



WorleyParsons

resources & energy

EcoNomics™

Marine and Coastal Facilities

Capability and Experience





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“There is no task so important or urgent in our business, or our customers’ business, that it overrides the need to work safely...”

John Grill, WorleyParsons CEO

Zero Harm is our corporate vision for health, safety & the environment (HSE).

We are committed to our vision; it applies to all of our operations, at all times, in all locations, and at all levels of responsibility.

We will actively work to align our expectations and behaviors with those required to achieve our vision through a dedication to continuous improvement.

The launch of our HSE framework, OneWay™, enables us to further align and consolidate our global systems and procedures and continue to work with our personnel to reinforce a culture that underpins our drive to achieve our corporate differentiator of industry leadership in HSE performance.

OneWay™
to zero harm

Corporate Overview

WorleyParsons is a leading global provider of professional services to the resources & energy sectors, and the complex process industries.

We cover the full asset spectrum, both in size and lifecycle, from the creation of new assets, to services that sustain and improve operating assets.

Our business has been built by working closely with our customers through long term relationships, anticipating their needs and delivering inventive solutions through streamlined, proprietary project delivery systems. Strong growth continues to characterize our performance both through organic development and through strategic acquisition as we strive to provide tailored services wherever our customers need us.

- Infrastructure & Environment
- Power
- Minerals & Metals
- Hydrocarbons

37
countries

114
offices

31,700
personnel

EcoNomics™ Delivering profitable sustainability

EcoNomics™ is our range of services and technologies that profitably embed environmental, social and financial sustainability into project delivery, across the asset lifecycle. It is a seamless extension of our established project delivery capability in the key areas of Assessment, Efficiency and Treatment & Mitigation. We are committed to working with our customers to turn their sustainability objectives into good business practice.

Marine and Coastal Facilities

WorleyParsons is a world leader in maritime engineering providing comprehensive design, project management and construction supervision services for all port, harbour and coastal works.

Our diverse marine capability, together with the understanding of complex port requirements for commercial ports, mining and hydrocarbons industries, allows us to deliver integrated and cost effective solutions to our customers. These solutions integrate the marine, product handling and storage requirements within environmental, coastal and geotechnical settings to deliver long term, cost effective and efficient solutions.

Key capabilities that WorleyParsons retains in the marine and coastal facilities domain include:

- Preparation of basis of design requirements
- Site selection
- Port and harbour master planning and operations
- Bulk handling facilities integrated design solutions
- Container and break bulk handling facilities planning and design
- Dredging and reclamation including approvals
- Vessel mooring analysis
- Jetties and wharves
- Coastal structures, breakwaters, seawalls and groynes
- Intakes and outfalls
- Coastal and beach processes analysis
- Dynamic simulation, numerical circulation and wave modelling
- Water quality and spoil dispersion assessments
- Environmental impact assessment, management, monitoring and approvals

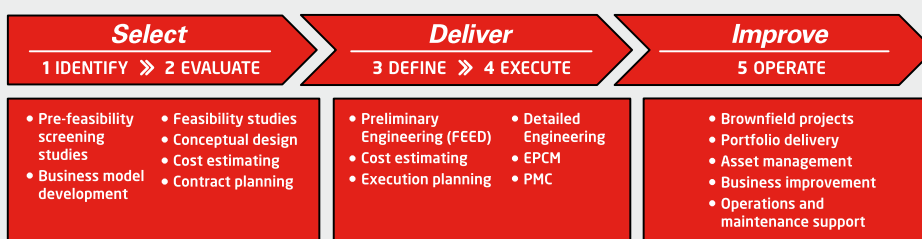
WorleyParsons has provided solutions globally for a wide range of customers from port site selection for greenfields projects through to full implementation and ongoing upgrades and optimisation studies. WorleyParsons provides services within multi-user harbour environments and project specific remote sites, providing customers with solutions for their complex and critical projects.

Marine and coastal facilities projects in

20+
countries

20+
years experience

WorleyParsons Project Phases



WorleyParsons' experience covers all five phases of the asset lifecycle. In each one of these phases we understand the critical issues and apply our specialist business lines, *Select*, *Deliver* and *Improve* to enable our customers to achieve their business objectives.

Our phased approach enables consistent project delivery worldwide and WorleyParsons' project systems are fully aligned to this process.



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Port Siting and Master Planning

With over 20 years of experience in master planning and feasibility studies, WorleyParsons prides itself on finding the right answers to the questions raised in the preliminary stages of a project.

