Rail Engineering

Capability Statement

COMPETENCY
CAPACITY
COMMITMENT

BG&E
RESOURCES

Acknowledgement of Country

BG&E Resources acknowledges Aboriginal and Torres Strait Islander peoples as the first peoples of Australia and the Traditional Owners and Custodians of lands and waterways on which we work and live.

Our operations are conducted on the traditional lands of the Whadjuk people of the Noongar nation in Perth, the Bindjareb people in Mandurah, the Larrakia people in Darwin, the Kaurna people in Adelaide, the Gurambilburra Wulgurukaba, Bindal, Nywaigi, and Gugu Badhun peoples in Townsville, the Turrbul and Jagera peoples in Brisbane, the Awabakal people in Newcastle, the Gadigal people of the Eora nation in Sydney, and the Wurundjeri and Boon Wurrung peoples of the Kulin nation in Melbourne.

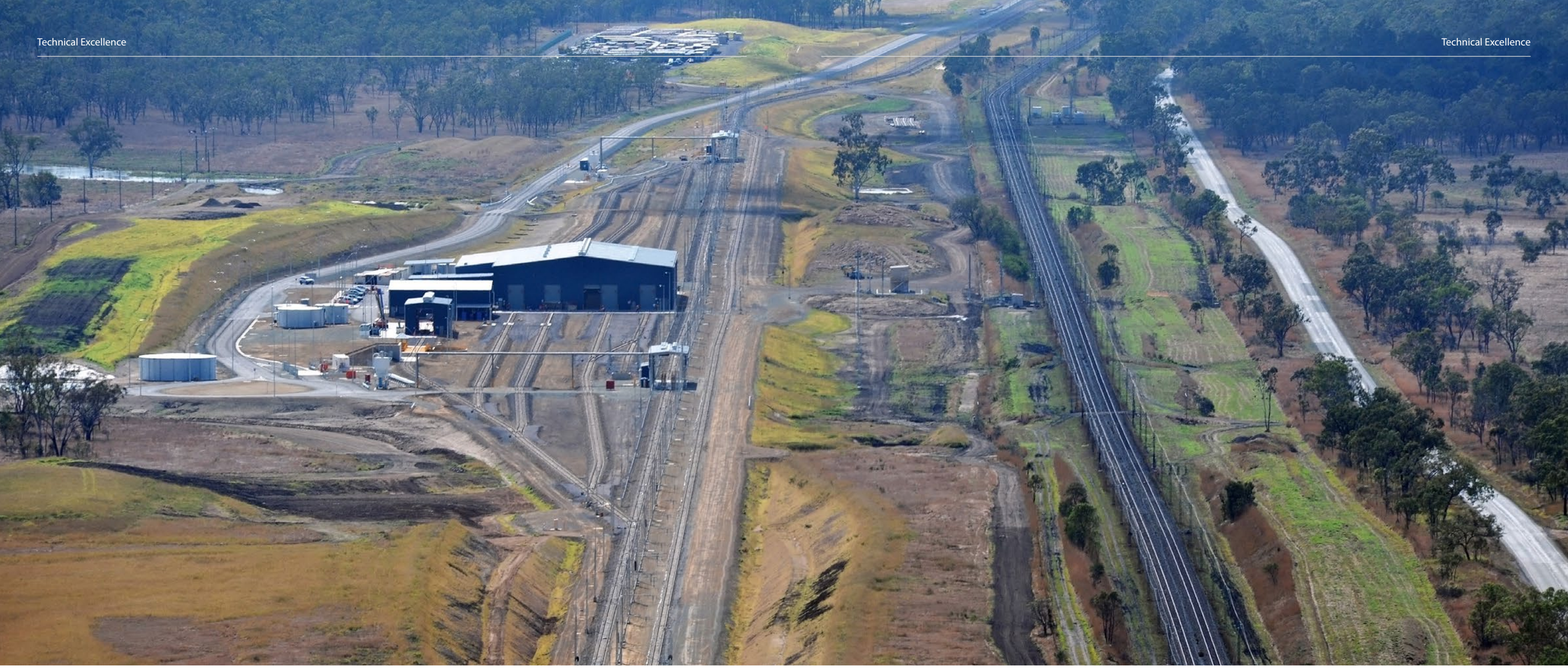
We honour the wisdom of, and pay respect to, Elders past and present, and we acknowledge the cultural authority of all Aboriginal and Torres Strait Islander peoples across Australia.

We also acknowledge the vital contribution made by our Aboriginal and Torres Strait Islander employees and we thank those who have guided our approach and generously shared their insights.

Image: Aboriginal artwork created by Jayda Sebire (Indigenous Artist and former BG&E Resources People and Culture Assistant). Copyright 2023, Jayda Sebire.

Acknowledgement of Country

Technical Excellence



Rail Engineering and Design for Pit to Port Optimisation

BG&E Resources (BGER) is a multidisciplinary engineering, EPCM and ESG consultancy, delivering technical solutions for clients in the Resources, Energy and Industrial sectors.

With offices on the East and West coasts of Australia, we are majority owned by our employees and committed to helping clients decarbonise in a net zero economy.

