

SECTOR CASE STUDY

Ports & Marine

OPPORTUNITIES
THROUGH
EXCELLENCE

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&E



Port of Townsville Wharf Berths

TOWNSVILLE, QLD, AUSTRALIA
CLIENT: XSTRATA COPPER

BG&E provided structural engineering and materials testing services for the Port of Townsville's berths - Northern Australia's largest import and export hub that has been in operation since 1864 and plays a key role in providing industry with access.

Specifically, our technical team investigated options to increase the wharfs operating lifecycle by an additional 15 to 20 years. As a result of the investigation, we proposed a strengthening solution for the wharf by utilising external prestressing.

This proposal provided a strengthening system to replace the tensile capacity of much of the corroded steel reinforcement, combined with concrete repair work. By adopting this approach, the inherent capacity of the existing materials that were still in sound condition was used without relying on the deteriorated sections.

The approach also provided an opportunity to refurbish the existing wharf structure in a cost-effective manner, given the deterioration noted in the investigations carried out.

Our analysis led the Port of Townsville to lift the 'unsafe to operate order', allowing operations to continue at the wharf.

Port of Albany Wharf

ALBANY, WA, AUSTRALIA

CLIENT: SOUTHERN PORTS AUTHORITY



To inform the master planning project, the Southern Ports Authority required an in-depth condition assessment of the Port of Albany wharf following the Wharf Structures Condition Assessment Manual. BG&E undertook the site inspection, collection and testing of samples, and non-destructive testing of concrete, steel, and timber elements.

The Port of Albany forms a part of the Southern Ports Authority, located in WA. The berths were showing signs of severe deterioration, including extensive cracking, spalling, timber rot, and corrosion.

BG&E reviewed site inspection notes and documented the defects at the port. An assessment of suitable remedial options, including cost estimation and repair life, was completed to enable the client to make informed decisions on asset management.

Esperance Tanker Jetty

ESPERANCE, WA, AUSTRALIA
CLIENT: SHIRE OF ESPERANCE



BG&E provided structural engineering, materials testing, and asset management services for the replacement of the Esperance Tanker Jetty, including a structural assessment of the original jetty to evaluate its condition.

Originally constructed from 1934 to 1935, the jetty comprised a 656 metre long timber structure with a 5.4 metre wide deck, extending southeast from the shoreline.

Due to storm damage in 1988, the tanker jetty was reduced from 192 to 143 piers. In 2016, the Shire of Esperance decided to replace the jetty. The revitalised 415 metre long 'over the water' structure was delivered in March 2021, now serving as a popular landmark for the local community and visitors.

Services provided by BG&E included:

- Conducting a structural assessment of the original jetty to evaluate its condition.
- Calculating the jetty load requirements based on Australian Standards and assessing these requirements against the structural analysis results.
- Developing an asset management plan outlining urgent maintenance actions and associated costs to maintain the structural integrity of the existing jetty before its replacement.
- Preparing an asset management strategy and financial plan to guide long-term maintenance and investment.

Australian Marine Complex

PERTH, WA, AUSTRALIA
CLIENT: MULTIPLEX



The Australian Marine Complex at Jervoise Bay, several kilometres south of the Port of Fremantle, is Australia's largest and most modern fabrication and assembly common user facility - servicing the marine, defence, oil and gas, and resource sectors.

The design and construct contract for the on-site fabrication facility provided essential infrastructure for the overall complex, including a deep water harbour, load-out wharf, craneage and supporting services requirements, and heavy and wide load access.

BG&E provided:

- Structural design of the fabrication hall, adjacent amenities and support buildings, and strip foundations for the 200 tonne gantry crane.
- Civil design of the surrounding hard standing area.

The unique features of the facility include:

- The fabrication hall (80 metres by 80 metres) is relocatable to eight different positions over a 160 metre span, effectively doubling the available workspace.
- At each location, the building can be locked down and a full range of services (power, potable water, fire water, sewer, and communications) is made available via flexible, quick-connect couplings.
- The building has an electronically operated eastern door comprising four leaves approximately 1.8 metres wide by 39 metres high. The doors are supported by tracks that move with the building.
- The building has a removable western wall, which enables completed items to be removed from the building to the designated load-out corridors.
- The 200 tonnes gantry crane, Australia's largest (60 metre clear span and 30 metres beneath the hook), can operate over the full length of the facility. The door tracks can be raised to provide access for the crane into the building.
- The whole area accessed by the fabrication hall includes a full range of services for fabrication and assembly purposes on a 20 metre by 20 metre grid.
- The surrounding chip and seal surface of the hard standing was selected to provide access for heavy vehicles and storage facilities and so that it could be easily repaired where construction activities cause damage to the surface.
- Site drainage utilised a single large infiltration basin instead of multiple small pits.

