is located (Wetlandsinfo and IBRA from DCCEEW). The Claraville Plains subregion has an area of approximately 3,709,694 ha, and has been used to assess cumulative biodiversity impacts that the Project may contribute to; as the subregion supports the most similar vegetation, flora, and habitat types for fauna, on a regional scale, as the Project.

Land use and projects in the Claraville Plain subregion that may contribute cumulative impacts

Within the Claraville Plains subregion, grazing contributes 95.4% to the land use. Other land uses in the subregion are transport and communication, residential and farm infrastructure, mining, intensive animal production and irrigated cropping; however, they contribute less than 0.1% of the total area. Wetlands, marsh, lakes and rivers contribute 4.5% of the subregion area.

In the subregion, remnant vegetation communities remain largely in place, relative to more eastern bioregions and subregions that have been subject to broad-scale clearing practices. However, despite its largely intact state, the subregion faces several threats, including land degradation from inappropriate grazing pressure and exotic plant invasion, such as Rubber Vine.

In the subregion, there is one town, Croydon, over 70 km north of the Project; and immediately to the north-east of Croydon, there is one mine, Croydon Gold mine - which proposes to recommence mining and processing gold ore. Jubilee Metals is in the construction phase now (accurate at time of reporting, January 2026). There are no other projects identified in the subregion. A recent ecological assessment undertaken for the Croydon Gold Mine (Epic Environmental 2022) identified REs within the site, including those potentially impacted by the recommencement of mining. There are no REs identified by this assessment that are found within the proposed Graphinex Esmeralda Project site, and therefore no cumulative impacts on regional ecosystems in the Claraville Plains subregion will occur. A total of 75.5 ha of remnant vegetation will be impacted by the Croydon Gold mine recommencement.

Land clearing

While grazing occurs in the surrounding area and land clearing for tracks and infrastructure has been undertaken, minimal land clearing for grazing has occurred, evidenced by remnant vegetation predominantly

occurring throughout the subregion. The Project, however, has the potential to contribute to the cumulative impact of land clearing with other mining activities.

The Project will result in direct disturbance of an estimated 2,413.7 ha of remnant vegetation, adding to the remnant vegetation clearing from other development in Croydon which is considered minor, for a cumulative impact of 2,489.3 ha. The impacted vegetation represents approximately 0.067% of the current extent (Accad *et al.* 2024) of remnant vegetation in the Claraville Plains subregion, and approximately 0.11% of the Gulf Plains bioregion.

Impacts to fauna

Impacts from noise and vibration, dust and air, and vehicle strike, are not expected to cumulatively impact fauna from other projects.

Downstream ecosystems

The Project is unlikely to impact major watercourses, such as the Warrigal Creek or the Clara River. Considering the lack of other development in the local catchment area, key ecosystem cycles are unlikely affected by cumulative impacts.

Biodiversity corridors

The Project will not contribute to cumulative impacts on known biodiversity corridors, that provide mobility for fauna and may also be considered climate refugia for some species (Reside *et al.* 2014).

Impacts within riparian corridors are limited to the upgrade of existing crossings of small tributaries along the transport corridor and the watercourse diversion.

Aquatic ecosystems

The Project is unlikely to impact major watercourses, such as the Warrigal Creek, the Borer River or the Clara River. These watercourses are also considered unimpacted by other minerals Projects, though they are considered likely to have been impacted by the agricultural land use activities of the area. Considering the lack of other development in the local catchment area, key ecosystem cycles are unlikely affected by cumulative impacts.

29.4.3.2 Mitigation, management and monitoring

Vegetation clearance, habitat disturbance and habitat fragmentation and connectivity

- Clearing activities will be undertaken progressively in accordance with the mine schedule and Project requirements and not before necessary, to protect the land.
- Vegetation/habitat adjoining proposed clearance areas will be delineated and clearly marked.
- Prior to vegetation clearing, areas to be impacted will be inspected to identify fauna at direct risk from clearing activities.
- Clearing operations will be managed to maximise the reuse of cleared vegetative material. This will include the potential to salvage and reuse select habitat resources from the cleared vegetation (e.g. logs) for habitat enhancement, either in the rehabilitation program or elsewhere on site, or mulching of removed vegetation for respreading to minimise erosion.
- Clearing activities will be undertaken in accordance with mitigations measures for cultural heritage matters, developed in consultation with the Tagalaka People (detailed in the Cultural Heritage EIS chapter for the Project).

Vehicle strike

- Speed limits will be implemented for vehicle strike.
- Safe driving procedures will be incorporated into site inductions to increase awareness of the risk of vehicle strike.

Weeds and pests

- A Project Weed and Pest Management Plan will be implemented to incorporate weed and pest management measures for the Project (Refer to Chapter 19 for further detail). The Weed and Pest Management Plan will include:
    - inspections within the Project disturbance area to identify areas requiring weed management to be implemented;
    - weed management measures (e.g. mechanical removal and application of approved herbicides) in consideration of weed control strategies outlined by the Department of Agriculture and Fisheries and the 'North West Queensland Regional Biosecurity Plan 2022–2027' (North West Queensland Regional Council 2022);
    - procedures for maintaining a clean, rubbish-free environment to discourage scavenging and reduce the potential for colonisation of these areas by introduced fauna; and
    - feral animal control strategies in consideration of pest control strategies outlined by the Department of Agriculture and Fisheries, 'North West Queensland Regional Biosecurity Plan 2022–2027' (North West Queensland Regional Council 2022) and Threat Abatement Plans applicable to the EPBC Act listed key threatening processes.

Noise and vibration

- Regular inspections and servicing of vehicles and equipment will be undertaken to ensure they are operating in accordance with specifications.
- Monitoring of noise and vibration impacts will be undertaken at sensitive locations.

Dust

- Dust management and mitigation measures will be undertaken, and will include watering or using chemical surface suppressants on unsealed roads, tracks and stockpiles as required.
- Air quality monitoring programs will be implemented to ensure protection of ecology and agriculture in accordance with environmental authority conditions.

Artificial lighting

- The exterior lighting design for the Project will consider the Australian Standard AS/NZS 4282:2019, 'Control of the obtrusive effects of outdoor lighting,' which acknowledges the potential impact of artificial light on biota (DoEE 2020).

Hydrological changes

- A water management plan will be developed and implemented to ensure effective design and management of surface flows around the mining operation, with consideration of surrounding biota, including wetlands.
- An erosion and sediment control plan will be developed and implemented to mitigate erosion processes and protect downstream ecosystems from increased sediments loads.
- A water quality monitoring program will be developed and implemented to confirm the effectiveness of management practices and the protection of downstream ecosystems.

Bushfire

- Bushfire prevention and management measures will be implemented for the Project, and
- Fire awareness will be included in the induction of personnel and contractors to minimise the risk of bushfire.
- The Project infrastructure design will install fire breaks where required, to act as a stop-gap between possible sources of fire, such as sparks and open flames, and vegetation.
- Fuel loads in vegetation surrounding the operation will be monitored and managed.

Water course and wetland impact mitigation

The Project is not expected to result in impacts to the aquatic ecology values of watercourses or wetlands. Notwithstanding this, proposed water management measures will be implemented such that potential impacts to aquatic ecology values are minimised. Chapter 14, Water Resources and Chapter 15, Water Quality identify the proposed management measures that will minimise potential impacts to surface water flows and quality.

The disturbance activities are not subject to the 'Accepted development requirements for waterway barrier works' (DPI 2025) and 'State code 18: Constructing or raising waterway barrier works in fish habitats' (DAF 2022) because they will be located within the Project's ML and, therefore, are exempt from assessment under the Planning Act. Notwithstanding, to minimise impacts to waterways providing fish passage, these activities will be configured and developed according to the accepted development requirements provided in the relevant guidelines.

In particular the diversion will be designed in accordance with the 'State code 18: Constructing or raising waterway barrier works in fish habitats' (DAF 2022) performance outcomes that are relevant to 'All Development' under the code.