Our fit-for-purpose engineering solutions enable mining and raw material proponents, energy and water utilities, and port authorities to optimise the performance of their assets, minimise operational disruption, improve safety and mitigate risks.

BGER's proven approach to deliver schedule and cost benefits through clever engineering and true collaboration is what sets us apart.

Our people pride themselves on providing smart and sustainable solutions to complex engineering problems; and importantly, on being great people to work with.

Technical Excellence

Our people are passionate about leveraging their technical ingenuity to solve complex problems.

Technical excellence is the bedrock of our business. It drives our people and propels the outcomes that we provide for clients, communities, asset owners and operators, and financiers.

Our dedicated professionals and subject matter experts focus on understanding our clients' business objectives, their desired project outcomes, as well as the latest industry research for the sectors in which we operate.

A Premium Client Experience

The success of our project work depends on leveraging the best expertise of our people. That's why we allocate the most qualified professionals to help realise our clients' development vision and bring their projects to life.

Our work is underpinned by strong engineering design principles, industry-leading technology and pragmatic advice to deliver exceptional outcomes, every time.

This approach provides the following benefits:

- Ease of understanding of regulatory frameworks
- Efficient navigation through the development approvals process
- Protection and preservation of our cultural heritage, the environment and waterways
- Healthy, transparent and trusted relationships are established with stakeholder groups
- Respectful liaison with Traditional Owners is undertaken
- Fair and equitable outcomes are achieved for First Nations' communities
- Project knowledge is retained, including lessons learned
- Innovation is embraced and deployed.

Technical Leadership Team

The quality and excellence of our world and ability to deliver the best technical and cost-effective solutions for our clients is guided by our Technical Leadership Team.

Led by the most senior members of our business, this team facilitates learning and knowledge transfer, professional collaboration and mentorship to drive continuous excellence in our technical capabilities. It also encourages our people to perform to high technical standards and rewards staff for incorporating innovation into projects.

Image: Steve Ash and Kanishka Pathirana at Paraburdoo Train Load Out Facility, Pilbara WA.

Safety is at the Heart of our Business

Our diverse and culturally aware teams embrace safe work practices that are environmentally sound.

Safety is integral to everything we do at BG&E Resources. We care about our people, clients, and the communities in which we operate, and strive for zero harm in everything we do.

Health, safety and quality are embedded in our work practices, while heritage and sustainability are considered throughout the entire project life cycle.

We recognise the importance of continuously reviewing safety in design issues at all stages of a project, from investigation, design, construction, operation (including maintenance), closure and rehabilitation.

Exceeding regulatory obligations, we leverage a formalised Health, Safety, Environment and Quality Management framework that allows us to analyse and implement practical measures to mitigate risks.

Leadership

- Understanding of client needs
- Technical Leadership Team governance
- Strong Chartered presence
- Adherence to Technical Standards & Regulatory Instruments
- Committed to Technical Excellence
- Striving for low-carbon impacts

Systems

- ISO Accredited Quality Management System (QMS)
- Design Assurance
- Engineering Verification Procedures
- Safety in Design
- Net Zero in Design
- Risk Mitigation & Management
- Project Governance (Action Tracking, Monitoring, Performance & Auditing)
- Continuous Improvement (Lessons Learnt)

Characteristics

- Client Centric
- Risk Adverse
- Reliable
- Accountable
- Innovative
- Simplification
- Community & Culture