The design and construct nature of the project necessitated a close working relationship between all members of the design team, including the design manager, structural and civil engineers, services engineers and the architect, together with the mechanical engineers responsible for the motive and craneage requirements of the project.

With more than 150 businesses operating in the Australian Marine Complex, the facility and its features are internationally competitive - attracting world-class projects to WA.

*Australian Marine Complex –
Perth, WA, Australia.*



Point Pier Murat

PERTH, WA, AUSTRALIA

CLIENT: AUSTRALIAN DEPARTMENT OF DEFENCE

This former Royal Australian Navy port is located at Point Murat, on the tip of the North West Cape, approximately 16 kilometres North of Exmouth in WA.

Built in 1964, the pier has historic, environmental, and scientific significance, as it was connected to the development of the United States Naval Communication Station.

The 356 metre long pier has prefabricated loose deck construction to cater for cyclonic conditions and gates across the pier control access, as well as a series of lights to illuminate the structure when required.

BG&E provided structural engineering services, specifically, our team documented a new concrete deck for the pier head of the jetty to replace the existing hardwood timber rafts which were supported by steel beams that formed part of the pier substructure. The hardwood had warped and was no longer suitable for access or as an operating platform.

After extensive consultation, the preferred approach replaced the existing timber decking with a deck constructed of concrete. The new deck was designed to maintain existing and future live loading conditions, as well as to provide safe access for future stakeholders.





Port Kembla Grain Terminal

PORT KEMBLA HARBOUR, NSW, AUSTRALIA
CLIENT: WGA AUSTRALIA

Port Kembla Harbour encountered a failure of hot rolled steel Z sheet piles. Specifically, a small number of these Z sheet piles became disconnected from the clutch shortly after installation. BG&E was engaged to develop a methodology to test the steel and investigate the cause of this failure.

The works undertaken by our team included:

- The development of sampling and testing methodologies to confirm the properties of the steel and investigate the failure that had been reported.
- Hardness testing and micrographic examinations of steel to identify any differences in microstructure that may be indicative of changes in steel properties, confirmation of mechanical properties and chemical composition to confirm steel grade and properties, and assessment of welds.
- A macrographic examination of the sheet pile and clutch to confirm the profiles as a part of the methodology.

The results of the testing were analysed by BG&E along with available information and drawings to confirm conformance of the steel to relevant ISO standards for hot rolled Z sheet piling, quality of the steel, and welding. The review also identified possible causes that may have contributed to the failure of the sheet piling that require further investigation.

Catherine Hill Bay Jetty

CATHERINE HILL BAY, NSW, AUSTRALIA

CLIENT: DEPARTMENT OF PLANNING & ENVIRONMENT

BG&E was engaged by the Department of Planning and Environment to conduct a thorough structural condition assessment of Catherine Hill Bay Jetty. The current concrete and steel structure, erected in 1974 to replace the historic timber jetty, has suffered neglect since 2009 when mining operations ceased. This assessment had two primary goals: evaluating adaptive reuse possibilities and considering demolition options.

BG&E, in collaboration with subcontractors, conducted a comprehensive structural engineering and durability assessment. This work involved extensive on-site works including:

- Conducting reality modelling and high-resolution imaging via UAV.
- Cleaning of steel piles in the tidal zone.
- Thickness testing of steel elements.
- Strength and integrity testing of concrete elements.

Following the on-site data collection phase, extensive structural engineering modelling and calculations were undertaken to determine the current load capacity of the jetty and whether strengthening was required. Durability modelling, to determine if there was any remaining life of structural elements, was also conducted.





*Catherine Hill Bay Jetty –
Lake Macquarie, NSW, Australia.*

Three options were explored in this assessment:

1. Partial demolition of the over-land portion: based on the initial high-risk report, this option involved demolishing the heavily deteriorated landside jetty while retaining and maintaining the over-water portion.
2. Full demolition to the seabed: this option considered the complete removal of the jetty in manageable sections, utilising both landside and marine equipment.
3. Rectification of the full jetty: this extensive option involved the comprehensive remediation of both over-land and over-water portions, including the demolition and replacement of various steel elements, such as landside columns, secondary steel framing, bracing, and multiple connections.