Fish passage

The disturbance activities are not subject to the 'Accepted development requirements for waterway barrier works' (DPI 2025) and 'State code 18: Constructing or raising waterway barrier works in fish habitats' (DAF 2022) because they will be located within the Project's ML and, therefore, are exempt from assessment under the Planning Act. However, in order to minimise potential impacts to aquatic ecology values of the Project area, the proposed diversion will be designed in accordance with the 'State code 18: Constructing or raising waterway barrier works in fish habitats' (DAF 2022) performance outcomes that are relevant to 'All Development' under the code. A summary of performance outcomes from State Code 18 considered relevant to managing potential impacts to fish passage from the diversion includes:

- The development will be designed, constructed and maintained to avoid and minimise impacts on matters of state environmental significance;
- Aspects of development are only permitted within a waterway where there is a functional requirement and the development cannot be feasibly located elsewhere. Ancillary elements will be located outside of the waterway;

- Development will not result in adverse impacts to fisheries resources;
- The design, construction and maintenance of the development will not result in non-essential hardening or unnatural modification of the main channel of the waterway;
- The development will retain natural fish habitat and features such as shade, pools, riffles, rock outcrops and boulders, wherever possible;
- The design, construction and maintenance of the development will not result in straightening of meandering waterways;
- Where channels are to be significantly modified, the design and construction of the development will replicate natural waterways and habitat features;
- The development will be designed, constructed and maintained to provide water exchange sufficient to maintain or improve water quality and flow conditions on which fisheries resources depend; and
- The development will be designed, constructed and maintained to not result in adverse impacts to beds, banks and vegetation adjacent to the permanent development footprint.
- Development activities within the waterways will be avoided during the wet season and will not occur during elevated flow periods. Given that direct disturbance will occur when waterways are not flowing, the likelihood of aquatic fauna becoming stranded or experiencing direct mortality is low.

29.4.4 Matters of State Environmental Significance

The Project's potential impact on Matters of State Environmental Significance (MSES) is detailed in Chapter 18, Flora and fauna.

29.4.4.1 Potential impacts

A significant residual impact assessment was undertaken for MSES. Potential impacts from the Project will occur for the matters presented in Table 29-2.

Table 29-2: Summary of MSES to have a significant residual impact from the Project

Matter of State Environmental Significance	Regional Ecosystem impacted	Area (hectares)
Regulated vegetation - Prescribed REs that intersect a VM Act wetland	RE 2.3.55d	10.45
Regulated vegetation - Prescribed REs located within the defined distance of a VM Act watercourse	RE 2.3.22 RE 2.3.26a RE 2.3.29b RE 2.5.14a RE 2.5.17b RE 2.5.18a RE 2.5.28a	8.99 19.07 42.02 7.38 16.13 0.42 1.90

29.4.4.2 Mitigation, management and monitoring

Under the EO Act, an environmental offset cannot be considered until it has been demonstrated that all reasonable avoidance and mitigation measures have been, or will be, undertaken. The mitigation hierarchy 'avoid - mitigate - offset' applies to prescribed activities that impact prescribed environmental matters. This means that in designing or planning the prescribed activity, impacts on prescribed environmental matters should, in the first instance, be reasonably avoided wherever possible. For impacts that cannot be avoided, the

extent of those impacts should be carefully managed and mitigated to the greatest possible extent. However, if there is still a significant impact to a prescribed environmental matter then an offset may be required.

The layout of Project infrastructure has been located to avoid and minimise impacts to the woodland communities with connectivity values, such as watercourses – as detailed in Chapter 18, Flora and Fauna, and Chapter 5, Project rationale and alternatives. However, a significant residual impact will occur for prescribed environmental matters. In accordance with the EO Act and Queensland Environmental Offsets Policy, offsets will be required for the Project for significant residual impacts on regulated vegetation (REs within mapped vegetation management wetlands; and REs within the defined distance of a vegetation management watercourse) (Table 29-3).

Table 29-3: MSES to be offset via the Environmental Offset Strategy

Matter of State Environmental Significance			**Extent of disturbance (ha)**	**Offset required**
Regulated vegetation	REs within mapped vegetation management wetlands	RE 2.3.55d	10.45	Yes
	REs within the defined distance of a vegetation management watercourse	RE 2.3.22	8.99	Yes
		RE 2.3.26a	19.07	Yes
		RE 2.3.29b	42.02	Yes
		RE 2.5.14a	7.38	Yes
		RE 2.5.17b	16.13	Yes
		RE 2.5.18a	0.42	Yes
		RE 2.5.28a	1.90	Yes

For all prescribed environmental matters, the size and scale of an offset is that which is necessary to achieve a conservation outcome.

Under the Queensland Environmental Offsets Policy, there are three offset delivery options, which include:

1) Proponent-driven offset: A proponent-driven offset may take the form of a traditional land-based offset; be undertaken through actions under a Direct Benefit Management Plan; or a combination of both. For a proponent-driven offset, the offset delivery liability remains with the proponent and the offset must be delivered in accordance with an Offset Delivery Plan approved by the administering agency.

2) Financial settlement offset: For financial settlement offsets, the payment amount must be calculated in accordance with the methodology set out in the QEOP. A web-based 'financial settlement offset calculator' is available on the Queensland government website that can assist in this process. The State is responsible for delivering a conservation outcome from the financial settlement offset payment.

3) A combination of a proponent-driven offset and financial settlement offset may be utilised. However, the Direct Benefit Management Plan can only contribute up to 10% of the offset delivery.

The Proponent will deliver offsets in accordance with the Queensland Environmental Offsets Policy. The preferred delivery mechanism is financial settlement; however, proponent-driven offsets or a combination may be considered, subject to availability of suitable land and conditions at the time of offset delivery.

An Environmental Offset Strategy has been prepared for the Project that presents the offset requirements for the MSES and proposed provision of offsets for impacted matters, as Attachment 6, Offset Strategy.

29.4.5 Water resources

The Project's potential impact on water environmental values is detailed in Chapter 14, Water Resources, and Chapter 15, Water Quality.

29.4.5.1 Surface water

The Project's potential impact on surface water environmental values is detailed in Chapter 14, Water Resources, and Chapter 15, Water Quality.

Potential impacts

Potential impacts to surface water resources include:

- impacts to streamflow in minor local drainage paths downstream of the Project;
- impacts on streamflow volumes and duration due to runoff capture within the Project water management system;
- impacts to flood flows and flood behaviour in surrounding waterways;
- temporary impacts associated with overtopping of sediment dams during large rainfall events;
- potential impacts associated with waterway barrier works and modifications to drainage connectivity; and
- cumulative impacts associated with existing and proposed developments within the surrounding catchments.

The Project is located within a catchment with limited existing or proposed mining development. The Croydon Gold Mine, located approximately 70 km north of the Project, is the only other known mining operation within the broader Norman River catchment.

The Project will require the development of a permanent watercourse diversion, to facilitate the staged mining of the pit. The diversion will collect the existing stream order 3 waterway, east of the pit and divert it around the pits northern extent to tie back into the original waterway to the west of the pit. Approximately 1.5 km of existing watercourse will be diverted to an engineered diversion approximately 1.8 km in length.

Given the relatively limited scale of mining activity within the surrounding region, cumulative impacts to surface water resources are expected to be negligible. The Project is not anticipated to result in a material cumulative reduction in regional streamflow volumes, flood conveyance or downstream water availability when considered in combination with existing land uses and developments.