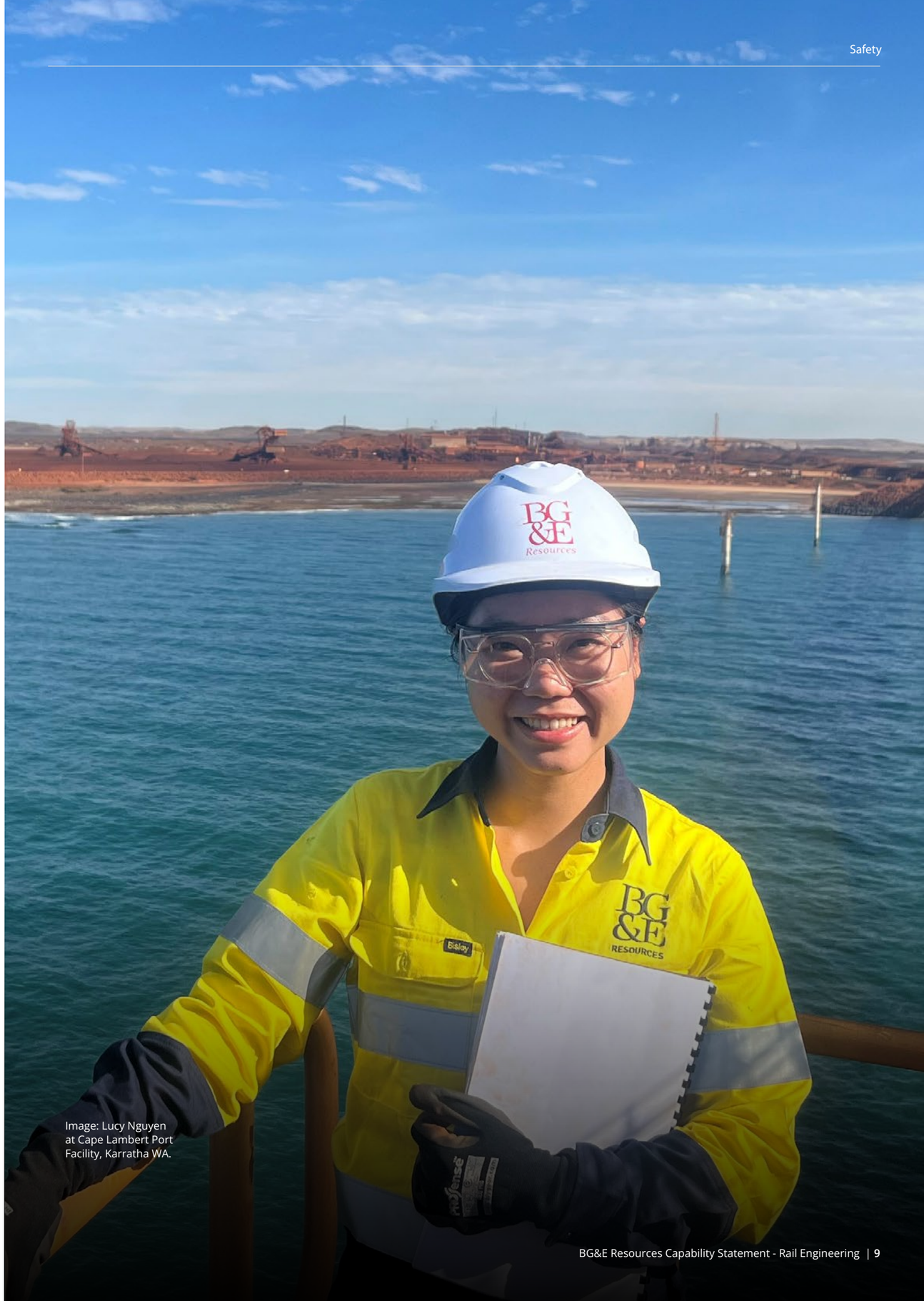


Image: Lucy Nguyen at Cape Lambert Port Facility, Karratha WA.

Respecting, Protecting and Preserving our Cultural Heritage

Diversity across our workforce and our supply chain is vital.

Our clients trust in our ability to enhance their social license to operate, including through the provision of mutually rewarding cultural heritage consultation and management, healthy Indigenous partnerships, and ethical procurement from Aboriginal-owned and operated businesses.

Working with Traditional Owners, First Nations peoples, Indigenous Prescribed Body Corporates and Aboriginal Corporations, is seeded in early engagement as it enables our team to deliver benefits for today (across the life cycle of proponents' projects) and for future generations.

Early engagement underpins our approach to cultural heritage management as it enables us to understand the needs and desires of all stakeholder groups, as well as any existing Indigenous Land Use Agreements (ILUAs) which have been registered with the National Native Title Tribunal (NNTT).

We partner with highly experienced local archaeologists and ethnographic specialists to provide clients with access to an abundance of heritage site data, and to collectively undertake walk-throughs of proposed project sites.

From the Kimberley in the North to Esperance in the South of WA, across central Australia and along the Eastern seaboard – we engage with Traditional Owners and Custodians, Prescribed Body Corporates (PBCs), Aboriginal development corporations and First Nations communities to preserve their cultural heritage and when helping proponents and/or government agencies to deliver projects.

Cultural Heritage Management Capabilities

- Stakeholder consultation and engagement to help Traditional Custodians of the land and Native Title Claimants to establish IULAs, registration to the NNTT and compensation frameworks (among others).
- Advice for proponents regarding the application of legislation including the Native Title Act 1993, Heritage Act 1972 (Aboriginal Cultural Heritage Bill 2021) and Repeal Bill 2023.
- Developing scopes for archaeological and ethnographic surveys.
- Indigenous business contracting (including teaming with Aboriginal-owned and Supply Nation-certified businesses to develop First Nations regional workforces).
- Capacity building (including coaching, mentoring and career pathway development, etc. for First Nations peoples).
- Reconciliation Action Plans.

Image: Indigenous peoples' hands. Copyright approved via Shutterstock.

First Nations' Partnerships

We have a range of actions in place to increase Aboriginal and Torres Strait Islander employment and engagement in our business, to help First Nations communities become self-sustaining (current participation is approximately 1.5 per cent of our workforce and we are striving to increase that to three per cent by December 2025).

We proudly support Aboriginal and Torres Strait Islander owned businesses and have established a majority-owned Aboriginal company, TICS (WA) Pty Ltd (TICS). TICS is a NATA-accredited laboratory to ISO 17025, providing non-destructive testing (NDT) services.

Similarly, we have strategic partnering arrangements with several Aboriginal-owned businesses, including Karlayura Contracting, which provides design and construction support for clients.