WorleyParsons can provide the skills to support customers with key select phase decision making including:

- Siting studies, master planning and feasibility
- Integration of new marine developments with new/existing industries
- Integration with new/existing transport corridors, haulage roads, causeways and load-in/out facilities
- Expansion of existing ports, harbours and marine facilities
- Problem identification, for poorly performing coastal and marine facilities
- Port operability and risk studies

The first key decision of a project is often choosing the right site. Incorrect location can add complexities in the design, construction, operability and long-term performance making this a critical decision milestone. WorleyParsons follows a rigorous procedure supported by relevant investigations prior to settling on a site and layout including assessment of:

- Available natural harbours
- Geology/hydrogeology
- Oceanographic and coastal setting
- Dredgability, including geology and oceanography
- Berth/ mooring performance
- Topography, vegetation and site access restrictions
- Access to common infrastructure
- Proximity to onshore facilities and industries
- Environmental and heritage issues
- Regulatory issues
- Future expansion potential including likely urban encroachment and other possible land constraints
- Potential of future expansion

Dynamic simulation is a core capability of WorleyParsons' Coastal & Ocean group that enables us to model port capacity, on-shore operations, moorings and vessel motion, plume dispersion, dredge material behavior and dispersion.

20+

years experience in port master planning

Projects to the value of US

\$5B



Project: Port Hedland/SIA Planning and Corridor Study**Customer: Port Hedland Port Authority****Phases:** IDENTIFY > EVALUATE > DEFINE >> EXECUTE >> OPERATE

Australia

WorleyParsons completed strategic master planning for the Port Hedland Port, surrounding urban and industrial land uses, proposed transport corridors, road, rail and services linking Boodarie estate to various port sites.

This port is the key strategic export facility for the Western Australian iron ore and minerals rich Pilbara region. Strategies and plans for rapid expansion of exports from 100 Mtpa to 400 Mtpa were developed. Outcomes included a detailed ultimate and strategic development plan, integrated service corridor plan, flood study assessment of constraints, buffer zones to residential areas, supply chain model of the port and documented evidence supporting the development strategy.

**Project: Kwinana Port Master Planning****Customer: James Point Pty Ltd****Phases:** IDENTIFY > EVALUATE > DEFINE >> EXECUTE >> OPERATE

Australia

The Government of Western Australia invited proposals to build, own and operate a multi-purpose port at Naval Base, Kwinana, in which WorleyParsons prepared the conceptual design and associated documentation for the successful bidder's submission. The work was comprised of a hydrographic survey, seabed probing, and evaluation of waverider data so that the basic port layout could be defined. Alternative port layouts and staging scenarios were then developed to suit the proponent's trade development forecasts.

**Project: Port of Mackay Master Planning****Customer: Mackay Port Authority****Phases:** IDENTIFY > EVALUATE > DEFINE >> EXECUTE >> OPERATE

Australia

The Port of Mackay is Queensland's fourth busiest multi commodity port in terms of cargo throughput and is the major servicing centre for the mineral rich Bowen Basin. The customer identified the need to update their planning strategies to secure the port's important role in facilitating ongoing regional development for the Mackay region of Queensland. WorleyParsons reviewed previous master plans developed for the port, established a detailed picture of trade potential and service capacity for the seaport, and ultimately provided direction for future expansion needs and possible opportunities.

**Project: King Abdullah Economic City – Millennium Seaport****Customer: EMAAR****Phases:** IDENTIFY > EVALUATE > DEFINE >> EXECUTE >> OPERATE

Saudi Arabia

EMAAR Properties, the world's largest real estate company, is developing King Abdullah Economic City near Rabigh, north of Jeddah, in what has been described as the biggest project of its kind in the Gulf region. Central to the mega project is the creation of a 2.6 million m² new millennium seaport. The state-of-the-art container port has a throughput capacity of 3.8 million TEU/year in Phase 1, increasing to 6 million TEU/year in Phase 2. There will be three slot berths to cater for mega vessels and linear berths for smaller vessels and feeder vessels. WorleyParsons performed the initial planning for the port, developed the port concept, estimated the construction cost and established an economic forecasting model.





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Ports and Harbours

WorleyParsons has a proven track record of addressing the multifaceted issues of site selection, planning, design, and project management for the delivery of complex port and harbour developments.

The technical services required to deliver optimum harbour design encompass a range of key areas in which WorleyParsons provides a world-class level of service.