Mitigation, management and monitoring

The Project is predicted to have a negligible impact on surface water (Engeny 2026), due to mitigation and management measures implemented during all stages of the Project. These measures include:

- clean water diversions will divert clean catchment runoff around the active mining area using diversion drains and bunds;
- sediment dams will capture sediment laden runoff from disturbed areas, topsoil stockpiles, and surrounding natural catchments;
- sediment dams have been sized to contain a 10% AEP, 24-hour storm event plus 10% sediment storage volume, in accordance with Environmentally Relevant Activities (ERA) stormwater guidelines and International Erosion Control Association Guidelines (IECA 2018) design standards;
- no mine affected water storage overtopping events have been modelled to occur;
- construction activities within watercourse areas will be undertaken during dry periods, to minimise erosion and sediment mobilisation; and

- a dedicated sewage irrigation area has been modelled to ensure issues related to nutrient leaching, waterlogging, runoff, and overflow are accounted for and addressed; and wet weather storage equivalent to three days of sewage effluent will prevent runoff during heavy rainfall events.

Mitigation and management measures will be supported by:

- a water management system;
- an erosion and sediment control plan;
- a surface water quality monitoring program; and
- a Receiving Environmental Monitoring Program.

The permanent watercourse diversion is designed in accordance with the *Guidelines for permanent watercourse diversions to maintain the existing hydrology, hydraulic, geomorphic and ecological features of the existing waterway* (DNRME 2019). The diversion will have similar hydraulic properties to the existing watercourse, including width and depth of the main channel. Re-vegetation of the diversion area will re-instate the environment to an aquatic ecosystem similar to the diverted channel.

It is expected that any potential cumulative impacts will be reduced by avoiding, minimising and managing the impacts generated from the Project.

29.4.5.2 Groundwater

The Project's potential impact on groundwater environmental values is detailed in Chapter 14, Water Resources, and Chapter 15, Water Quality..

Potential impacts

Potential impacts on groundwater environmental values include:

- groundwater drawdown on third-party users, or groundwater dependent ecosystems;
- seepage from waste rock dumps, tailings storage facilities, or mine affected water (MAW) storage; and
- backfilling on the pit with tailings and waste rock.

Mitigation, management and monitoring

To mitigate, manage and monitor potential impacts on groundwater environmental values, the Project has developed a groundwater monitoring program (refer to Appendix L), with the following objectives:

- establishing monitoring sites that are located downgradient of potential contaminant sources, such as the TSFs;
- establishing monitoring sites capable of monitoring groundwater flow paths between sources and receptors;
- establishing a long-term dataset that represents baseline groundwater information (i.e. baseline groundwater level and quality conditions);
- allowing the ability to confirm model predictions of groundwater levels and drawdown resulting from Project mining activities; and
- allowing the ability to assess whether there is potential for environmental harm.

For the groundwater monitoring network to be effective and fit for purpose its monitoring locations have the following objectives:

- monitoring sites will be suitably designed and constructed to provide representative groundwater data;
- monitoring sites will be located within the predicted maximum zone of drawdown in order to validate the groundwater drawdown predictions of the approved mining activity;
- monitoring sites will be spatially distributed around the Project area in order to have a robust understanding of groundwater drawdown effects from approved mining activities; and
- monitoring sites that are representative of groundwater table conditions in order for effects of drawdown to be assessed on the shallow groundwater regime.

To prevent seepage, tailings storage facilities will include HDPE lining and be actively dewatered to a MAW sump. MAW storages will also be lined with HDPE, and overflow paths will report to the pit as a contingency measure. The WRDs are supported by sediment dam storage, and directly adjacent to the pit which will capture any seepage through the modelled drawdown zone.

It is expected that any potential cumulative impacts will be reduced by avoiding, minimising and managing the potential impacts from the Project.

29.4.6 Air quality

The Project's potential impact on air environmental values is detailed in Chapter 23, Air Quality.

29.4.6.1 Potential impacts

Particulate and gaseous emissions from the Project are modelled as not having a significant impact on sensitive receptors in the Project area. Due to the distance from other projects which may have high levels of particulate or gaseous emissions, cumulative impacts to air quality are not expected.

No other significant new developments or potential sensitive receptors have been identified in the area, or are expected in the near future, and as such, no cumulative air quality impacts from regional developments are predicted. Therefore, cumulative impacts on air quality are equivalent to the Project alone.

In terms of intra-project cumulative impacts, both cumulative particulate and gaseous emissions concentrations from the Project are predicted to be well within the relevant emissions criteria at all sensitive receptor locations.

29.4.6.2 Mitigation, management and monitoring

While cumulative air quality impacts from the Project are not likely to be significant, a general dust suppression plan will be implemented to reduce and mitigate dust and any other potential air quality impacts. The dust management plan outlines routine dust mitigation measures for each phase of the Project, as well as monitoring and inspection procedures to manage dust impacts under adverse meteorological conditions.

The Project may avoid high dust generation activities during adverse weather conditions.

Meanwhile, odour and fumes are expected to be minor and only detectable in the immediate vicinity of the processing plant. Any potential impacts will be managed through treatment, buffer distances, spray control and timing irrigation to avoid sensitive conditions.

29.4.7 Greenhouse gas

The Project's potential impact on greenhouse gas is detailed in Chapter 27, Greenhouse gas.

29.4.7.1 Potential impacts

The Project is expected to cumulatively contribute to Greenhouse Gas (GHG) emissions inventories and reducing the available budgets against 2050 net zero targets. The Project's cumulative abated GHG emissions

were compared against remaining global, Australian and Queensland emissions budgets for the period 2027 to 2050, aligning with the Project commencement year and the net zero end point. Project emissions occurring after 2050 were excluded from this comparison.

The Project's cumulative abated emissions from 2027 (approximate Project commencement) to 2050 (net zero) represent a small proportion of the assessed budgets, comprising approximately 0.29% of the Queensland budget, 0.068% to 0.076% of the Australian budget, and 0.036% and 0.0046% of the remaining global 1.5°C and 2.0°C carbon budgets, respectively.

The Project will not have any Scope 2 emissions, as it will generate its own electricity on-site.

Where GHG emissions are not abated globally, climate change conditions are expected to worsen.

Potential climate change impacts on workforce

Climate change projections include increase in temperature, heatwaves, and more severe weather events such as flooding and cyclones. Climate change has been linked to hazards of national significance with cross-system impacts that may involve workforce stability and productivity, personnel health and wellbeing, essential services and logistics systems, and emergency response and recovery capacity.

Extended heat stress as a result of warmer days over longer periods may impact human health, workplace safety and productivity, infrastructure, and essential services such as public transport, and exacerbate other natural disaster events such as drought and bushfire (Steffen et al. 2014). Additionally, work capacity and labour productivity may be reduced during the period of heat stress (Zander 2015), potentially impacting the Project works as well as supply chains and essential services during the Project's operation.

Similarly, increased frequency, duration, and severity of heatwaves may increase bushfire risk at the Project site or in the region. While the site would have fire management practices in place to minimise impact, a bushfire may trigger an emergency evacuation procedure of the workforce. Indirect impacts may also occur, including where smoke lingers from bushfires in the region. Work capacity and labour productivity may be reduced during such an event.

Climate change exacerbated flooding and cyclone events may additionally trigger evacuations to reduce the risk of injury to the workforce. The Project will install a flood protection levee for the main infrastructure area, and the accommodation facility has been sited in an area not anticipated to be subject to significant flooding impacts (Chapter 16, Flooding and regulated structures). The design and construction of the site has been informed by flood modelling inclusive of climate change scenario data.

Hazards, health and safety is detailed further in Chapter 22, Hazards, health and safety

29.4.7.2 Mitigation, management and monitoring

The following mitigation measures will be applied for the Project, where practicable and cost-effective, to achieve GHG emissions abatement. This will support regional, state, federal, and global emissions reductions targets. Mitigation measures are structured by the key result areas (KRA) of the GHG Guidelines abatement hierarchy, i.e., avoid, reduce, substitute, and offset.

The indicative risks and opportunities, and potential emissions reduction associated with each management control are presented in the following sections and extended in Table 29-4.

Avoid

The objective is to avoid GHG emissions through design and planning decisions made before operations begin.