We have also established a similar partnering agreement with i24s, an Aboriginal-owned and operated workforce company, providing security, civil works and commercial cleaning services for mine sites in remote locations across Australia, as well as for commercial premises in capital cities (their clients include BHP, Horizon Power and Cundaline Resources, among others).

Most recently, we also established a partnership with Pirrpala, a 100 per cent Aboriginal-owned and operated small scale project delivery provider.

Our partnerships also span the globe, specifically in China, for the procurement of equipment and professional services, including on Country inspections of fabrication, testing, compliance and design reviews.

Reconciliation

Review our Innovate Reconciliation Action Plan, Aboriginal and Torres Strait Islander Engagement Strategy, Human Rights Statement and Anti-Discrimination Policy.

Rail Engineering

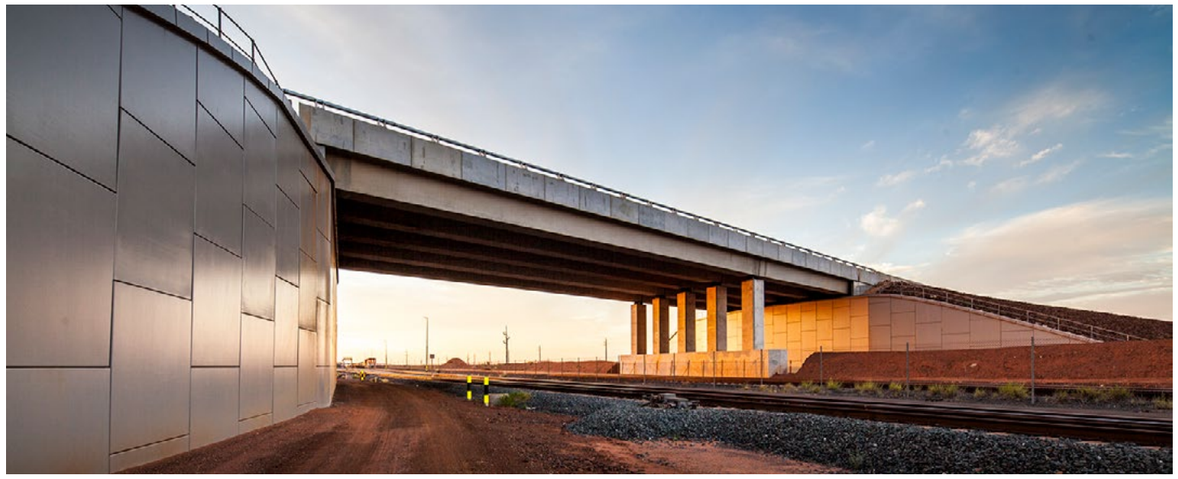
Providing structural and civil engineering services for major intermodal facilities, refurbishment/upgrade projects and new rail lines.

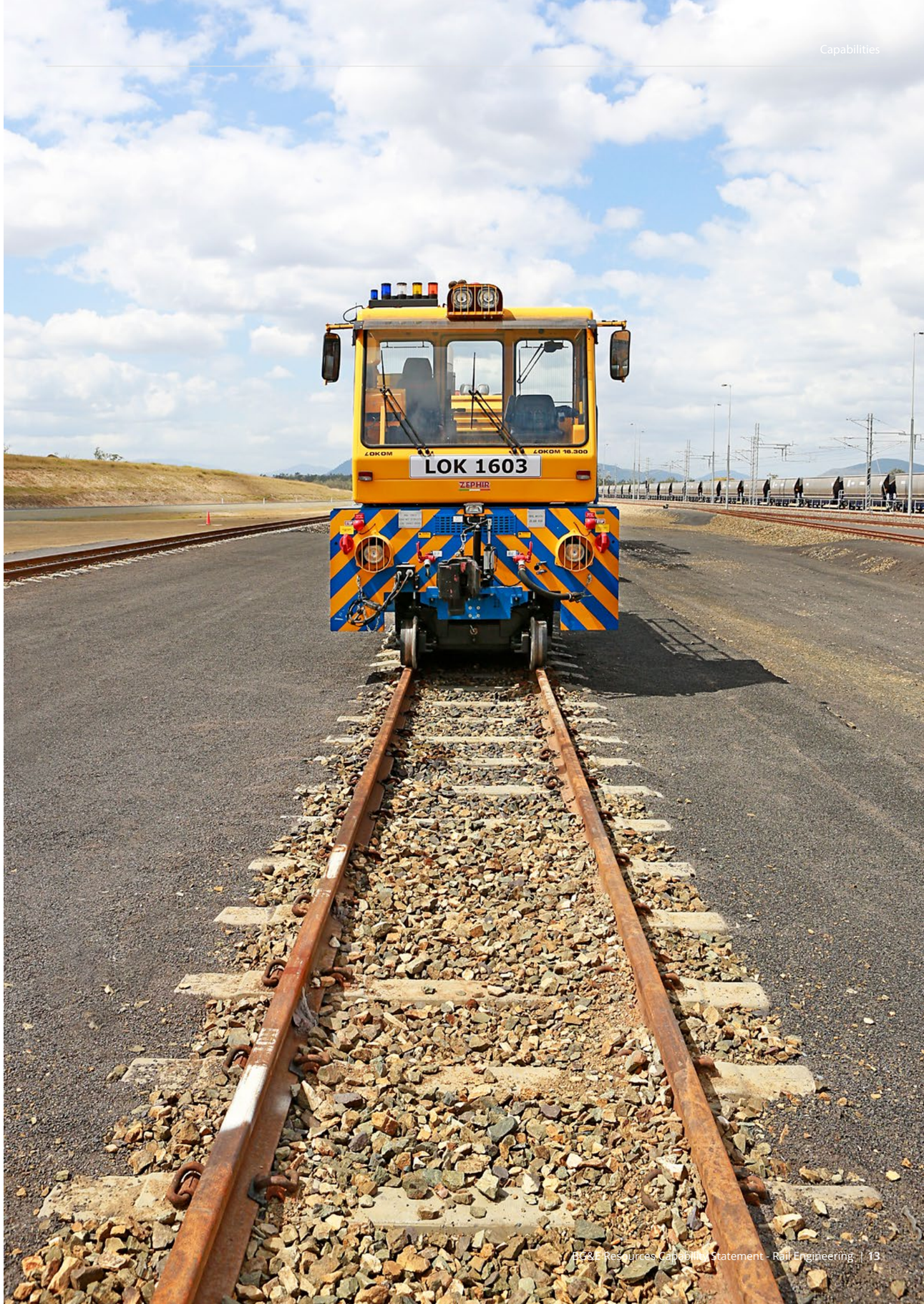
We have a strong reputation for heavy haul projects through our ongoing involvement in railway infrastructure.

