

Chapter 5
Project Rationale and Alternatives

ESMERALDA GRAPHITE PROJECT

aarc ENVIRONMENTAL SOLUTIONS
APEM Group

GRAPHINEX

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5 Project rationale and alternatives

5.1 Project rationale

Graphite is recognised as a 'critical mineral' by the Queensland and Australian Governments, reflecting its strategic importance and limited global availability. The Project would develop Australia's nascent graphite industry and would ensure the long-term domestic supply of high-grade graphite by bringing to market the third largest deposit in the world.

Current global graphite supply is largely limited to overseas producers. No large-scale graphite mines are currently operating in Australia. Limited opportunities exist for sourcing graphite interstate, with graphite reserves and resources restricted to Queensland, South Australia and Western Australia.

The properties of graphite, including its high thermal and electrical conductivity, make it suitable for a wide range of applications including:

- production of battery anodes;
- production of electronic components;
- use in lubricants;
- nuclear technology;
- steel making; and
- other products.

Graphite produced at the Project, with further refinement, is intended for use as a battery anode material.

Graphinex has made a strategic investment in a demonstration facility for downstream graphite processing in Townsville, designed to prove the viability of graphite processing and to advance Australia's capability in battery anode material production. The demonstration facility is not part of the Project assessed in this EIS. At this stage, approximately 100% of the product graphite is expected to be directed to international markets.

Key benefits of the Project would include:

- providing secure and long-lasting skilled employment opportunities in a regional location during construction and operation;
- help achieve the targets of the Queensland Government's *Delivering Queensland's Critical Minerals Future 2026-30*;
- significant investment at a regional and State level, including through downstream processing facilities and further development of domestic value-adding industries; and
- growing the Australian critical minerals industry to achieve the Australian Government's vision of becoming a global leader in critical mineral production by 2030.

Queensland

Recent global increases in the demand for graphite has triggered the Queensland government to implement a goal to capitalise on the State's resource potential in order to become a global leader in producing and exporting graphite. This will be achieved through partnerships forged between industry and government and build upon the mining expertise and potential for downstream domestic processing in Queensland.

The Queensland Government's *Delivering Queensland's Critical Minerals Future 2026-30* states that *'Queensland has one of the most significant graphite deposits globally and some of the highest-grade graphite resources. With emerging mine-to-refinery projects and manufacturing capability, the state is well-positioned to become a global hub for graphite production, processing and battery anode manufacturing*.' The Project would directly facilitate this by developing a long-term extraction and processing stream for graphite in Queensland.

Commonwealth

The Australian Government's *Critical Minerals Strategy 2023–2030* (DISR 2023) (Strategy) forecasts that global demand for graphite will increase by approximately 20 times 2020 levels by 2040. The Strategy emphasises the need for Australia to develop sovereign processing and refining capability to capture greater value from its geological potential and to diversify global supply chains currently dominated by a limited number of countries.

The Australian government's vision is to become a global leader in critical mineral production by 2030. The Project will contribute to the Strategy by facilitating growth in the production and export of critical minerals to meet global demand.

The objectives of the Strategy are to (DISR 2023):

- create diverse, resilient and sustainable supply chains through strong and secure international partnerships;
- build sovereign capability in critical minerals processing;
- use our critical minerals to help become a renewable energy superpower; and
- extract more value onshore from our resources – creating jobs and economic opportunity, including for regional and First Nations communities

The Project supports these objectives by:

- diversifying global graphite supply chains through the development of Australia's third largest graphite deposit and the distribution of product to international markets;
- building sovereign capability in critical minerals processing through on-site concentration;
- contributing to Australia's transition to a renewable energy superpower by producing graphite intended for use as battery anode material; and
- extracting greater onshore value from Australia's resources by generating long-term skilled employment, significant regional and State-level investment and economic opportunity in regional Queensland.

5.2 Project design

The Project has been designed to maximise, to the extent practicable, the extraction and utilisation of the inferred graphite resource.

The cost-benefit analysis (Chapter 21, Economics) and economic assessment (Appendix P, Economic Impact Assessment[1]) determined that the Project is economically viable. Technical assessments and consideration of other environmental values, including but not limited to terrestrial and aquatic flora and fauna, social and cultural values, surface water and groundwater, has further determined that the Project can be developed in a manner that will minimise significant residual impacts.

Where unacceptable impacts were identified, the Project has been revised to ensure that these do not eventuate. For example, reducing impacts to watercourses by locating all disturbance areas and infrastructure (except for the pit, watercourse diversion and flood protection levee) outside of the watercourse and riparian extents. Where unavoidable impacts have been identified, mitigation and management measures have been proposed, including offsets only as a last option.