- **Hybrid power station (A1).** The main avoidance measure is a 21.3 MWp solar PV farm and 1.6 MWh BESS integrated with the diesel power station. It will be commissioned before first ore processing, so the Project will never operate on diesel alone. The power station is sized to an average demand of approximately 16 MW, which avoids oversizing and unnecessary fuel use.

  - Performance targets. The hybrid system is designed to achieve at least 38.7% renewable penetration and a system emissions intensity of 0.44 kg CO_2-e/kWh. Both will be verified from metered data each reporting year. Compared with a diesel-only supply, this reduces diesel power generation emissions by about 41%.

- **Land clearing (A2).** Clearing will be limited to the approved disturbance footprint of 2,413.7 ha and carried out in the year of construction. Mine planning and site layout also minimise haul distances and vehicle movements.

Reduce

Where emissions can't be avoided, the objective is to reduce the emissions intensity of operations.

- **Renewable-first dispatch (R1).** An energy management system will dispatch solar and battery power ahead of diesel. It will shut down generators when renewable supply allows, known as hydrocarbons-off (HOFF) operation, and keep running generators at efficient loads. The hours of operation and resulting diesel combusted by the power supply will be monitored monthly whilst the effectiveness of the energy management system will be reviewed annually for potential optimisations.
- **Fleet and equipment efficiency (R2).** A fleet management system will monitor idle time, payloads and haul routes, and equipment will be serviced to Original Equipment Manufacturer (OEM) schedules. The target is to reduce Scope 1 emissions from mobile fleet and stationary equipment by 5% within five years, against a baseline set from the first full year of steady-state mining.

Substitute

The objective is to progressively replace diesel with lower-emissions energy sources and technologies. Each option below has a decision point, so it will be either adopted or ruled out on defined criteria.

- **Renewable expansion (S1).** Additional solar and battery capacity will be assessed at each five-yearly Abatement Plan review. The current system is expected to generate about 52,960 MWh of renewable electricity each year.
- **Electric conveyor (S2).** A feasibility study for an in-pit to plant electric conveyor to replace diesel haul trucks will be completed by Project year 3. The study will calculate the net emissions benefit and net present value after allowing for the extra electricity demand.
- **Low-emission fleet (S3).** Battery electric and hybrid options for light vehicles, and battery electric, hybrid and trolley-assist options for mining machinery, will be evaluated at each fleet replacement.
- **Grid connection (S4).** Grid connection will be assessed once sufficient network capacity is available, such as on completion of CopperString 2032, with a decision made within 12 months of capacity becoming available. Connection would replace on-site diesel generation but introduce Scope 2 emissions, as Queensland's grid emissions factor currently exceeds that of the Project's diesel generation. This gap is expected to narrow as the grid decarbonises. A renewable power purchase agreement will be evaluated on connection
- **Renewable fuels (S5).** A feasibility study for renewable diesel and biodiesel blends in mining equipment will be completed once supply is reliable, OEM warranties are maintained, and the cost premium over conventional diesel is commercially acceptable.

Offset

Offsets will only be purchased if the Project becomes subject to the Safeguard Mechanism, which applies where Scope 1 emissions exceed 100,000 t CO_2-e per year. In that event, the Project's Safeguard baseline will become the reference point, and offsets will be used only as a last resort to address residual emissions above

the baseline that cannot be reduced through on-site abatement. Preference will be given to Australian Carbon Credit Units (ACCUs) generated by Queensland-based projects, subject to availability

Table 29-4: Project GHG abatement hierarchy including Key Result Areas and KPIs

Key Result Area	Management Control (SMART)	Timeframe	Risk assessment (risks, cost, practicality, effectiveness)	Indicative Opportunities	Justification and best practice comparison	Emissions reduction estimate for Project
Targets	T1. Reference point and emission reduction targets Action: Adopt a net Scope 1 reference point equal to projected unabated emissions as set out in EIS Appendix B and manage emissions to the targets below. Measure: Annual Scope 1 emissions (t CO_2-e) calculated using NGER methods and compared with the reference point for the same year and stage; emissions intensity (t CO_2-e per t graphite concentrate). Target: Scope 1 emissions 30% below the reference point by Project Year 5, with targets reviewed thereafter.	Reference point fixed in first version of GHG Abatement Plan Net Scope 1 emissions calculated annually	Production variability changes absolute emissions. The reference point is stage-specific and is restated if production differs from plan by more than 10% If Scope 1 exceeds 100,000 t CO2-e/yr, the Safeguard Mechanism baseline replaces the reference point for Scope 1	Links every measure to a target year	Application of best practice emissions reduction options for energy generation based on feasibility assessment	Reference point: 121,614 t CO_2-e/yr at steady state; 6,567,130 t CO_2-e over the life of the project (LOP) LOP emission reduction : 1,967,984 t CO_2-e; annual average emission reduction 36,444 t CO_2-e
Avoid	A0. Project alternatives considered Action: Document the design and site alternatives considered to avoid emissions, including power supply (diesel-only, hybrid, grid), purification process route, haulage method, plant location and footprint, and the alternative of not	Before EIS submission	An information request is likely if alternatives not considered Alternatives not feasible at FID (NEM connection, conveyor) are carried forward as S2 and S4	Shows that the hybrid power station (A1) was selected over diesel-only supply on emissions and cost grounds	Guideline s3.3 (Avoid): explain feasible alternatives considered to avoid or reduce emissions, including not proceeding	Principal contributor to site-wide emissions reduction (see below)

Key Result Area	Management Control (SMART)	Timeframe	Risk assessment (risks, cost, practicality, effectiveness)	Indicative Opportunities	Justification and best practice comparison	Emissions reduction estimate for Project
	proceeding. State the option selected and why. Measure: Alternatives assessment included in the EIS GHG chapter Target: Completed for EIS submission.					
	A1. Hybrid solar–diesel–BESS power station Action: Design, construct and commission a 21.3 MWp solar farm and 1.6 MWh BESS integrated with the diesel power station, so that no part of the operating phase relies on diesel-only generation. Measure: Annual renewable penetration (% of site electricity from PV/BESS) and system emissions intensity (kg CO_2-e/kWh), from metered generation and fuel data. Target: ≥38.7% renewable penetration and 0.44 kg CO_2-e/kWh, averaged over each reporting year. Monitoring: PV, BESS and generator output, and fuel use logged continuously by the EMS; annual performance report.	PV and BESS commissioned before first ore processing Performance verified at end of first full operating year	Increased generator emissions intensity from part-load operation and managing residual diesel generation Variability in renewable penetration from seasonal and weather-related intermittency High initial installation cost Battery degradation, storage performance and/or equipment failure Control system integration challenges	Energy security and independence Reduced diesel consumption and exposure to fuel price volatility Low operating and maintenance costs Predictable generation profile supporting forecasting and future grid integration Peak shaving and load shifting via BESS	Hybrid PV–BESS–diesel supply is established practice for off-grid Australian mines Selected over diesel-only supply (A0)	~41% reduction in power-generation Scope 1 emissions relative to diesel-only supply. Average reduction of 35,159 t CO_2-e/yr or 1,898,595 t CO_2-e for the LOP. Principal contributor to the site-wide 30% target