Our experience extends to the field of hydrology models, waterways analysis, bridges and culvert design.

Capabilities

- Rail Alignment
- Track Structure
- Formation and Earthworks
- Signalling
- Geotechnical Investigations and Design Services
- Drainage and Scour Protection
- Rail Access Road
- Rail Maintenance and Operational Facilities
- Rail Access Roads
- Overhead Wire and Traction Power
- Surveying
- Corridor Access Permits
- Hydrology and Waterways
- Bridges and Culverts
- Systems Capacity Modelling
- Quantity Surveying
- Environmental Services





Rail Infrastructure

BGER has successfully delivered multi-purpose rail facilities, providing a range of specialised integrated services for mining companies from pit to port.

Our capabilities on railway infrastructure extend to the field of hydrology models, waterways analysis, bridges and culverts as well as integration with port supply chains.

We have played a significant part in optimising heavy haulage rail networks, particularly in the Pilbara region, working with companies including BHP, Rio Tinto, Roy Hill and Fortescue.

Capabilities

- Railways – Heavy Haul and Freight
- Railway Stations and Tunnels
- Railway Track and Civil Works Including Deviating Existing Railways
- Railway Station Building Structures with Inclusivity and Accessibility
- Railway Yards, Terminals and Associated Maintenance Facilities
- Bridges – Rail Over Road/River; Road Over Rail and Pedestrian Over or Adjacent Rail
- Pavements, Car Parks, Roadworks and Drainage Associated with Rail Infrastructure Including Bus-Rail Transfer Stations
- Hydrology and Waterways Analysis for Rail Crossings of Water Courses
- Culverts, Guide Banks and Scour Protection
- Inspection and Maintenance of Existing Bridges and Culverts
- Independent Design Verification and Review Services
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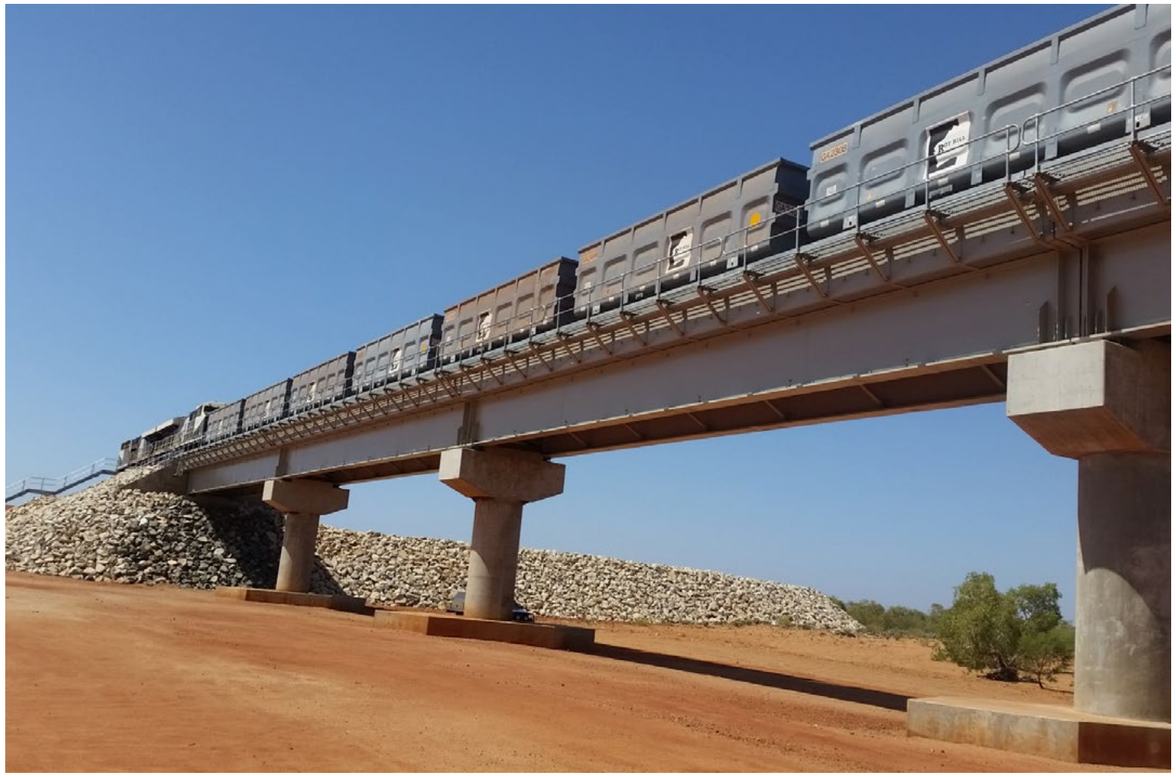
- Quantity Surveying
- Environmental Services