The Project would adopt a hybrid on-site and off-site approach: graphite ore would be mined and concentrated on-site, where the proximity of the mineral processing plant to the pit supports efficient operations and reduces the volume and cost of transporting raw material, while downstream coated purified spherical

[1] A commercial-in-confidence version of Appendix P (Technical Report – Economic Impact Assessment) has been provided separately to the Coordinator-General to support the evaluation of the EIS. Appendix P contains commercially sensitive information relating to Graphinex's project economics and is therefore not publicly available.

graphite (CPSG) production would be undertaken off-site. The hybrid model represents the optimal balance between operational efficiency and the practical constraints of the Project's location. Carrying out the CPSG production process on-site would also increase the environmental footprint of the Project by requiring additional cleared land for processing facilities, greater volumes of water and energy inputs, expanded waste management systems and increased transport movements for materials and personnel. These factors would compound the operational, logistical and environmental demands of operating in a remote setting, without delivering proportionate benefits.

The mineral processing produces a tailings stream. The expected quantities, and chemical and physical properties, of this tailings stream was analysed by RGS (2026). The results of this analysis informed the requirement for tailings storage facilities (TSFs) to be built, installed with liners to prevent seepage and constructed with suitable overburden material to ensure stability.

Concurrently, the mining pit was assessed as having a requirement to be backfilled to surface to ensure no final void in the rehabilitated landscape. As a result, the backfill of tailings to the base of the pit, and waste rock from out-of-pit dumps, is required to provide the material balance. Backfilling cannot commence until approximately year 35 in the operational phase of the Project, given ongoing resource extraction. Therefore, three individual TSFs are required to store the quantity of tailings produced until such a time as backfilling begins. A fourth TSF cell will be constructed and receive tailings generated across the period where mineral processing of stockpiled material occurs, but backfilling of the tailings portion of the pit has ceased.

By returning three TSF cells to the pit, the Project can rehabilitate the disturbed footprint to a productive post-mining land use of grazing. The fourth TSF cell will be encapsulated to mitigate potential risks to the environment and retained in the final rehabilitated landform with a post-mining land use of native grassland.

The Project would require active de-watering of the pit (associated water) to ensure safe operating conditions across the construction (initial pit excavation) and operational phases of the Project, including during the backfill of the pit. This would be authorised under section 334ZP of the *Mineral Resources Act 1989* (MR Act) and carried out in accordance with the Proponent's environmental obligations – including to monitor, measure, and report the volume of associated water taken. In addition to ensuring the mine can operate safely, the associated water de-watering process will provide a supply of raw water for the Project. A dedicated pit dewatering dam, raw water dam, and other water management infrastructure will support the use of this water for activities including mineral processing, potable water supply and dust suppression.

Alternatives have been considered for various Project elements (Section 5.3). The comprehensive assessment of alternatives concludes that the Project as proposed would result in the most overall benefit to the environment and people. This is detailed further in Chapter 31, Conclusions and Commitments.

5.2.1 Similar projects

The Project considered the status of similar technologies and processes globally, including any known environmental impacts and how these impacts have been managed or mitigated.

The Balama Graphite Operation (Balama) is a large, open-cut graphite mine located in Mozambique, featuring integrated on-site processing. Processing includes conventional crushing, grinding, flotation, filtration, drying, screening and bagging to produce graphite concentrate. This process is an industry standard for graphite, and proves the process is feasible and reliable for mineral production.

As a large, operational mine, key documented potential risks from Balama include:

- TSF failure;
- groundwater contamination/seepage;
- surface-water contamination;
- water consumption and process-water management; and
- greenhouse gas emissions.

Balama operates a conventional TSF for the mineral processing stream, with lined cells to protect groundwater and surface water from potential contamination and seepage. To support water consumption and management of process-water, Balama has designed the TSF cells with an underdrainage channel system such that water can be recovered from the TSFs for process plant re-use (Chafy et al. 2018). This significantly reduces the demand for raw water into the processing system at the same time as reducing standing water within the TSFs and potential for TSF failure.

The power supply for Balama is a combination of on-site diesel power and solar photovoltaic array supported by a battery energy storage system. This reduces greenhouse gas emissions while balancing reliability of power supply for continuous operations.

Assessing the design, implementation and success of Balama has informed the development of the Project. For example:p

- process water, including that captured within the TSFs, would be re-used to reduce water consumption and risk to the environment from the TSFs; and
- a combination power supply solution would be implemented, with diesel generators, solar array and battery storage to ensure sustainable operations and reduced greenhouse gas emissions.

5.3 Project alternatives

Project alternatives have been evaluated, resulting in the Project as currently proposed in this EIS. The Project determined potential alternatives by evaluating industry standards, including solutions used by operating mines in similar conditions, and potential emerging technologies. Alternatives which did not fit the context of the site were not considered.

For each alternative, several key strategic decisions were evaluated based on previous Project plans, feedback from regulators, feedback from stakeholders, and responsible economic and resource stewardship options that consider current and projected conditions. In addition to considering Project alternatives, a ‘do nothing’ scenario has been included to establish a baseline outcome.