Key Result Area	Management Control (SMART)	Timeframe	Risk assessment (risks, cost, practicality, effectiveness)	Indicative Opportunities	Justification and best practice comparison	Emissions reduction estimate for Project
	A2. Minimise land clearing and carbon stock loss Action: Restrict clearing to the approved disturbance footprint Measure: Area cleared (ha) against approved footprint and schedule; clearing emissions (t CO2-e) estimated using FullCAM or NGA methods Target: Zero clearing outside the approved footprint Monitoring: Clearing permits and as-cleared surveys; reported following construction	From start of construction (2027) From start of construction	May increase the complexity of mine scheduling and access to high value resources Cost: Low Practicality: High Effectiveness: Limits clearing emissions in the inventory estimate	Reduced clearing means reduced rehabilitation requirements, PMLU obligations, and costs May improve ability to sequester extra carbon in the PMLU	Clearing emissions are within the Guideline scope (land use assessment, s2.2) although not reported under NGER Footprint control is standard practice for vegetation management	Maximum clearing emissions of 377,148 t CO_2-e included in Scope 1 inventory
Reduce	R1. Renewable-first dispatch and generator efficiency Action: Operate an energy management system (microgrid controller) that dispatches PV and BESS ahead of diesel, shuts down generators when renewable supply allows (HOFF), and loads running generators within their efficient operating range. Measure: Hours of diesel generation and the resulting kL combusted Target: 42.5% reduction in emissions resulting from the combustion of diesel for electricity generation	Energy management system commissioned with PV/BESS Annual review of energy management system effectiveness	Part-load operation raising generator emissions intensity Seasonal and weather intermittency reducing HOFF Battery degradation or equipment failure Control system integration challenges Cost: Included in A1 capex Practicality: High Effectiveness: High Technology risk: Low	Maximises return on renewable investment Fewer generator run-hours and lower maintenance Predictable energy pattern for forecasting	Automated renewable-first dispatch and generator loading control is standard for hybrid microgrids	Delivers the A1 reduction

Key Result Area	Management Control (SMART)	Timeframe	Risk assessment (risks, cost, practicality, effectiveness)	Indicative Opportunities	Justification and best practice comparison	Emissions reduction estimate for Project
	Monitoring: EMS data; monthly KPI report; annual check of meter calibration					
	R2. Mobile fleet and stationary equipment efficiency Action: Implement a fleet management system (FMS) with idle-time alerts, payload monitoring and haul-route optimisation. Service engines, generators and compressors to OEM schedules with performance monitoring. Measure: Fleet fuel intensity (L diesel per tonne of material moved); idle time (% of engine hours); average payload (% of rated); fuel use per unit output for stationary equipment. Target: Reduce fleet fuel intensity by 5% against a baseline set from the first full year of steady-state mining, to be achieved within five years of the baseline being established Monitoring: FMS and fuel dispensing records; annually reports (at a minimum)	FMS operational from start of mining Baseline set from the first full year of steady-state mining Target to be achieved 5 years after the baseline	Operational coordination complexity with haul routes, scheduling and mine utilisation Reduced flexibility in operational timing, especially during peak production Maintenance constraints Cost: Payback from fuel savings expected within three years Practicality: High Effectiveness: Medium Technology risk: Low	Reduced fuel consumption and operating costs Improved equipment efficiency and maintenance standards Lower emissions intensity per unit of material moved	FMS, idle control and payload management are standard practice in Australian open-cut mining	5% reduction in Diesel emissions from Project Years 5 to 53; equivalent to 1,285 t CO_2-e/yr (on an average basis) or 69,389 t CO_2-e for the LOP.
Substitute	S1. Renewable capacity expansion Action: Assess expanding PV and BESS capacity at each five-yearly Abatement Plan review	Review every 5 years	Land availability and capital cost Curtailment without additional storage	Further diesel reduction Lower exposure to fuel price volatility	Guideline App. A (f): regular review of new technologies and opportunities	To be quantified in feasibility study

Key Result Area	Management Control (SMART)	Timeframe	Risk assessment (risks, cost, practicality, effectiveness)	Indicative Opportunities	Justification and best practice comparison	Emissions reduction estimate for Project
	Commitment: review previous and future committed; installation conditional on the decision criteria. Decision criteria: available land constraints and levelised cost ≤ diesel generation cost Measure: annual renewable penetration (%) and site power demands Target: To be determined based on feasibility review		Cost: To be determined per additional MWp / MWh Practicality: High Effectiveness: High; limited by storage Technology risk: Low			
	S2. In-pit electric conveyor Action: Complete a feasibility study for an electric conveyor from the mine pit to the process plant, replacing diesel haul trucks. Study to include net emissions after allowing for the additional site electricity demand Commitment: feasibility study; implementation conditional Decision criteria: proceed if net present value is better than the haul truck case; T1 targets unchanged if not adopted. Measure: Study completed and decision recorded; diesel displaced (L/yr) after commissioning	Feasibility study completed by Project year 3 Implementation subject to study outcome	High upfront capital Technology readiness and operational disruption during transition Added electricity demand met partly by diesel generation, reducing net benefit unless renewables expand (S1) Cost: capex to be determined Practicality: depends on pit geometry and mine life Effectiveness: medium to high; net benefit depends on S1/S4 Technology risk: low (proven); site-specific risk moderate	Displaces haul truck diesel Higher energy efficiency than diesel haulage Lower operating costs	In-pit crushing and conveying is an established lower-emission alternative to truck haulage	To be quantified in the feasibility study

Key Result Area	Management Control (SMART)	Timeframe	Risk assessment (risks, cost, practicality, effectiveness)	Indicative Opportunities	Justification and best practice comparison	Emissions reduction estimate for Project
	Target: Feasibility study by end of Project Year 3					
	S3. Low-emission mining and light vehicle fleet Action: Evaluate battery-electric or hybrid light vehicles and battery-electric, hybrid or trolley-assist options for the heavy mining fleet at each fleet replacement cycle. Criteria: Procure low-emission options where OEM equipment is commercially available and offers a lower lifecycle cost inclusive of ancillary infrastructure (on a net present value basis) than diesel equivalents. Commitment: Evaluation studies	Evaluate low-emission mining and light vehicle fleet at each fleet replacement cycle	Charging infrastructure and capital cost Disruption during transition between diesel and electric systems Cost: light vehicles low; heavy fleet high Practicality: high (light); uncertain (heavy) Technology risk: medium to high for heavy fleet	Progressive integration of emerging technologies	Fleet electrification is cited in Guideline App. C	To be determined from evaluation
	S4. NEM connection and renewable PPA Action: Complete a NEM connection feasibility assessment Commitment: When connection becomes available	Feasibility study when connection becomes available Connection subject to network availability	Introduces Scope 2 emissions Uncertain network timing and connection cost Uncertain availability, cost and additionality of renewable PPAs Cost: To be determined for FID Effectiveness: High	Enables wider electrification (S2, S3) Substantially lower diesel consumption	Scope 2 to reduce as grid decarbonises	Up to 100% of generator Scope 1 emissions, partly replaced by Scope 2 at the Queensland grid factor, declining over time, unless covered by a renewable PPA

Key Result Area	Management Control (SMART)	Timeframe	Risk assessment (risks, cost, practicality, effectiveness)	Indicative Opportunities	Justification and best practice comparison	Emissions reduction estimate for Project
	Target: Connection decision within 12 months of capacity becoming available and feasibility assessed;		Technology risk: Low; availability risk high			
	S5. Renewable diesel and biodiesel blends Action: Complete a feasibility study for adoption of renewable diesel (HVO) or biodiesel blends in mobile or stationary equipment. Commitment: Feasibility assessment once renewable diesel and biodiesel blends are commercially available.	When supply is reliable, OEM warranties would be maintained, and cost premium could be abated	Supply availability in regional Queensland Cost premium and sustainability certification Engine compatibility Cost: Fuel premium Practicality: High (drop-in) Technology risk: Low; supply risk high	Drop-in fuel for existing equipment with little capital Reduced exposure to diesel price volatility	Recognised substitution measure (Guideline s3.3, lower-carbon fuels)	CO_2 reduced in proportion to the renewable fraction of the fuel
Review, monitoring, and reporting	G1. Abatement Plan review and public reporting Action: Review the Abatement Plan every five years, including an assessment of new technologies and progress against targets. Publish an annual progress report against the Plan targets. First review of dates following approval and commissioning. Monitoring and auditing: annual Scope 1 emissions calculated using NGER methods; independent audit against T1 by	Review of target dates following project approval and commissioning Annual reporting from first NGER year FY28 Five-yearly reviews Audit every three years	Reporting burden Public scrutiny if targets are missed	Meets Guideline requirements for technology review and public reporting Supports ESG and climate disclosure obligations	Guideline App. A (f) technology review, (g) monitoring and auditing, (h) public reporting	Enabling measure; no direct reduction claimed

Key Result Area	Management Control (SMART)	Timeframe	Risk assessment (risks, cost, practicality, effectiveness)	Indicative Opportunities	Justification and best practice comparison	Emissions reduction estimate for Project
	an appropriately qualified person every [2] years. Reporting: annual public report on Proponent's website covering emissions against T1, status of each measure (including decisions on S1–S5 with reasons) and offsets used. Measure: Review completed; annual public report published Target: Review every five years; annual report published by 31 December each year					

29.4.8 Noise and vibration

The Project's potential impact on environmental values through noise and vibration is detailed in Chapter 24, Noise and vibration.