Project Phases

BGER offers multidisciplinary services throughout the project life cycle - from concept to PFS, FS, Detailed Design through to construction, commissioning, asset management and remedial engineering.

Capabilities

- Concept Studies
- Pre-Feasibility Studies
- Feasibility Studies
- Capacity Improvements, Expansions and Upgrades
- Asset Maintenance / Remedial Engineering
- Detailed Design
- Independent Verification
- Construction Support

Projects

Projects

Projects

Railway Bridges and Overpasses

Client: Fortescue

BGER executed the detailed design for critical bridges and overpasses over the Great Northern Road Highway (GNH) Solomon Road to facilitate Fortescue's T155 expansion project.

To increase existing iron ore exports to 155 Mtpa, Fortescue sought our help to develop infrastructure over existing roads, waterways and railway works, and realign sections of road.

We provided civil engineering services including the detailed design and documentation for:

- Three railway bridges over waterways in concrete composite girders and concrete substructure designed for extreme flood events.
- One rail-over-rail overpass consisting of a steel through-girder superstructure with an in-situ concrete substructure, designed to resist the impact loads from heavy haulage rail trains.
- One road-over-rail overpass on the Great Northern Highway, designed as precast and prestressed concrete beams with a composite in-situ deck. This single span arch bridge carries the GNH over the existing Solomon Railway Works and includes realigning associated sections of existing road.

The rail bridge design featured modular steel-concrete composite girders on piled foundation for the river bridges, including design for heavy haul rail loads and for significant scour depths.

The river bridges comprised five-spans, four-spans and two-spans with a common modular span length of 25.6 m.

The rail overpass bridge featured a steel through-girder bridge with deep fabricated plate girders and fabricated cross girders supporting a longitudinal in-situ deck slab. Each of the rail bridge spans were designed to be delivered to site almost fully complete, with only the handrails and reinforcement to be placed on site, on the ground prior to lifting.

The only site work once the beams were lifted into place was pouring the deck slab and place ballast mats. This approach to modular design highlights BGER's consideration of constructability and our understanding of optimal construction techniques in remote locations.

The waterways investigations included detailed hydrological analysis such as application of regional methods, run-off routing, flood frequency studies of gauged study and assessment of rainfall runoff on 2D models. The hydraulic modelling also included 1D and 2D models for the bridges. We designed culverts for a 40 km section of rail where the railway crosses the Fortescue River Valley, west of GNH.

We deployed a variety of 1D and 2D models on broad and local scales to assess the interconnected behaviour of the streams and culverts. Our team also designed multiple culvert banks in the central part of the valley to cater for the total flow across the wide floodplain and to achieve minimal water shadow and environmental impact.

The GNH overpass part of the project included designing the overpass bridge, realignment to GNH and associated local access roads and intersections. The bridge was designed to AS5100 with reference to relevant Main Roads Western Australia (MRWA) SES Circulars, contract specifications and guidelines. The bridge consists of tee off precast prestressed beams with an in-situ composite deck. The bridge supports are subject to rail impact loads from the Fortescue heavy haulage railway below. The pier and abutment consist of in-situ concrete walls on piled foundations and were designed for rail impact loads.