Several strategic options were evaluated to further optimise the Project. The key decisions evaluated were:

- transport of supplies and workforce;
- workforce accommodation strategy;
- final tailings disposal;
- water supply;
- power supply; and
- mining process.

The outcome of the evaluation is summarised in Table 5-1 and detailed in the following sections.

An alternative Project layout and disturbance extent was presented as part of the Project initial advice statement (IAS) submission to the Office of the Coordinator General on 2 July 2025. This included a larger area of maximum disturbance in the main production area, and a variation in general infrastructure layout. The total footprint for the IAS disturbance extent was approximately 3,042 ha. The footprint of the EIS Project is 2,413.7 ha. The layout as presented in the IAS would have had a larger direct impact on Matters of State Environmental Significance, watercourses, and land. In consideration of this, the Project layout was revised to reduce significant residual impacts. A comparison of the initial and current Project disturbance extents is presented in Figure 5-1.

Table 5-1: Project alternatives assessment summary

Project matter	Alternative 1	Alternative 2 (preferred)	Alternative 3 (do nothing)
Transport – FIFO workforce	Existing airport	On-site airport	n/a
Transport - material	Material transport by rail	Material transport by road	n/a
Accommodation	Accommodation in Croydon	On-site accommodation	n/a
Tailings treatment and disposal for closure	4x Retained surface tailings storage facilities	Backfilled void + 1x retained surface tailings storage facility	n/a
Water supply	Surface water harvesting	Groundwater	n/a
Power supply	100% diesel or 100% solar	Combination of diesel, solar and battery	n/a
Mining process	Electric conveyor system from pit to mineral processing plant	Conventional truck and shovel	n/a