Port and harbour design is driven by a requirement of tranquil waters within which berths and loading facilities can be located. The decision to create a harbour basin or offshore loading facility may have significant cost implications to a project and will require assessment of key selection criteria including:

- Oceanographic conditions
- Mooring analysis and optimization
- Port operability
- Site selection which aims to maximize natural shelter
- Integration with onshore infrastructure
- Environmental and regulatory considerations
- Heritage issues
- Geotechnical and hydrogeological conditions
- Proximity to building materials

WorleyParsons has completed numerous front end engineering studies and investigations to support this assessment process and has followed through with the implementation of key harbour developments globally.

WorleyParsons has a culture which seeks to challenge conventional and preconceived ideals and has the sophisticated tools and skills necessary to provide innovative advice to our customers in this area. Coastal and oceanographic conditions are modelled using state-of-the-art numerical and physical modelling techniques, dynamic mooring analysis tools are adopted to assess vessel behavior, and geological modelling and analysis techniques are used to assess seabed and borrow areas/quarries to provide the information required to deliver the optimal solution.

150+

Mtpa of new capacity planned/
engineered

320

thousand DWT vessels



Project: Esperance Harbour Expansion Project**Customer: Esperance Port Authority****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

WorleyParsons was commissioned by the Esperance Port Authority to undertake master planning and detailed engineering of the Esperance Port breakwaters and reclamation as part of the Harbour Deepening project.

Dredged material from the harbour deepening exercise was used to reclaim land on the seaward side of the existing breakwater. The work scope included reclamation, repair and extension of breakwaters, the construction of a new seawall, coastal processes assessment, and numerical modelling of sediment transport to determine impacts of the port expansion. Breakwater and groyne cross-sections were developed meeting the customer's budget, functional requirements, on-site quarry yields and matched to an on-site quarry.

**Project: Corral Port Master Plan****Customer: Valdivia Municipality****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Chile

WorleyParsons was contracted to study the development of a master plan for the construction of a Panamax bulk and general cargo port and its associated access systems. The port is located at Corral Bay, in the Valdivia River mouth zone. The study included the analysis of site, soil mechanics, oceanography, climate and environmental conditions; river and road transportation studies; definition of hinterland and demand study for port services; competition analysis and forecasting of product utilization; estimation of congestion levels and their associated costs; and the predesign of the required infrastructure for this port.

**Project: Oakajee Port****Customer: Department of Resources and Development****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

The Oakajee Port project required all aspects of port planning from site selection, evaluation of design criteria, dredging of variable calcarenite materials in a severe wave climate, quarry potential, harbour layout design and cost estimates. A critical component of the project consisted of balancing the breakwater and dredging requirements to provide the required level of tranquillity and basin depth. The project will form the basis of port facilities for the Mid West iron ore mining groups with associated downstream iron and steel beneficiation. WorleyParsons progressed designs and associated documentation to a level suitable for inclusion in a BOOT tender process.

**Project: Greenfields Port Development****Customer: Queensland Government****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

WorleyParsons completed this detailed technical, environmental and operational feasibility study for a new AU\$100 million port in Queensland. The study investigated multiple sites including preliminary design for each site. An evaluation of various options for dredging and reclamation by numerical hydrodynamic modelling was undertaken for an assessment of the associated impacts on sedimentation, marine life and seagrass beds. In addition, WorleyParsons determined capital, operational and maintenance cost estimates for each site and life cycle costs for all aspects of the project over a 50 year design life.





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Jetties

WorleyParsons has developed innovative engineering solutions for jetty and berth projects utilizing advanced technology to assess operability, and construction options for the delivery of cost effective structural outcomes.

The use of jetty structures with integrated loading berths in open ocean conditions is a cost effective means of providing ship-loading facilities for dedicated ports (where land backing is not required or cost effective). WorleyParsons has a thorough understanding of the likely oceanographic conditions, including extreme design loadings and berth operational requirements, essential for robust jetty design.

Upon selection of the jetty option as the preferred solution for a port, it is important to address the key process of optimizing jetty length versus dredging strategy and berth orientation versus oceanographic conditions. This requires a sound understanding of the coastal geology and dredging conditions, possible mooring solutions at the berth, and the berth response to various oceanographic conditions. WorleyParsons has developed state-of-the-art analysis techniques to investigate these issues and can provide our customers with early strategic advice and sound economic solutions.

WorleyParsons has delivered a number of projects for the hydrocarbons and bulk minerals industries including:

- Isolated sea island berths
- Jacket structures in poor ground conditions
- Rapid installation modular construction
- Long span incremental launch and heavy lift jetty segments
- Pre-installation of jetty topsides with jetty segments

WorleyParsons also provides topsides engineering, procurement, construction and project management services for jetty topsides facilities including bulk liquids and bulk solids loading systems.