Heavy Haul Rail

Client: Roy Hill

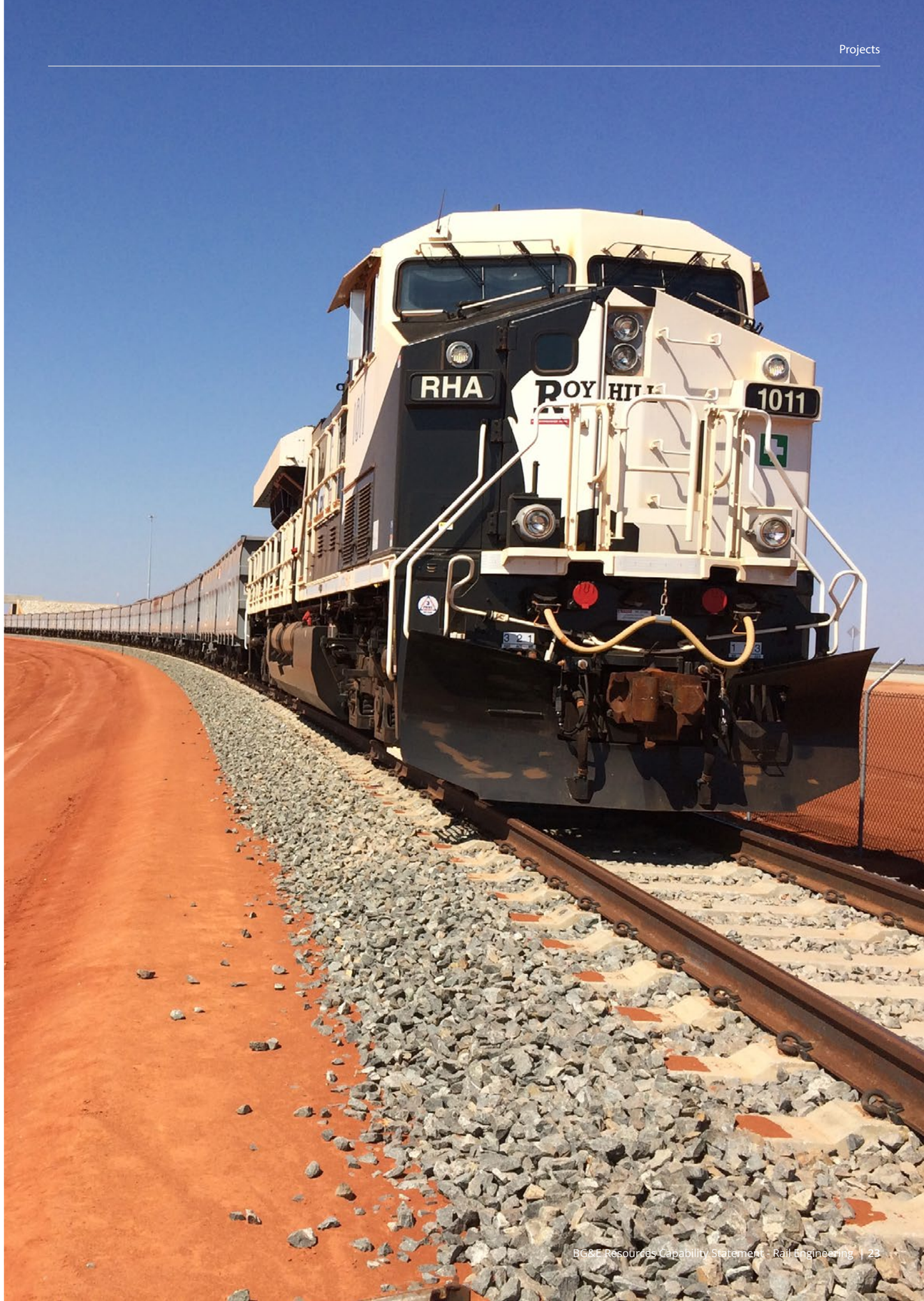
BGER provided bridge and civil design services for the Roy Hill Iron Ore Project's 350 km of heavy haul rail line and port facility at Boodarie Industrial Estate.

The Roy Hill mine is located approximately 277 km south of Port Hedland and is at the eastern end of the Chichester Range in the east Pilbara region of Western Australia. The mine, rail line and port facilities were designed to produce 55 Mtpa of Hematite iron ore.

BGER was engaged at both the ECI and EPC stages of the project to undertake bridge and civil design services.

Scope of works:

- Analysis of waterways including hydrological analysis, hydraulic analysis, scour estimation, and design of scour protection for major river crossings.
- Detailed design of 8 rail-over-water bridges (steel-concrete composite) and 3 rail-over-rail overpass bridges (steel through-girder). Independent internal verification.
- Detailed design of road-over-rail bridge over the port rail loop.
- Civil roadworks design of GNH intersection, level crossing, Port Access Road and intersection, and rail construction yard.
- Bulk earthworks for rail construction support.
- Management of geotechnical investigation including fieldwork, testing, interpretive reporting and design for bridges.
- Design of pavement and surfacing for access roads and GNH.
- Safety and constructability reviews and workshops.
- Liaison with stakeholders, including Main Roads WA, FMGL, BHPBIO and BC Iron.
- Technical specifications to both Roy Hill and MRWA requirements.
- Construction support.



Abrolhos Overpass

Client: Fortescue (Central Systems)

We enabled autonomous mining access over an existing live rail network at Fortescue's Cloudbreak site.

Collaborating with Central Systems, we designed both the concrete and steel plate arch structures.

As a consultancy who prides itself on being client focused and technically excellent, it is exciting to see our knowledge and expertise contributing to such an impressive solution to a complex problem.