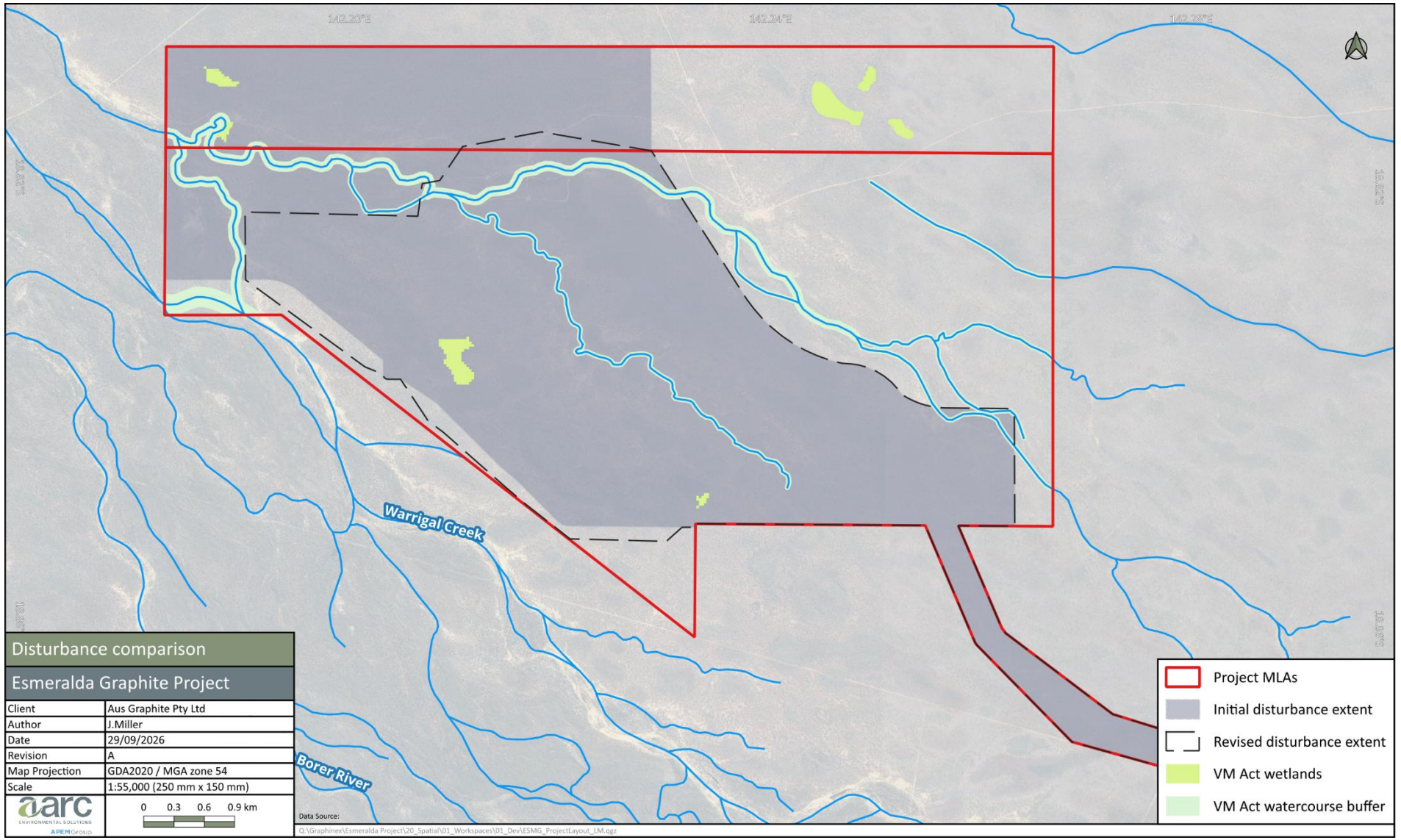


Figure 5-1: Disturbance extent comparison

5.3.1 Accommodation and transport

5.3.1.1 Transport

The Project assessed the viability of several options for the transport of materials and workers to and from site.

Due to the remote location of the Project, on-site accommodation would ensure that the workforce does not require significant daily travel times or distances to the Project site. To further support efficient and safe transport, the Project has determined that an on-site airstrip would receive direct FIFO flights through private charter aircraft. This has numerous benefits over existing airports by reducing travel time for the workforce and avoiding impacts to the capacity of other airports.

The transport of material by rail would not be viable, as there is no rail connection near the Project site. There is a rail connection from Townsville to Mount Isa, through Richmond, Julia Creek, and Cloncurry, however it is not feasible to develop a connection to these points from the Project site. Therefore, material to and from site will be transported via truck. Mineral product sent from site to Townsville would be via B-Double trucks, and material directed to site from various sources would be transported in the most suitable vehicle type. This may include B-double trucks, rigid trucks, flatbed trucks, tankers for fuel and chemicals, and other suitable types.

5.3.1.2 Accommodation

During the construction phase of the Project, temporary accommodation would be available for non-resident workers within the local region or on-site (through mobile accommodation facilities). During the operational phase of the Project, the workforce would be accommodated in an on-site workers accommodation camp. This camp would be established during the Project's construction phase.

The on-site workers accommodation camp would include:

- sleeping quarters;
- associated meal facilities;
- an adjacent sewage treatment plant (STP);
- capacity to accommodate the peak operational workforce expected to be on shift at any given time; and
- access to the camp from the mine access road.

Graphinex has undertaken significant community consultation, including a social impact assessment. Graphinex has maintained ongoing engagement with local stakeholders, including local government, relevant landowners, State Government agencies and entities (Health/Education/Roads/Development), the Office of the Coordinator-General, local emergency services and numerous private sector partners.

The consultation process has determined that an on-site workers accommodation camp would address key potential concerns around housing the workforce in Croydon, including:

- a restricted housing supply market; and
- possible anti-social behaviour from a considerable increase in the town’s current population.

On-site accommodation may reduce the direct expenditure of the workforce in the local community, however the Project has engaged local companies in the region to establish a local procurement policy. Where practicable, resources to develop and operate the Project will be sourced through local supply agreements. This ensures that the Project would provide long-term support for local businesses and industry. In combination with the additional benefits of reducing transport and housing requirements, likelihood of unsociable behaviour, the on-site accommodation is considered a net-positive for the region.

5.3.2 Tailings treatment and disposal for closure

During the operational stage, the Project would generate and store tailings in four TSFs adjacent to the mineral processing plant. Tailings management options were investigated and refined through laboratory testing and modelling to develop a preferred strategy that protects environmental values, aligns with land use policy and reduces residual risk post-mining. Two options were assessed:

- capping and rehabilitation of surface TSFs – which would retain all four TSFs at surface, and increase long-term liability and potential for negative impacts on post-mining land use objectives; or
- in-pit disposal – which has been determined to be an environmentally sound and practical approach to ensure the sustainability and usability of the post-mining landform, while resulting in no final void post-closure.

Surface level TSFs require capping and rehabilitation in a manner that limits the post-mining land use (PMLU). The majority of the Project site would be rehabilitated to a PMLU of low intensity grazing of native grassland (Chapter 13, Rehabilitation and closure, and Appendix T, Progressive Rehabilitation and Closure Plan). However, a rehabilitated TSF would only support a PMLU of grassland that is unsuitable for grazing.

The in-pit disposal of tailings to the base of the void would allow for full rehabilitation of the footprint of three of the four surface TSFs to a PMLU of low intensity grazing of native grassland. The Project site could return to being used as a cattle station.

In-pit disposal of tailings also supports backfilling the pit to surface level in accordance with Project design and mine planning, ensuring no final void remains post-closure.

Modelling and technical assessment of the backfilled void show there is low potential and magnitude of risk from backfilling with tailings (Chapter 15 Water Quality, and Appendix T, Progressive Rehabilitation and Closure Plan.