Modular jetty construction

4

kilometers long

Jetty projects executed in

10+

countries



Project: Bonney Export Terminal**Customer: IPCO Marine****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE**Nigeria**

WorleyParsons carried out the planning, analysis of design criteria, mooring analysis and detailed design for a sea island terminal to accommodate twin 85,000 DWT bulk liquid carriers.

This project was part of an overall downstream hydrocarbon facility in Nigeria. The project commenced with the identification stage and WorleyParsons completed a review of berth occupancy criteria and layout of moorings and fenders, determination of fender and mooring design loads, and advice on breasting and mooring dolphin design criteria and mooring equipment. This progressed into detailed design and construction support.

**Project: Liquid Natural Gas Harbour****Customer: SONATRACH, Ministry of Public Works, Government of Algeria****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE**Algeria**

WorleyParsons developed the requirements and design criteria for all port facilities for this new liquefied natural gas (LNG) harbour and terminal, 30 miles east of Oran. It was designed to handle the largest LNG transport ships envisioned for the future (up to 200,000 m³ capacity). The LNG terminal was designed to serve a fleet of 22 ships carrying LNG between Algeria and the United States East Coast, as well as a fleet of nine ships serving Southern Europe. The terminal simultaneously serves three crude oil or condensate supertankers independent of the LNG loading operations.

**Project: Jubail Port****Customer: Jubail Royal Commission****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE**Saudi Arabia**

WorleyParsons Petrocon, a WorleyParsons joint venture with in-country presence, was contracted by the Royal Commission to provide engineering services to Jubail Port. The work scope includes master planning through to design and construction supervision of bulk liquid tankage, onshore storage, and pipelines and terminal facilities. The scope was expanded to capture full marine facilities work including design and construction management of new berths for bulk liquids export.

**Project: Tocopilla Coal Unloading Port****Customer: Codelco Chile Tocopilla Division****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE**Chile**

As part of the fuel conversion project for the Codelco Tocopilla Power Plant, ARA WorleyParsons in joint venture with Soros Associates was awarded the engineering, procurement and field inspection services for the coal unloading port and material handling system up to the power plant 'day bins'. Scope of work included basic and detail engineering, procurement activities and construction supervision services for the 70,000 DWT ship berthing facilities, ship 1,500 TPH unloading facilities, coal handling and storage, reclaiming, general cargo loading/unloading, oil unloading and storage tanks, and ash handling and disposal systems.





Wharves and Berths

Applying our broad experience, WorleyParsons can assist customers in the design of general cargo wharves, container berths, dry bulk terminals, dolphin berths and inshore facilities.

The use of land backed berth facilities to support cargo handling is often necessary for efficient solutions. Land backing ensures a direct interface with storage facilities, land transport systems to provide an integrated transport solution for the project. WorleyParsons offers the full range of services required for delivery of land backed wharves and berths, including:

- Constructability assessments
- Marine engineering
- Geotechnical and pile design
- Rail/road and storage facilities integrated planning
- Container stacking and storage area planning
- Berthing and fendering systems
- Materials handling
- Ship-loading systems design and procurement
- Hazardous cargo considerations for planning and design of efficient port systems

WorleyParsons seeks to deliver innovative, effective solutions to suit customer's requirements by adopting techniques which minimize whole-of-life cost and maximize serviceability. These techniques include:

- Minimizing over-water work by providing innovative prefabrication techniques
- Considering hand-over-hand construction techniques
- Identifying cost effective and schedule saving procurement options
- Considering cost effective fendering and berth solutions
- Specifying an appropriate combination of material solutions, coating and active corrosion protection systems to maximize design life
- Providing 'fit for purpose' berth and onshore solutions to deliver normal wharf and berth operations and to allow simple implementation of future expansions

WorleyParsons' experience includes all phases of wharf and berth projects including planning, concept design, detailed design and documentation, maintenance upgrade surveys and management, construction supervision and project management.

Projects to the value of US

100

million dollars

Berth capacity in excess of

45

MTPA



Project: Bunbury No. 6 Berth**Customer: Worsley Alumina (BHP Billiton)****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

The No. 6 alumina berth required a cost effective solution which could be delivered within the short schedule set by Worsley Alumina.

WorleyParsons were commissioned for this critical project in recognition of their strong EPCM delivery capability and the need for this approach to achieve the defined technical and commercial constraints. The project incorporated all marine, onshore and associated alumina storage, materials handling and procurement of ship-loading facilities. The facility is designed for up to 80,000 DWT Panamax vessels of a maximum overall length of 240m, with a radial track structure supported on piles for the 2,500 TPH radial ship-loader. The first shipment was made in March 2006 enabling a record export tonnage from Bunbury port to be achieved in the same month.