The project involved the construction of a concrete arch over a live rail network which provided some unique challenges and additional safety considerations. Significant planning and effort were required to safely complete the project while accommodating regular interruptions of the Fortescue trains. Full credit to the entire team and their ability to consider, plan and deliver the project safely.

We delivered the project through the COVID-19 lockdown, meaning a significant component of the design was delivered by our team in their home offices. The increased communication between Fortescue, Systems and BGER was beneficial to the design process and has been adopted by us moving beyond the project.

A combination of steel plate and concrete arches enabled the team to take advantage of the benefits each arch provided and deliver the most efficient and cost-effective solution for Fortescue.

Image: Cloudbreak Iron Ore Mine, Pilbara WA.

Low Level Bridges Replacement Program

Client: BHP

We developed an innovative solution for the replacement of ageing low level steel beam bridges using offline construction with multiple cost effective precast box culverts, reducing shutdown times and costs.

The Low Level Bridge Replacement Program (LLBRP) consisted of the replacement of seven existing steel bridges on the BHP Newman Main Rail with new concrete culvert structures. The objective was to ensure sustainable, safe operation of the railway and to consider future haul capacity expansion.

Due to BHP's operating requirements, each bridge had to be replaced within a 12-hour shutdown window. Each new concrete bridge was constructed offline approximately 10 m adjacent to the existing bridge, then jacked into position on the existing rail alignment.

BGER was engaged by Laing O'Rourke for the post tender, pre-award, detailed design and construction support phases of the LLBRP including detailed design documentation.

The new concrete bridge culverts included 1 x 6 span, 1 x 5 span bridge and 5 x 4 span bridges, the largest weighing approx. 600 T. Bridges were lifted with locking collar hydraulic jacks and slid using rollers and strand jacks.

Rail Bridge Detailed Waterways

Client: BHP

BGER completed the detailed design and documentation for 10 new dual-track rail bridges over major waterways.

BHP operates an integrated system of four iron ore processing hubs and five mines which are connected by more than 1,000 km of rail infrastructure and port facilities in the Pilbara region of Western Australia.

The company engaged us for the detailed design and documentation of 10 new dual-track rail bridges over major waterways, as part of the company's RGP5 Mainline Rail Upgrade, between Newman and Port Hedland.

Our team developed a modular steel bridge system, consisting of common steel-concrete composite deck units, steel headstocks, steel pier trestles supported on standardised concrete pile caps and footings throughout the bridges.

The use of modular, offsite fabrication and standardised construction provided a cost-effective solution, which streamlined the construction process and allowed for rapid and safe installation.

The project included installation of 216 piles, 13,000 m3 of reinforced concrete and 5,500 T of structural steelwork.

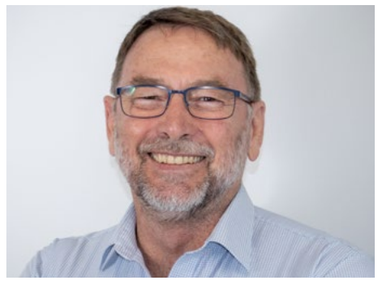
Our Rail Engineering Team

Brad Thomas
Discipline Lead - Civil

11 years of experience in both contracting (Alliance, D&C JV, construct-only) and consulting backgrounds throughout Western Australia in civil construction and mining operations. With a high attention to detail, Brad is focused on continually improving safety, productivity, efficiency, and quality for the benefit of all related parties whilst working in a team with a hands-on approach and putting people first.

Steve Evans
Technical Director - Civil

30 years of experience in civil engineering, including over 14 years in the resource industry on various national and international projects across Africa and South America. As a Principal Civil Engineer, Steve was responsible for the design of the various non-process infrastructure facilities within projects which include access roads, haul roads, earthwork pads, laydown areas, accommodation camps, raw water dams, tailings storage facilities and drainage.



Peter Stanes
Technical Director - Civil

40 years of experience in both engineering and commercial aspects of major resources development projects including, heavy haul railroads, roads and bridges, public works the timber industry and commercial developments. He has extensive professional experience working within the civil and rail engineering sector.

Anders Tan
Project Director - Civil

26 years of experience in civil design, construction and maintenance. Anders experience extends to heavy haul rail, rail embankment, roads, highway, drainage extending to track and civil maintenance and operations.

Robert Street
Lead Civil Designer

30 years of experience in civil design and drafting for Rail, Road, Drainage, Bulk Earthworks and Site Layouts. The past 18 years has been focused in the Heavy Haul Rail field for major infrastructure projects, including Alignment Design, Route Analysis, Earthworks and Site Modelling along with site-based Construction/Design and CAD drafting support.

Ryan Brook
Lead Civil Engineer

11 years of experience as a senior hydrologist developing remedial details for embankments, culverts and drains at various locations in the Pilbara railwork network. Ryan is also experienced in constructability around operating railway lines with the intent of minimising requirements for track shutdowns.

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BG&E Resources is a multidisciplinary engineering, design, project delivery and advisory consultancy, providing technical solutions for clients in the Resources, Energy and Industrial sectors. We are majority owned by our employees, who are united by our purpose – together, we embrace innovation to solve complex problems, for today and future generations.

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