East Coast Cement Master Planning

NEWCASTLE, NSW, AUSTRALIA
CLIENT: VUE

BG&E was engaged by Vue to develop a master plan, vision, and growth strategy for two sites in Kooragang – the East Coast Cement site and an adjacent vacant site.

The Port of Newcastle currently berths carriers at K2 and K3, delivering various cementitious products via conveyors to East Coast Cement's silos. While the port continues upgrading its unloading and conveying systems, there is a significant opportunity for Vue and its partners to enhance storage and distribution on land.

BG&E conducted a review of the current processes both port-side and land-side to see where optimisations and opportunities may exist for additional storage, improved transport, distribution, and on available free land.

Key objectives of the assessment:

- Expedite product movement through Kooragang, minimising storage as the preference is to not store the material.
- Maximise the efficiency and flow of the site whilst introducing infrastructure to address as many processing options as possible.

This masterplan involved:

- Traffic management for trucks.
- The introduction of rail.
- Silo storage.
- Conveying of products.
- The introduction of bagging facilities.
- Risk analysis.

Eastern Basin Master Planning

NEWCASTLE, NSW, AUSTRALIA

CLIENT: LINX CARGO CARE

BG&E was engaged to conduct extensive master planning for a LINX operated facility in the Port of Newcastle on Kooragang Island. The project included concept design for new modular offices, heavy and light pavements, and rail infrastructure.

Our scope of work included:

- Structural engineering for new offices and warehouse extensions.
- Pavement engineering for light vehicle parking and heavy vehicle hardstands for container storage.
- Quantity surveying services to estimate budgets and 3D renders of the proposed structures.



Toronto Baths Jetty Upgrade

TORONTO, NSW, AUSTRALIA

CLIENT: LAKE MACQUARIE CITY COUNCIL



BG&E was engaged to inspect and assess the structural integrity of the jetty at the end of Wharf Road, Toronto, within the City of Lake Macquarie, Greater Newcastle.

The assessment aimed to evaluate the structure's condition, identify major defects significant to overall structural integrity, and undertake analysis to determine the maximum berthing vessel weight with the aim of achieving a 25 tonne ferry berthing load.

Key responsibilities and achievements on the project included:

- Conducting durability and water testing to select appropriate materials for construction.
- Designing new structural jetty components.
- Providing tender drawings.



Queens Wharf Durability Assessment & Pile Remediation

NEWCASTLE, NSW, AUSTRALIA

CLIENT: CITY OF NEWCASTLE

BG&E was engaged to assess the durability of the Queen's Wharf in Newcastle, which was built in 1988 for the bicentenary and consists of two mirrored L-head jetties connected to a long-shore platform.

We tested concrete elements and steel piles using both invasive and non-invasive testing.

This included:

- Visual inspection and mapping:
 - Assessing concrete, steel, timber, and masonry elements for defects.
 - Inspecting the rock wall for erosion or deterioration.
- Diving inspection:
 - Unwrapping, assessing, and rewrapping petrolatum tape and rubber sleeves on four piles.
 - Removing marine growth.
 - Evaluating corrosion above and below the low-water mark using visual and ultrasonic thickness testing.
- Concrete testing:
 - Scanning reinforcement depth and spacing.
 - Breakout testing to assess reinforcement condition, corrosion, and section loss.
 - Extracting concrete cores for compressive strength assessment, chloride testing (three cores, one per location), and additional compressive strength testing (three cores, one per location).

Based on durability modelling, remediation strategies were proposed and the residual service life was estimated.



Berry's Bay Upgrades, Western Harbour Tunnel

SYDNEY, NSW, AUSTRALIA

CLIENT: TFNSW & NORTH SYDNEY COUNCIL

As part of a major upgrade of marine facilities at Berry's Bay in Sydney Harbour, BG&E undertook the design of a variety of new facilities and upgrades to existing infrastructure to Transport for NSW standards and a 50 year design life.

Design elements for the structural (non-maritime and maritime) design in this package have been developed through cross-disciplinary coordination. The scope of the civil and structural design included the following maritime and non-maritime elements.