**Project: Pilbara Iron Ore and Infrastructure Project - Marine Structures****Customer: Fortescue Metals Group****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

The Pilbara Iron Ore and Infrastructure project and has re-defined what is achievable in schedule and innovation for large-scale mining projects. This project included new port facilities, associated materials handling, 250km of rail and the development of a new mine site. The marine facilities were completed in an operating port with significant technical challenges. 45Mtpa of iron ore will be exported through the port which is a schedule critical milestone. The marine structures include conveyor trestles traversing 2,000m over poor ground conditions, a 100m long approach jetty, two berths and fifteen dolphins to accommodate vessels up to 300,000 DWT and a ship-loader support structure complete with a 12,500 TPH ship-loader.

**Project: Port of Prony****Customer: Inco Australia Management and Goro Nickel****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

New Caledonia

WorleyParsons provided project management, construction management, and specialist technical critique services for the detailed design of onshore civil works and earthworks, and offshore marine facilities for this US\$100 million greenfields port. The facilities within WorleyParsons' scope of work included a four hectare container and break-bulk storage yard (including a hydrocarbon tank farm, dredge spoil pond and sediment containment ponds), a general cargo wharf, a bulk solids wharf, a ferry terminal, upgrade of an existing wharf and procurement of new tugs.

**Project: Wharf 10****Customer: Port of Brisbane Corporation****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

WorleyParsons was commissioned to complete detailed design and documentation of Wharf No.10 at Fisherman Islands. The wharf is an integral component of the port expansion to accommodate growth in container trade. The project incorporated design of gantry container crane support systems. Finite element analysis of the structures was adopted to optimize design for stack loads, crane pad loads and bulk material storage in poor geotechnical conditions. WorleyParsons provided an interactive design aid role to assist the port in assessing capacity of the dock to carry specialist loading patterns within their operating conditions.





Marine Support Facilities

WorleyParsons recognizes the significant functional requirements that marine support facilities fulfil in large project delivery, marine operations and the repair and maintenance of operating vessels.

Significant exposure to these requirements has given WorleyParsons a broad range of support facility experience to assist our customers in all phases of their project cycle. The functional requirements of marine support facilities are onerous and require attention to detail to deliver efficient operations. WorleyParsons has completed site selection and concept selection through to full implementation for a range of projects including:

- Wharfs to support work boats, supply vessels and general cargo vessels
- Heavy load-out wharfs for roll-off and heavy lifting of modular facilities associated with process plant and mining facilities
- Tug pen facilities
- Supply base marine facilities
- Supply base onshore facilities including consideration of offshore drilling requirements to support offshore construction, servicing of supply vessels and work boats, chemical and other general storage facilities
- Vessel lifting systems for marine repair facilities
- Vessel onshore transfer systems
- Onshore specialist vessel refit and maintenance buildings and facilities including all temporary power systems, IT and active defence systems

The delivery of marine support facilities is typically required earliest in the project delivery cycle and facilities such as supply bases, heavy load out wharfs and those for general support must be sensitive to the project schedule. Solutions which allow early mobilization and completion are required particularly in remote locations.

In the areas of vessel repair and support facilities, WorleyParsons has experience in:

- Wet berth facilities for vessel support
- Synch lift facilities
- Dry docking facilities including fixed and floating facilities
- Slipways
- Ramps
- Onshore vessel transfer systems

Heavy load out capacity designed for

2,500
tonne modules

20+
projects for support facilities including siting, planning and delivery



Project: Dampier Supply Base Heavy Load Out Wharf**Customer: Mermaid Marine Australia****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

This facility has enhanced Mermaid Marine's reputation as an emerging world class leader in logistics management and provides a much needed boost to the facilities required to support the exploitation of oil and gas reserves in the expanding offshore oil and gas market in Western Australia.

WorleyParsons provided a well planned and cost effective solution from concept select, approval management, detailed design and construction management services for this project in the complex geological and oceanographic settings of Mermaid Sound. We also completed the environmental studies including extensive numerical modelling of water quality and sedimentation. The heavy load-out wharf is a unique and innovative design comprising extensive prefabrication of cells in complex ground conditions.

**Project: Tug Pen and Cyclone Haven****Customer: Woodside Energy Limited****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

WorleyParsons carried out the conceptual design and project management of an inshore berthing and service facility and cyclone haven for four 32m long ship handling tugs in an exposed corner of an existing bay with a tidal range in excess of five meters and seasonal tropical cyclones. The solution adopted included a stub breakwater and prefabricated steel floating jetty. The design of the cyclone mooring and fender system was developed using hydrodynamic modelling in the time domain to provide suitable performance during significant cyclonic events and the concept was developed to lend itself to modular fabrication off site.