Therefore, in-pit disposal of tailings has been identified as the preferred alternative tailings treatment and disposal method for closure, with one surface TSF retained and suitably rehabilitated to a PMLU of grassland.

5.3.3 Water supply

Due to the remote location of the Project, water security is a key factor in Project viability. All phases of the Project will require access to a secure water supply, including for use in mineral processing, dust suppression and potable water. Two options were assessed:

- extraction from Warrigal Creek during high flow events under an allocation of water held in the Strategic Reserve; or
- groundwater supply from pit dewatering as 'associated take'.

Extraction from surface water sources would not be reliable given the ephemeral nature of the watercourses in the region. Additionally, it could reduce water availability during flow conditions.

Pit dewatering would be an operational requirement to ensure that Project operations can be undertaken safely, and water balance modelling indicates a reliable quantity of water could be sourced in this way to support most of the Project's water demands.

Therefore, groundwater from pit dewatering as “associated take” is determined the preferred option for Project water supply.

5.3.4 Power supply

An isolated grid solution is required as there is no grid connection available for the Project. There are limited options due to the remote location and environmental context of the Project site. Complete reliance on either diesel or solar (with battery supply) was assessed against a solution which uses both sources.

A substantial quantity of diesel would be required for full diesel generation with inputs only available by truck along the proposed transport route. The additional demand and quantity of trucks required would considerably increase Project impacts, including increased greenhouse gas emissions.

The footprint required for the solar array with battery supply would be too large to fit within the proposed disturbance footprint extent. Additionally, a diesel generator backup would likely still be required to ensure continuous supply could be achieved where batteries have been exhausted.

Based on these conclusions, the Project design combines diesel generators with solar and batteries to ensure that:

- inputs to the Project site would be minimised;
- greenhouse gas emissions would be mitigated;
- power supply would be sustained; and
- site layout constraints would be managed.

5.3.5 Mining process

Most surface mining operations worldwide employ the truck and shovel mining method (QMEB 2015). The Project would also conduct truck and shovel operations as it enables quick establishment of the Project through fleet mobilisation by contractors. It is acknowledged, however, that the use of trucks in the extraction and movement of ROM ore is a contributor to dust and greenhouse gas emissions (Katestone 2026a, 2026b).

A fully electric conveyor, known as an in-pit crushing and conveying (IPCC) system, is an alternative to the truck and shovel method. The conveyor would:

- have minimal downtime;
- reduce greenhouse gas emissions by requiring less diesel combustion; and
- lower operating costs associated with the operation and maintenance of the truck fleet.

IPCC systems have a greater initial capital cost, and it has not been demonstrated to the Proponent that it is currently technically and economically viable for the proposed Project. The Proponent would re-evaluate the electric conveyor method if it becomes technically and economically viable in the future to reduce diesel consumption and greenhouse gas emissions by reducing the number of truck movements.

5.3.6 Alternative 3 – Project not proceeding

The Project has assessed a ‘do nothing’ scenario, whereby the Project does not proceed. The following consequences are inferred:

- employment opportunities of approximately 100 during construction and 192 FTE over the life of the Project would be foregone, and the associated flow-on effects would not be created;
- approximately 170 Mt of graphite ore would not be mined, significantly reducing State and Federal capacity to develop and support an economy which produces and processes critical minerals domestically;
- a net benefit of approximately $2.7 million in annual mining royalty payments to the State would be foregone;

- the potential environmental impacts described in this EIS would not occur;
- economic and social benefits to the region associated with the Project would not be realised;
- loss of Federal tax revenue; and
- loss of State tax revenue royalties.

5.3.7 Alternative evaluation summary and preferred alternative

Alternative 2, being the Project as described in this EIS, has the following key advantages over Alternative 1:

- efficient transport of workforce and materials;
- viable location of the Project workforce accommodation;
- enhanced environmental outcomes from backfilling of the pit;
- reduced infrastructure requirements and environmental impacts on surface water values by aligning pit dewatering requirements with water supply demands;
- reduced inputs to the site and greenhouse gas emission abatement; and
- an effective and proven mining process.

Alternative 2 maximises positive outcomes, including health and safety of the workforce, while minimising environmental impacts, and delivering significant economic and social benefits to the region and the State.

Alternative 2, being the Project, is the preferred alternative.

Given the lack of other advanced regional projects targeting graphite, the Project has not explored initiatives such as common user infrastructure. Should other projects proceed to development, common user infrastructure may become viable and economical and would be assessed at that stage.

The site layout of Alternative 2 has been designed to achieve the best combination of economic and environmental outcomes. The pit is sited over the identified resource, the mineral processing plant is located in close proximity to the pit to support efficient operations, the accommodation facility is positioned away from operational areas where possible, and impacts on watercourses and vegetation have been minimised.