Maritime elements:

- Sandstone foreshore steps.
- Reinforced concrete kayak ramp.
- Steel walkway over kayak ramp.
- Masonry sea wall crack remediation.
- Rip rap rectification for the sea wall along the site.

Non-maritime elements:

- Reinforced concrete retaining walls.
- Reinforced concrete integrated pavements.
- Steel viewing platform and stairs.
- Steel walkway over channel.
- Steel raised walkway in bund area.
- Steel shelters.
- Reinforced concrete stairs.
- Sandstone gravity walls.
- Sandstone bund wall openings.
- New Woodley shed steel and timber structure.

Ex-HMAS Adelaide

CENTRAL COAST, NSW, AUSTRALIA

CLIENT: DEPARTMENT OF PLANNING, HOUSING & INFRASTRUCTURE

The Ex-HMAS Adelaide, a former Royal Australian Navy Town-class light cruiser, was scuttled off the Central Coast of NSW near Avoca Beach to create an artificial dive reef. Following a severe storm, its aluminium superstructure detached from the hull and settled on the seabed.

BG&E was engaged to assess the structural integrity of the site to ensure diver safety, providing structural, materials, and durability engineering expertise.

Engineering review included:

- Desktop assessment of dive reports.
- Materials engineering, including evaluation of exposure conditions, corrosion mechanisms, and deterioration progression.

Further works are likely at the recommendation of BG&E for multi-beam scanning and underwater ROV inspections.



Subsea Maintenance Facility

INDONESIA

CLIENT: UNDISCLOSED



BG&E provided full engineering design services for a Subsea Maintenance Facility (SMF) for a leading global natural resources production company. The facility delivers specialist subsea services, including industry leading inspection, repair, and maintenance solutions for subsea modules and supporting infrastructure.

BG&E's role:

- Feasibility study.
- Seismic study and classification.
- Flood risk analysis.
- Value engineering.
- Inground services coordination.
- Civil and structural design.
- Building permitting.

The SMF features a pressurised main workshop with tight humidity and temperature control with 300 tonne lifting capacity - utilising four 75 tonne synchronised quad lifting gantry cranes. It also includes external campaign and storage areas (with a ground floor area of approximately 6000 square metres), along with administration facilities, tooling workshops, dangerous goods storage, and warehousing.

Structural facility design features include:

- Deep foundation solution to reduce installation costs and construction duration.
- Movement-resisting frame with a braced bay structure for an efficient combined lateral resistance system.
- Prefabricated structural elements to maximise program efficiency and safe construction.
- Full-height gable folding doors for SPMT and module logistics.
- 300kPa main workshop loading capacity for stooling and jacking.
- Optimised warehouse column for smart racking arrangement and flexible campaign layouts.

Civil facility design features include:

- Balanced cut and fill of site and flood risk consideration for platform level determination, including tidal storm surge protection.
- Efficient site planning for combined services network, parking, loading, and security zoning circulation.
- Proficient layout of sewerage and drainage network including location and design of stormwater management system.

*Subsea Maintenance Facility –
Indonesia.*



Jurong Port Suction Pile Storage

SINGAPORE
CLIENT: QUBE

BG&E provided structural and civil engineering design services for the Jurong Port Suction Pile Storage, including the logistical structural assessment of 12 of the world's largest suction piles - each over 25 metres tall and weighing more than 400 tonnes - for offshore deployment.

BG&E's role:

- Feasibility study of the lifting plan and SPMT route.
- Review of the proposed transportation frame for dressed weight CoG.
- Structural modelling of steel supports, stool arrangement, and ground-bearing load distribution.
- California bearing ration analysis and pavement stress assessment to ensure compliance with Port Authority limitations for designated storage areas.
- General arrangement for concrete stools, road plates, and spreaders to support loading for SPMT transportation.
- Assessment of existing jetty capacity to support suction pile loads during lifting and transportation.



At BG&E, we are united by a common purpose – we believe that truly great engineering takes curiosity, bravery and trust, and is the key to creating extraordinary built environments.

Our team of more than 700 highly skilled people, in 15 offices across Australia, New Zealand, South East Asia, the United Kingdom and Middle East, design and deliver engineering solutions for clients in the Property, Transport, Ports and Marine, Water, Defence, Energy and Resources sectors.

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