**Project: Australian Marine Complex Phase 1 Expansion****Customer: LandCorp****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

The Australian Marine Complex Common User Facility (CUF), located in Cockburn Sound, Western Australia has two operational berths. The CUF was developed to facilitate the fabrication, assembly and load-out of pre-assembled units for local, national and international projects associated with the oil & gas, resource and defence industries. The CUF will also support a floating dock and transfer system for maintenance of the Collins Class Submarines from 2009. WorleyParsons was engaged to undertake the detailed design and documentation of the Eastern wharf expansion works to create a third berth for the fit out of Naval vessels and to support the floating dock.

**Project: Extensions to Wharf and New Heavy Load-out Wharf****Customer: Dampier Port Authority****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

To overcome the congestion caused by the increased offshore oil and gas activity, WorleyParsons was commissioned to provide the conceptual and detailed design, documentation, project management and supervision for upgrade and extensions to an operating finger pier. In addition, WorleyParsons designed and implemented a land backed heavy load-out wharf to accept 2,500 tonne modules for LNG train construction and rock load-out used in offshore construction.





Moorings

Suitable operability of onshore and offshore moorings is a fundamental design requirement for any new development, along with the design of robust and functional mooring systems. WorleyParsons has the full spectrum of specialist skills to provide solutions in even the most complex environments.

Vessel and mooring system response to environmental loadings is crucial to the operability of any mooring system. Those involved in operational management of moorings require prediction of moored vessel behaviors under existing and forecast environmental conditions. The interaction between berth availability, on and off loading requirements, and adjacent facility structures also requires careful planning to maintain a safe and efficient operation.

WorleyParsons has comprehensive mooring design capability and the skills to assess the response and stability of a wide range of floating bodies in open ocean and sheltered harbour environments. Our capabilities include:

- Provision of extreme and operational met-ocean design criteria
- Modelling of wave and current conditions
- Design of optimal berth location and orientation to minimize downtime
- Determination of limiting conditions for berth occupation and operation
- Mooring system design and assessment
- Condition surveys
- Vessel motion response analysis
- Vessel manoeuvring analysis and UKC studies
- Evaluation of the consequences of line failure
- Prediction and monitoring of vessel, gangway and manifold movements
- Mooring safety and procedural studies

WorleyParsons uses a range of numerical models to assess coastal processes and vessel motion. These models include AQWA, MOSES, SHIPMA and the shallow water vessel motion model TERMSIM. WorleyParsons has also developed a rapid operability assessment system, applying the combination of detailed met-ocean and vessel motion modelling.

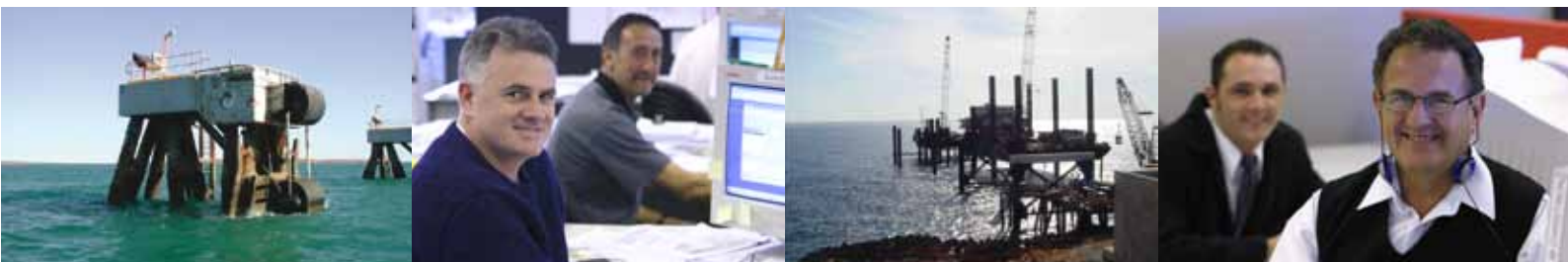
20+

years mooring
experience

Mooring projects in

10+

countries



Project: Cape Cuvier Marine Terminal**Customer: Dampier Salt****Phases:** IDENTIFY >> EVALUATE >> DEFINE >> EXECUTE >> OPERATE

Australia

At Cape Cuvier, bulk carrier vessels up to 75000 DWT are loaded with salt at an exposed, isolated offshore multi-buoy mooring.