5.3.7.1 Future Project review

The Proponent would continue to assess operational performance and viability, as well as social and environmental obligations, on an ongoing basis to ensure that the Project evolves alongside micro and macro conditions. Additionally, if technological advancement supports alternatives, these would be evaluated on a case-by-case basis. This includes:

- enhanced solar and battery storage capacity; and
- electric conveying to replace trucks.

5.3.8 Comparison of costs and benefits

The Project would have environmental costs and benefits across a range of matters, as assessed by the Economic Impact Assessment and discussed in Chapter 21, Economics. A detailed assessment of potential beneficial impacts is provided in Table 5-2, and potentially adverse impacts in Table 5-3. The positive benefits of the Project (including graphite production, job creation and the establishment of an emerging industry in north Queensland) outweigh the potential impacts.

Impacts on agricultural production in the Project area would occur for the life of the Project. At the end of the Project life, the site would be rehabilitated to support a PMLU of low intensity grazing of native grassland. This is consistent with the pre-mining land use and would minimise long-term impacts.

Table 5-2: Assessment of beneficial impacts

Impact	Description
Economic Growth	The Project will contribute to increased levels of Gross Regional/ State/ Domestic Product (GRP/ GSP/ GDP) in the Regional Mine Catchment, the Processing and Port Catchment, Queensland, and Australian economies during construction and operations, flowing from both direct and flow on impacts: • Construction is estimated to contribute $90.9 million in GRP to the regional catchment, including $39.5 million directly and $51.4 million through flow-on activity; • This level of activity is estimated to support a contribution of $203.7 million to GSP in Queensland (inclusive of regional catchment impacts), including $78.8 million directly and $124.9 million through flow-on activity; • At full operations, the Project is estimated to support an average annual contribution of $318.8 million in GRP directly for the regional catchment; and ▪ Direct activity is estimated to deliver an additional $57.3 million in flow-on activity to GRP in the regional catchment, and additional $109.7 in flow-on GSP in Queensland (inclusive of Regional Catchment flow-on activity).
Employment	The Project would support jobs in the regional and Townsville catchments supporting mining, processing, port and input sectors. The Project would not utilise a 100% FIFO workforce and would support local employment. The Project is estimated to: • during construction, generate a total of $239.7 million in the regional catchment, of which $142.1 million would be supported directly through the initial construction spend stimulus and $97.6 million through flow-on activity, supporting 366 FTE; and • during operations, an additional $125.5 million in industry output through flow-on activity, estimated to generate an annual average of $376.1 million in GRP in the regional catchment, supporting 465 FTE jobs.
Household Incomes	The increase in employment would also support increased incomes in the regional mine catchment, the Port catchment, Queensland, and Australia flowing from both direct and flow on impacts: During full operations, the Project is estimated to directly generate about $542.8 million per year in the regional catchment and supporting another $125.5 million through flow-on activity. This is estimated to generate an annual average of $376.1 million in GRP in the regional catchment, supporting 465 FTE jobs (including direct and flow-on activity).
Government Revenue	The Project would provide a lift in Queensland and Australian government revenues through a variety of taxes and royalties. Overall, the Project is estimated to deliver government benefits: • $60.3 million in total during construction ($57.1 million to the Australian Government, and $3.2 million to the Queensland Government); • $77.4 million per annum on average during operations ($72.4 million to the Australian Government and $5.0 million to the Queensland Government); and • These additional revenues can be used by government to provide additional infrastructure and services to support business and households throughout Australia.
Opportunity for New Industry Development	Graphite concentrate produced at scale in Queensland, presenting a case study in expanded domestic critical minerals production.
Population Retention in the Regional Mine Catchment	The local catchment population is low and projected to decline. The attraction of workers to the area (although temporary) would help sustain demand for a range of goods and services provided by the local economy, supporting the scale of activity required for local businesses to remain viable.

Table 5-3: Assessment of potential adverse impacts

Impact	Description
Impact on Land Uses and Agricultural Production	Lost value from grazing activity is estimated to be $5.6 million over the life of the Project. This conservatively assumes the land disturbed would otherwise provide a value for grazing production of approximately $45.49 per ha (in line with the average value in the Regional Catchment in 2021), and all of this value would be lost as a result of the Project until the land is rehabilitated, which likely overstates the impact that would be realised.
Impact on Environmental Uses	The Project would cause a significant residual impact to Matters of State Environmental Significance (MSES). A financial offset is proposed to satisfy offset requirements.
Impacts on Labour Demand	The Project is expected to employ up to 192 personnel, with ~128 of these directly related to mining activity and the remainder undertaking mineral processing and general site work. At full operations (from year five of operations to year 40 of operations), the Project is estimated to average around 166 operations staff per annum. The source of labour during operations is expected to be similar as during construction, with up to around 5% of the workforce sourced locally (within 125 km of the Project) and the remainder being FIFO workers.
Impacts on Local Businesses from Competition for Resources	While the Project will provide incomes for various businesses and employees engaged either directly or indirectly by the Project, some businesses/ industries may experience small reductions in growth relative to what would otherwise be expected to occur without the Project. This is primarily due to increased competition for constrained resources, particularly in sectors such as mining and manufacturing. Within the regional catchment, these sectors might face higher costs due to the competition for limited labour resources and rising input prices.
Impacts on Property Markets	The Project workforce would be predominantly FIFO and accommodated on site. The use of a FIFO workforce minimises pressure on local accommodation and the local and regional property market.
Impact on GHG Emissions	Scope 1 GHG emissions attributable to the Project is estimated to equate to 85,169 t CO_2-e annually.
Impact on Traffic	The total cost of additional traffic generation due to the Project, as measured through additional vehicle operating costs, road damage costs, and road safety costs, has been estimated and included in economic modelling.