29.4.8.1 Potential impacts

On an inter-project cumulative basis, the Project is a significant distance from other potential and significant projects (approximately 70 km away). Given the significant distance, the cumulative noise and vibration impact from multiple mines are negligible for all modelled scenarios. Hence, it is considered that there will not be any cumulative noise and vibration impacts on any environmental values or sensitive receptors.

The wider region (including the township of Croydon) also supports other projects of smaller scale and intensity, including agriculture and limited housing development, however these projects are not expected to contribute significantly to noise or vibration impacts.

The only significant source of vibration on the Project site is from blasting in the open-cut pit (10 km from the nearest sensitive receptor), and therefore a blasting impact assessment has been undertaken.

29.4.8.2 Mitigation, management and monitoring

While cumulative noise and vibration impacts are not expected, general noise management will be practised in the following order based on feasibility and practicality:

1) avoid the noise generation (e.g. locate an industrial activity in an area that is not near a sensitive receptor);
2) minimise the noise in the following order:
    a) orientate an activity to minimise the noise (e.g. face the part of an activity that makes noise away from a sensitive receptor); then
    b) use the best available technology to minimise the noise; and
3) manage the noise (e.g. use heavy machinery only during business hours).

A noise management plan (NMP) has been developed to manage potential impacts in consideration of the acoustic quality objectives outlined in the EPP (Noise) and the noise limits. The NMP will be finalised prior to Project construction and be implemented for all phases of the Project.

29.4.9 Hazards, health and safety

The Project's potential impact on hazards, health and safety is detailed in Chapter 22, Hazards, health and safety.

29.4.9.1 Potential impacts

The Project is not expected to result in a significant exacerbation of natural hazards, including flooding, and bushfires. The Project is located within an area prone to flooding with very flat surrounding topography that contributes to widespread flooding with interactions between the major waterways during significant flood events. However, the Project will have minor impacts to flooding due to a proposed levee and a permanent watercourse diversion.

The Project area has been identified by the Queensland Fire and Emergency Service as having the potential for a bushfire to take hold, based on local conditions such as vegetation type, topography and other indicators.

However, the Project is largely disconnected from other projects and therefore it is not expected that there will be a significant cumulative impact to or from flooding and bushfires.

Inter-project cumulative impact on public health and safety could include an increase in demand for emergency treatment and emergency services. There is an increased risk of traffic accidents because of the cumulative increased traffic generated by the Project. However, the Project will implement mitigation measures such as a Road Use Management Plan to reduce the likelihood of traffic-related accidents.

On-site incidents have the potential to cause injury to personnel and harm to the environment. The management of health and safety incidents will be undertaken in accordance with the requirements of the *Work Health and Safety Act 2011* (Qld) and will include the development and implementation of a mandatory Safety and Health Management System (SHMS).

There is an increased risk of exposure to designated pests under the Public Health Act 2005 (Public Health Act), including mosquitoes and rodents associated with the increased workforce, goods and traffic movements generated by the Project.

The workforce may be exposed to pathogens and aerosols from dispersed effluents used for the spray irrigation system deployed at the Sewage Treatment Plant (STP). Mitigation measures such as reduction of the production of aerosols during irrigation, access restrictions to the irrigation area and buffer zones will be implemented.

The Project will use and store dangerous goods and hazardous substances that may pose a risk to human and wildlife health and safety and the environment through characteristics such as flammability, explosive or corrosive potential, toxicity and/or radioactivity. The Project was assessed against the major hazard facility criteria from the *Work Health and Safety Regulation 2011* (Qld) and is not expected to meet the definition of a major hazard facility. At appropriate intervals, an assessment will be made to determine whether more than 10% of the threshold for any Schedule 15 chemical is likely to be present for the remaining life of the Project and, should this occur, undertake the required notification.

The Project will also store and use bulk explosives during the operational phase. The explosives store will be sited in accordance with prescribed regulations. A dedicated fuel and lubricant facility will be constructed and maintained in line with the containment and spill response requirements of Australian Standard 1940 – The Storage and Handling of Flammable and Combustible Liquids. Other mining projects in the region are expected to store and handle similar materials, however the cumulative risk to public health and safety is considered low due to the standards and requirements associated with handling and storing these materials, and the spatial separation of each project.

Given the mitigation measures in place, the intra-project cumulative impact of the Project on public health and safety is low.

29.4.9.2 Mitigation, management and monitoring

The Project will implement a Workforce Management Plan to reduce work-related accidents and support the health and wellbeing of the Project workforce. With regard to public health risk from vector-borne diseases, the Project has mitigation measures to limit the potential exposure of the designated pests under the Public Health Act. A Weed and Pest Management Plan (WPMP) will be prepared and implemented. To reduce the risk of mosquito outbreaks, the following practices will be implemented:

- General protection measures will be implemented to reduce the likelihood of mosquito bites (e.g. long sleeves on shirts and insect repellent).
- Potential breeding sites for mosquitoes will be eliminated by identifying and minimising the potential for water ponding to occur.
- Should employees begin to show symptoms associated with vector-borne diseases, they will be monitored and taken for treatment, and details of the incident will be reported to appropriate authorities.

To control rodents, the following measures will be implemented:

- A clean, rubbish-free environment will be maintained to discourage the rodents from scavenging and colonising the Project area.

- Potential attractant waste material will be appropriately stored and disposed in accordance with the Waste Management Plan.
- If and when necessary, eradication programs will be implemented.

'Dangerous' goods will be managed through the following mitigation measures:

- In the fuel and lubricant storage facilities, appropriate aprons and hardstands, spill clean-up equipment and fire extinguishers will be placed.
- Staff involved in fuel storage and handling activities will be trained in the operation of the refuelling equipment, spill clean-up equipment and response in the event of an emergency incident.
- Staff involved in handling, storage, and transport of graphite concentrate will be trained in the use of PPE, respirators and controls associated with reducing the potential for exposure to fumes and dust from the mineral processing circuit.
- The fuel storage facility will be constructed and operated in accordance with AS 1940 'The Storage and Handling of Flammable and Combustible Liquids'. Regular inspections will be conducted to monitor the structural integrity of the fuel storage facility.
- A secondary containment system will be in place for the storage of hazardous materials, including drainage or bunds around fuel and hazardous liquids, and containers for hazardous substances.
- Modelling determines that no hazardous materials will be located in areas prone to flooding – riverine or as a result of overland flow.
- The quantity of lubricants to be stored on-site at any one point will be limited, and the storage will utilise secondary collection and storage measures, such as bunded pallets or self-bunded shipping containers.
- All other hazardous substances will be stored and handled in accordance with relevant standards, label instructions and material safety data sheets. It is therefore not expected that hazardous chemicals will present a significant risk to the workforce, surrounding community or receiving environment.