WorleyParsons helped develop varying solutions to ongoing mooring fatigue and wear issues, provide upgrade solutions to accommodate 90,000 DWT vessels and risk assessments for mooring failure. WorleyParsons also performed an investigation into how to improve berthing and unberthing operations using fewer mooring lines and tugs. A comprehensive investigation into the use of Cape size vessels at the terminal was also conducted including mooring design, ship-loader modifications, tug sizes, limiting environmental conditions and estimates of capital cost.

**Project: North West Shelf Venture LNG****Customer: Woodside Energy Limited****Phases:** IDENTIFY >> EVALUATE >> DEFINE >> EXECUTE >> OPERATE

Australia

The LPG and LNG berths are located adjacent to the LNG Plant on the Burrup Peninsula in Dampier Western Australia. The berths are used for the export of costly LNG cargos from the plant in very sophisticated vessels. Safety of the cargo and vessels is a primary requirement. WorleyParsons undertook a detailed numerical vessel motion and mooring analysis study using in-house computer modelling capabilities. The limiting conditions for mooring lines were assessed to determine the maximum allowable cyclonic swell conditions at the berth. Under keel clearance along the Woodside Shipping Channel were also analyzed and the results of the combined analyses formed the basis of port operating procedures.

**Project: Cossack Pioneer FPSO Field Support Vessel Study****Customer: Woodside Energy Limited****Phases:** IDENTIFY >> EVALUATE >> DEFINE >> EXECUTE >> OPERATE

Australia

WorleyParsons developed a model to simulate the station keeping performance of a turret based floating production, storage and offloading facility tandem moored to an offloading tanker. The model accounted for differing vessel sizes and ballast conditions as well as multi-directional wind, wind-sea, swell and current conditions and determines vessel orientations, turret loads and tandem hawser loads. The effect of static tow from a Field Support Vessel was also simulated.

**Project: Austal Cat Moorings****Customer: Austal Ships Pty Ltd****Phases:** IDENTIFY >> EVALUATE >> DEFINE >> EXECUTE >> OPERATE

Australia

The growing shipbuilding industry situated in Cockburn Sound is constructing ever increasing numbers and sizes of high speed catamaran ferries for the export market. Prior to final delivery, local sea trials are undertaken. During these periods, the vessels can be exposed to severe storm conditions due to winter storm fronts and tropical cyclones. WorleyParsons undertook studies and completed mooring designs for the extreme environmental wind and wave conditions and developed vessel loadings appropriate to the site and exposure conditions.





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Dredging & Reclamation

WorleyParsons has completed a multitude of environmental assessments, investigations, detailed engineering, project management and construction management of large complex dredging and reclamation assignments through to small environmentally sensitive projects.

WorleyParsons has the skills and experience to successfully implement dredging and reclamation projects, which rely heavily upon a comprehensive understanding of:

- Coastal geology
- Oceanographic conditions
- Marine ecology
- Dredge disposal and reclamation permitting
- Reclamation design including performance requirements
- Equipment selection and strategy for materials handling offshore
- Sediment and water quality assessment

WorleyParsons services all of these areas and can also provide valuable technical support on modelling and monitoring of dredging material behavior, both in situ and at the dredging and disposal locations. We have a team of world class specialists in the field of coastal geology and materials characterization to satisfy the stringent requirements typical of dredging contracts. In many cases, these specialist services are called upon by WorleyParsons' partners and competitors in recognition of our experience and high standards of work.

Provision of comprehensive documentation to support dredging and reclamation tender and contract documents is also a key requirement of successful delivery. WorleyParsons is experienced and extremely competent in the preparation of these documents and in delivering ongoing project and construction management of the associated works.

45+

million m³ individual dredging projects

320

thousand DWT vessels

20+

years experience in dredge investigation and characterization



Project: Pilbara Iron & Infrastructure Project**Customer: Fortescue Metals Group****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

This turnkey project included extensive marine facilities to enable export of 45 Mtpa of iron ore through Port Hedland, comprising conveyor trestles traversing 1,400m over complex ground conditions, a 90m approach jetty, two dolphin berths to accommodate vessels up to 300,000 DWT and a ship-loader support structure.

The expansion of the ship manoeuvring area, departure area and berthing basin included some 4.5 million m³ of dredged silt and sandstone used in strategic reclamation of the stockyard area. Work included full delivery of all marine structures, ship-loading equipment, dredging, stockyard areas and rail interfaces.