5.3.8.1 Ecologically sustainable development

Ecologically sustainable development (ESD) is defined by the Australian Government's 'National Strategy for Ecologically Sustainable Development' (NSESD) (DEE 1992) as:

> *…using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.*

The objectives reflected in the strategy are:

- enhance individual and community wellbeing and welfare by following a path of economic development that safeguards the welfare of future generations;
- provide for equity within and between generations; and
- protect biological diversity and maintain essential ecological processes and life-support systems.

Aligning decision-making concurrently with these abovementioned objectives should achieve the strategy's overarching goal of:

> *…development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.*

Guiding principles are provided to silo efforts appropriately towards this outcome:

- Decision-making processes should effectively integrate both long- and short-term economic, environmental, social and equity considerations.
- Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
- The global dimension of environmental impacts of actions and policies should be recognised and considered.
- The need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised.
- The need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised.
- Cost-effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive mechanisms.
- Decisions and actions should provide for broad community involvement on issues which affect them.

Consideration has been given to incorporate these principles into all phases of the Project design and environmental impact assessment—in particular, the design, planning and rehabilitation stages. Application of measures arising in accordance with ESD guiding principles relevant to the Project, as put forward in Alternative 2, are detailed in the following subsections.

Precautionary principle

The precautionary principle stipulates the need to consider uncertainty and reinforce the extent of risk when contemplating actions that may result in threats of irreversible environmental damage. In environmental assessments, qualified professionals often have to predict when the environmental outcomes are likely to be post-development. The principle precludes, regardless of scientific certain for the outcome, that measures should be enacted.

A Hazards and Safety Assessment has been undertaken for the Project to identify Project related risks and develop appropriate mitigation measures and strategies. The assessment considers both on-site and off-site risks to people, property and the environment (in the presence of controls) and is included in Chapter 22, Hazards, Health and Safety of the EIS.

Potential short-term, long-term and cumulative impacts have been acquired from qualified professionals to determine the likelihood of environmental impacts. In the preparation of this EIS, definitive features of air quality (inclusive of greenhouse emissions), surface water, groundwater, socioeconomic, transport, climate, aquatic and terrestrial ecology, noise, soil and land, cultural heritage and visual amenity have been assessed.

In response to these assessment findings, a series of monitoring programs, avoidance actions, mitigation measures and environmental offsets have been proposed to adequately address the predefined risks. These include, but are not limited to, operational controls (e.g. haul road watering) and physical controls. Contingency protocols have also been considered in the design, operational and rehabilitation phases. Peer reviews have been undertaken by recognised technical experts for the Groundwater Modelling and Assessment. The peer review is provided in Appendix R of this EIS.

Intergenerational equity

Intergenerational equity is defined in the '2015 Intergenerational Report Australia in 2055' as 'to make choices today to build a strong and resilient economy and lay the foundation for future prosperity' (Australian Government 2015, p.vii). In particular, intergenerational equity seeks to ensure that the health, diversity and

productivity of the environment is preserved to enable this prosperity for future generations. The following measures have been integrated into the Project to guarantee this principle is addressed:

- assessment of the Project's contribution to climate change and greenhouse gas emissions;
- consideration of potential short-term, long-term and cumulative impacts on air quality (inclusive of greenhouse emissions), surface water, groundwater, socioeconomic, transport, climate, aquatic and terrestrial ecology, noise, soil and land, cultural heritage and visual amenity have been addressed in the preparation of this EIS; and
- monitoring programs, avoidance actions, mitigation measures and biodiversity offsets have been proposed to adequately address the predefined risks.

Consideration has been given to the increase in social welfare, wellbeing and infrastructure that arises from an increase in economic activity. Benefits are realised by the expansion of employment and regional business opportunities for current and future generations.

The continuation of employment opportunities is to be properly accounted for during the closure period in order to withhold social equity. Consecutive royalties and taxes would be paid by both the Proponent and Project employees to all three levels of government, then distributed back on the basis of shared services such as health, education, police, community services and roads. Longevity of employment opportunities are to be accompanied by an employment transition strategy prior to mine closure. This strategy should seek to ensure skills are transferable post-closure or otherwise offer a support alternative to employees during the transition.