An Emergency Response Plan will be implemented that will include a Bushfire Management Plan (BMP). The BMP will outline the response to fires, including bushfires. The plan will include:

- a bushfire hazard analysis and risk assessment for the approaching season;
- fire regimes for vegetation communities;
- detailed bushfire mitigation strategies;
- identification of fire management zones;
- identification of existing and proposed firebreaks and fire management lines;
- assessment of any proposed vegetation clearings for fire control;
- fire protection controls and maintenance of controls;
- specification of firefighting equipment;
- strategies to achieve development outcomes in Part E of the State Planning Policy – Natural Hazards, Risk and Resilience are to;
    - avoid activities in bushfire hazard areas of the Project when practical;
    - support the Queensland Fire and Emergency Services;
    - avoid an increase in the severity of bushfire hazard;
    - avoid risk to public safety from hazardous materials; and
    - maintain natural bushfire processes as applicable.
- proposed monitoring and auditing of the BMP; and
- detailing emergency contact information.

A risk-based environmental management system will be developed to identify and manage the environmental hazards associated with site mining operations. Both the Safety and Health Management System (SHMS) and environmental management system will include procedures and systems for risk minimisation, as well as emergency response and clean-up procedures.

It is expected that cumulative impacts will be reduced by avoiding, minimising and managing the impacts generated from the Project.

29.4.10 Social

The Project's potential impact on social values is detailed in Chapter 20, Social.

29.4.10.1 Potential impacts

A community may experience cumulative social impacts when experiencing effects of combined impacts from multiple projects occurring in a similar timeframe in a particular location.

Positive cumulative impacts are very likely in terms of increased employment and opportunities for training and skills development. The Croydon LGA in particular will have significant changes to the employment landscape due to the presence of the Croydon Gold Mine at the edge of Croydon township. The construction and operation of proposed Projects will enhance potential opportunities and benefits arising from improved infrastructure investment, enhanced services supported by funding, and local employment and procurement opportunities.

Potentially negative cumulative impacts include increased demand for short-term accommodation, housing, emergency and health services, and increased traffic on the Richmond-Croydon Road and Flinders Highway. Positive cumulative impact on these values are expected through improved infrastructure investment, enhanced services, and increased local employment and procurement opportunities, particularly given the presence of the Croydon Gold Mine and other proposed projects in the Croydon LGA.

The Social Impact Assessment (SIA) concluded that provided the potential impacts of the Project are suitably managed through the implementation of management strategies for workforce management, housing and accommodation, local business and procurement, health and community wellbeing and stakeholder engagement; any cumulative impacts are considered to be minor.

Cumulative impacts are summarised in Table 29-5.

Table 29-5: Cumulative impacts on social values

Impact category	Cumulative impact	Description
Workforce management		
Employment	Increase in employment opportunities	Within the Croydon LGA, there is the potential for significant changes to the employment landscape, for local people and new residents. This will particularly be due to the presence of the Croydon Gold Mine, located just on the edge of town. Within the broader region, there is also potential for increased employment opportunity, diversity and choice.
Training	Increase in training and skills development opportunities	These projects will bring about increased training opportunities, particularly during the operations phases. This may include potential for increased apprenticeships and other training pathways.
Housing and accommodation		

Impact category	Cumulative impact	Description
Temporary accommodation	Increase in demand on local short-term accommodation	Within Croydon and the broader region, it is likely that there will be increased demand for local short-term accommodation with the construction and operational phases of the proposed projects. This may impact on the accessibility of short-term accommodation for tourists / visitors.
Housing	Increase in demand for local housing	Within Croydon and the broader region, it is possible that there will be increased demand for housing with the construction and operational phases of the proposed projects.
Local business and industry procurement		
Procurement and business activity	Increase in procurement and industry diversification opportunities	Construction and operation of the proposed projects will engender increases in procurement opportunities for local, regional and First Nations businesses. This will likely support economic development in the region and provides potential opportunity for diversification for existing or emerging businesses.
	Increase in economic activity	Within Croydon, with the increase in transient population within the town, there is potential for increased economic activity for local businesses, during the construction and operations phases. More broadly, the projects will bring about increased economic activity for businesses within the region.
Competition for labour	Increase in labour draw and competition for other businesses	Within Croydon and the broader region, given the increased employment opportunities, it is likely that this may engender increased competition for labour. For Croydon, this is likely to be due to the employment opportunities generated by the Croydon Gold Mine (given the opportunity to work at that mine without the need to be accommodated at on site camp).
Health and community wellbeing		
Social infrastructure	Increase in demand for health and emergency services	Within Croydon and the broader region, there may be potential for increased demand on health and emergency services during the construction and operations phases of the proposed projects.
Roads	Increase in road safety risks (e.g., accidents, road condition deterioration, etc)	There may be potential for increased road safety risks with the increased vehicle movements associated with the proposed projects. This may be experienced along both the Richmond-Croydon Road and the Flinders Highway.
	Improved access and connectivity	There is potential for cumulative improvements to the road network, particularly along the Richmond-Croydon Road.
Environment	Changes to environmental values	There may be potential for increased concern about or changes to environmental values in the region.
Population	Increase in resident population	Within Croydon and the broader region, there is potential for resident population increases with the increases in employment opportunities.
Community benefit	Increase in community support / benefit opportunities	Within Croydon and the Richmond LGA, there is potential for cumulative benefits due to the proposed projects.

29.4.10.2 Mitigation, management and monitoring

The Project will be undertaken in ways to minimise potential negative cumulative impacts and maximise potential benefits regarding social matters. Mitigation and management measures have been compiled into a

suite of Social Impact Management Plans (SIMPs). The SIMP is consistent with safety and health management systems. These subordinate plans include a:

- Workforce management plan;
- Housing and accommodation plan;
- Local business and industry procurement plan;
- Health and community wellbeing plan; and
- Community stakeholder and engagement plan.

The SIMPs have been developed through ongoing stakeholder consultation. To ensure that the Project's social impact management measures remain current and effective, an adaptive approach to monitor and update the implementation of SIMPs will be used throughout the life of the Project. Updates will be made in response to data collected through regular monitoring and reviews. This will enable modification if required and appropriate, ensuring that the management of social impacts identified in the SIA would result in minimising negative social consequences while maximising social benefits.

Subsequently, it is expected that, by implementing the above-mentioned mitigation measures, potential negative cumulative impacts will be avoided, reduced, or mitigated, and any benefit will be maximised.

29.4.11 Economic

The Project's potential impact on economic values is detailed in Chapter 21, Economics.

29.4.11.1 Potential impacts

Cumulative economic impacts are assessed in terms of labour market, housing affordability, and statewide development, including towards meeting net zero emissions.

Where the Project is developed within similar timeframes as other major projects, the cumulative impact on labour demand (and subsequent increased competition for labour resources) has the potential to reduce the availability of labour for local businesses, drive-up labour costs for businesses, increase reliance on non-local labour forces to support delivery of projects, and potentially delay projects.

Non-local workforce across multiple cumulative projects can result in increased demand for short-term accommodation (e.g. motels/hotels/workers accommodation villages/camp sites) and housing. The increased demand caused by non-local workers will increase the 'tightness' in an already tight housing market, resulting in increased prices for accommodation and housing across the region. However, as the Project will provide on-site accommodation, this Project is unlikely to have or contribute to a significant impact on housing affordability.

The cumulative effect of the Project, in conjunction with the proposed critical mineral projects throughout the Regional Mine Catchment and elsewhere in Queensland, will improve Queensland's ability to produce critical minerals. Increasing production of critical minerals has the potential to support the transition to renewable energy sources and thereby support Queensland and Australia in meeting net-zero emissions targets.

29.4.11.2 Mitigation, management and monitoring

The economic impact assessment quantified the expected beneficial and adverse economic impact of the Project on the regional and state economies. The report determines that significant economic benefits would be derived from the existence of the Project the contribution to local, regional, state and national economic contributions. These include direct contributions through tax and royalties and indirectly through the flow on economic activities and employment.

The workforce will be predominantly housed in the on-site accommodation facility, avoiding a substantial demand for regional short or long-term housing.

The economic benefits of the Project will be maximised through strong collaboration with local communities and all levels of government. The Tagalaka people will also be engaged directly through the development of the CHMP. By operating efficiently, maintaining engagement, and continually seeking improvement opportunities, the Project aims to deliver lasting value to the communities in which it operates. Throughout the mine life, decisions will be guided by both production needs and community priorities to ensure shared, long-term economic benefits.

29.4.12 Transport

The Project's potential impact on transport values is detailed in Chapter 25, Traffic and Transport.

29.4.12.1 Potential impacts

The Project will utilise road, sea, and air transport routes for goods, and workforce. This is expected to generate impacts on:

- Road:
  - traffic generation;
  - road conditions;
  - road safety and efficiency;
- Sea:
  - Use of the Port of Townsville capacity and export routes overseas;
- Air:
  - Use of airport hubs (i.e. Townsville, Mount Isa, Brisbane) to transport the FIFO workforce to site via an on-site airstrip.

The development of other regional projects may increase traffic along similar routes that would be used by the Project.

29.4.12.2 Mitigation, management and monitoring

To mitigate and manage potential impacts on traffic and transport, the Proponent will engage with relevant authorities to maintain the road network under appropriate agreements. This may include roadworks required prior to Project commencement. This is expected to be undertaken through an infrastructure agreement with the relevant local or state governing bodies that would be entered into to address the ongoing use of road infrastructure and any upgrades required for the Project

In addition, targeted mitigation measures for impacts of traffic generated by the Project include:

- monitoring and enforcement of appropriate:
  - workforce hours;
  - driver behaviours;
- implementing standard operating procedures;
- limit transit during and immediately following wet weather;
- assess the condition of the route prior to commencement of vehicle transit;
- use of vehicles on public roads to consider vehicle noise and movement at night;
- wide loads to have pilot and escort vehicles;
- traffic control at property entrances when load is in transit along the route; and
- selective tree and vegetation management to provide load clearance.

No specific sea transport mitigation measures are proposed to be implemented for the Project. The Port of Townsville is assessed as having sufficient capacity for Project exports.

No specific airport facilities mitigation measures are proposed for regional airports. The Project proposes a private gravel airstrip, used by chartered aircraft, within the mining lease which will directly mitigate any impacts on regional airport facility capacity.

The adaptive and pre-emptive controls listed are expected to be suitable to respond to changing conditions, such as the development of projects in the region which may increase traffic.

29.4.13 Cultural

The Project's potential impact on cultural values is detailed in Chapter 11, First Nations cultural heritage, and Chapter 12, Non-Indigenous cultural heritage.

29.4.13.1 Potential impacts

Indigenous cultural heritage

There are no known cultural or Indigenous heritage sites within the MLA areas. The land on which the Project is situated is subject to a Native Title determination (Tagalaka People #2 – Tribunal ID QCD2012/013). The relevant Native Title Representative Body is the Tagalaka Aboriginal Corporation Registered Native Title Bodies Corporation (RNTBC).

Potential impacts may be associated with disturbing land for infrastructure and mining. Activities such as vegetation clearing have the potential to disturb fauna and flora species and disturb or damage artefacts of cultural heritage significance.

The likelihood of any potential impacts to cultural heritage values is low as there are no known cultural or Indigenous heritage sites within the MLA areas.

Non-indigenous cultural heritage

The Project area will be impacted by construction and mining operation activities. This includes impacts from initial vegetation clearing, topsoil stripping, excavation and bulldozing, and other ground disturbance related to mining activities.

Due to the lack of identified non-indigenous cultural heritage sites within the Project area, the risk of the Project impacting on sites of historical cultural heritage significance is considered to be low. However, it is possible that unidentified sites and items may be identified during works. As a result, it is recommended that a site assessment is conducted to identify areas that may require further management or monitoring.

29.4.13.2 Mitigation, management and monitoring

Indigenous cultural heritage

The Project will follow the procedures set out by the Queensland Government to develop a CHMP under the Queensland Aboriginal Cultural Heritage Act 2003 and Torres Strait Islander Cultural Heritage Act 2003 (Indigenous Cultural Heritage Act/s).

The CHMP will be developed and finalised prior to any construction activities, to ensure that it reflects the aspirations and expectations of the Tagalaka People; and ensure that potential impacts are mitigated or managed.

In addition to developing the CHMP, additional consultation has included:

- discuss managing cultural heritage matters with the Tagalaka People;
- attended OCG pre-lodgement discussions to describe the Project in detail and raise any relevant matters;
- attended on-site meetings to discuss cultural heritage engagement and processes;
- discussed and corresponded on various agreements via the Tagalaka and North Queensland Land Council; and
- discussed and corresponded regarding potential employment opportunities and training.

It is expected that, by implementing the above-mentioned mitigation measures, potential negative cumulative impacts will be avoided, reduced, or mitigated, and any benefit will be maximised.

Non-indigenous cultural heritage

Due diligence will be practiced during works within the Project area, particularly during clearing and/or construction activities. To support these obligations, training materials will be developed that assist workers to identify non-indigenous cultural heritage material and outline protocols to safely manage the materials.

This will include a non-indigenous cultural heritage induction booklet, that will be prepared by a suitably qualified heritage professional and is to be provided to all Project personnel during site induction. Subsequent procedures will be incorporated into general procedures for land disturbance and clearing.

The Project will utilise a 'Stop Work' procedure for relevant matters of non-indigenous cultural heritage, including in dealing with the discovery of currently unknown and unidentified sites, places, or items. Additionally, the Project will implement mitigation measures for matters regarding fossils found in the Project area. Some of the mitigation measures recorded by the Queensland Museum include:

- Unexpected Finds Protocols: Implement detailed procedures to be followed in the event that a fossil find is unexpectedly encountered during excavation activities.
- Worker Inductions: Conduct training sessions for all personnel who might come into contact with fossil finds. Engagement of a Palaeontologist: an 'on-call' specialist who can attend the site in an event of unexpected fossil find.
- Establish a collaborative agreement with the Queensland Museum to facilitate the assessment, removal, and preservation of significant fossil finds.

By avoiding, minimising, and managing potential impacts of the Project, it is expected that any cumulative impacts will be reduced.

29.5 Conclusion

Cumulative impact assessments should be proportionate to the scale and significance of the potential cumulative impacts of the proposed Project, combined with the impacts of other relevant future or existing projects.

All impact assessments undertaken for the proposed Project have considered existing projects within baseline conditions. The Proponent has also committed to mitigate, manage, or avoid impacts where possible, resulting in impacts on all environmental values being assessed as meeting relevant regulatory requirements. Further, it is considered that there is limited potential for combined incremental impacts to arise on a background of compliance with regulatory requirements.

Future projects were identified to have limited opportunity to present cumulative impacts on the proposed Project due to distance and timing considerations.

29.6 TOR Reconciliation table

Terms of reference - Content requirements of the EIS		EIS Section
Section 29 - Cumulative impact		
29.1	Provide a cumulative impact assessment that considers the combined effect of potential impacts of different components/aspects of the project on the same environmental value (i.e. intra project cumulative impacts) and the impacts of other relevant projects acting in combination on the same environmental value (i.e. inter-project cumulative impacts). The cumulative impact assessment must identify potential cumulative environmental, social, economic and cultural impacts for each phase of the project on identified environmental values, including consideration of the likelihood, intensity, duration, magnitude and extent of impacts.	Section 0
29.2	Describe how identified cumulative impacts may be affected by climate change, including the frequency and intensity of extreme weather events.	Section 29.4.7.1
29.3	Describe how the cumulative impact assessment and management measures could be progressed further on an inter-project basis.	Section 0
29.4	Discuss the impact of the project on overall state and national GHG inventories and targets.	Section 29.4.7.1
29.5	Describe measures that would be used to avoid, minimise, or mitigate any identified cumulative impacts.	Section 29.4