Conservation of biological diversity and ecological integrity

Biological diversity refers to the diversity in three states:

- gene variation (within a population);
- species variation (between populations); and
- ecosystem diversity (different habitat and communities present).

Comparatively, ecological integrity can be defined as the resilience of an ecosystem to maintain function ecosystem health with a diverse range of species and habitat present. The existing land on and surrounding the Project area is reflective of a typical rural grazing landscape, where some grazing disturbances on the native vegetation can be observed.

A total of 87 native flora species were recorded in the Project area from the field surveys conducted by AARC (2026), representing 28 families and 67 genera. The species inventory also includes one introduced flora species, rubber vine (*Cryptosteaia grandiflora*), which was recorded in low abundance. Rubber vine is classified by the Australian Government as a Weed of National Significance (WoNS).

Two species listed under the NC Act were assessed as potentially occurring within the Project area, *Solanum carduiforme* (listed as vulnerable under the NC Act) and *Acacia armitii* (listed as near threatened under the NC Act). No conservation significant flora species listed under the EPBC Act were assed as having the potential to occur in the Project area through desktop assessment. No terrestrial flora species of conservation significance under the EPBC Act or the NC Act (Qld) were identified during field surveys of the Project area (AARC 2026). Additionally, no listed threatened ecological communities (TECs) were observed during the field surveys (AARC 2026).

A total of 144 native species of terrestrial vertebrate fauna species were recorded during the field surveys, comprised of six amphibians, 25 reptiles, 100 birds, and 13 mammals (AARC 2026). Five introduced terrestrial fauna species were also observed (AARC 2026). Additionally, two bird species of conservation significance (MNES) were observed during the field surveys (AARC 2026), being the White-throated Needletail (*Hirundapus caudocutus*), listed as vulnerable and migratory under the EPBC Act, and the Fork-tailed Swift (*Apus pacificus*), listed as migratory under the EPBC Act.

An additional five introduced fauna species have been recorded, by detecting scats, tracks, sensor camera detection, and/or direct observation. These were cane toads (*Rhinella marina*), dingo (*Canius lupus dingo*), feral cat (*Felic catus*), cows (*Bos taurus*) and feral pig (*Sus scrofa*).

It was concluded that the ecological values within the Project footprint are unlikely to be significantly impacted by the Project activities. In accordance with the ESD principles, the Project addresses the conservation of biodiversity and ecological integrity by proposing an environmental management framework designed to conserve ecological values where practicable or otherwise provide for environmental offsets.

5.4 TOR reconciliation table

Terms of reference - Content requirements of the EIS		EIS Section
Section 5 - Project rationale and alternatives		
5.1	Describe the objectives and rationale for the project, including strategic, economic, environmental, and social implications, technical feasibility and commercial drivers. Describe the markets the project is proposed to service and specify if the product will be for export, local markets, or both.	Section 5.1
5.2	Demonstrate the need and scale of the project including in a regional, state and national context. Consider this in the context of other major relevant infrastructure projects proposed and/or under development in the region.	Section 5.1
5.3	Provide a summary of the current status of similar technologies in Australia and globally, known environmental impacts associated with similar operations, and how these impacts are managed/mitigated.	Section 5.3.5
5.4	Describe the expected benefits and opportunities associated with the project and the relevant recipients of these benefits and opportunities (supported by relative evidence).	Table 5-2
5.5	Describe the process and criteria used in selecting the site and defining the project footprint and alignment options for new or existing infrastructure. Where relevant, the multi-criteria analysis is to assess the shared used of common user infrastructure with nearby mines/projects, in accordance with Queensland Government common user infrastructure assessment principles.	Section 5.2
5.6	Describe the feasible alternatives to the project and project infrastructure configuration, including conceptual, technological, scale, locality and alignment alternatives that may improve environmental and coexistence outcomes. Detail the criteria used to determine the alternatives.	Section 5.2
5.6	Provide sufficient detail to support selection of the preferred option(s).	Section 5.3
5.7	Describe the options assessed for transport of materials and workers to site, and why the preferred option was selected with reference to managing health and safety considerations.	Section 5.3.1
5.8	Where project options or alternatives are still under consideration, provide a description and assessment of each option and a timeframe of when the option will be confirmed. Briefly describe how the potential impacts of these options have been assessed, for example, consideration of worst case or greatest disturbance scenarios.	Section 5.3.7.1
5.9	Demonstrate why the preferred option(s) has been selected by summarising the comparative environmental, social and economic impacts of each project option (supported by a cost-benefit analysis), with particular regard to the principles of ecologically sustainable development.	Section 5.3.7
5.10	Describe the consequences of not proceeding with the project or any component of the project.	Section 5.3.6