**Project: Gorgon Development LNG Port****Customer: Chevron****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

WorleyParsons undertook near-shore and onshore geotechnical investigations for the marine facilities and pipeline crossings at the environmentally sensitive Barrow Island in Western Australia. WorleyParsons completed a karstic hazard and risk assessment of coastal limestones at the proposed plant and port site located at Town Point on Barrow Island, a Class A nature reserve. This was completed through a combination of desktop study and site mapping. Near-shore geotechnical investigations were also undertaken for LNG export marine facilities on the east coast of Barrow Island and feed gas pipeline shore crossings on the west coast. Investigations included diver operated drilling from the seabed in up to 20m water depth and vibrocoring operations.

**Project: Pluto LNG Project****Customer: Woodside Energy Limited****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

WorleyParsons is involved in siting studies for the LNG project's shipping channel and turning basin dredging. A total of approximately 10 million meter³ of dredging in complex geology was proposed. WorleyParsons' role included geotechnical investigations, channel design optimization and preparation of tender documents. WorleyParsons is currently engaged in the delivery stage of the project in joint venture.

**Project: Ma'aden Port Development****Customer: Ma'aden (Saudi Arabian Mining Company)****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Saudi Arabia

This landmark project creates an international profile for the WorleyParsons infrastructure business in greenfields project delivery. Ma'aden recently announced the award of an estimated US\$130 million program management services contract to WorleyParsons for the provision of master planning engineering and project management services for this phosphate and industrial estate infrastructure project. The port component of the project comprises a US\$600 million port consisting of 45 million cubic meters of dredging for the channel and harbour basin, seawalls and reclamation of up to 500 hectares of waterfront land, four berths and all onshore infrastructure and services for the port facility.





Breakwaters and Seawalls

WorleyParsons has a wealth of experience in the design and construction of seawalls and breakwaters. Our experience ranges from concept design and master planning of breakwaters for major ports to small seawalls for residential marina developments.

WorleyParsons applies the latest design tools, including both numerical and physical modelling to ensure an appropriate and cost effective solution is achieved. WorleyParsons' experience includes:

- Derivation of design wave and water level conditions
- Modelling of wave conditions for different breakwater configurations
- Identification of quarry sources and assessment of armor and rubble yields
- Preliminary and detailed design utilizing numerical analysis tools
- Seawall physical modelling seawall condition and integrity assessments
- Project and construction management
- Construction supervision

WorleyParsons delivers efficient breakwater designs by interfacing design criteria requirements (wave and water level conditions) with quarry yields. Our designs also include evaluation of extreme design criteria, optimizing CAPEX and maintenance costs/benefits over the design life of the structure.

- WorleyParsons takes the time to fully understand and develop our customer's requirements into a 'fit for purpose' effective solution that includes:
- Mass armor that provides economic solutions in severe wave climate conditions
- Breakwaters that are designed for cyclone exposure where a critical assessment of risks and consequences (to minimize CAPEX with a 'fit for purpose' strategy) has been performed
- Application of state of the art oceanographic design criteria analysis to ensure designs are matched to the real design climate
- Artificial armor units, sheet piled or caisson-type structures where quarry yields are unsuitable for the proposed applications
- Minimized breakwater infrastructure without compromising harbour or facility operational criteria

Breakwaters for cyclonic conditions and

10+

meter wave conditions

10+

million m³ of planned and completed breakwater construction works



Project: Hamersley Iron Seawalls

Customer: Minenco Pty Limited

Phases: IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

WorleyParsons was commissioned to provide strategy and implementation for repair and upgrade to Hamersley Iron’s vital seawall infrastructure in Mermaid Sound following significant damage suffered from a severe tropical cyclone.

The scope of work included derivation of design wave and water level conditions, preliminary and detailed design of rubble armored seawall, risk assessment, development of construction methodologies, budget cost estimation, project management, and construction management of the upgrade.



Project: Esperance Harbour Seawalls

Customer: Esperance Port Authority

Phases: IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

WorleyParsons carried out the detailed design and construction supervision of the Esperance Port breakwaters as part of the harbour expansion project. Dredged material gained from the deepening exercise was used to reclaim land on the eastern side of the existing breakwater. The project is located in an exposed location on the southern ocean and use of local quarries to source construction materials was adopted as a cost-effective means of delivering this strategic infrastructure.



Project: Hamersley Iron Seawalls Physical Modelling Study

Customer: Minenco Pty Limited

Phases: IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

Hamersley Iron operates several port facilities that are protected by several kilometers of seawalls, exposed under extreme cyclonic conditions to wave heights of up to 7.5 meters and extreme water level storm surges. New seawall designs were developed for the upgrade using state of the art computerised design tools. The most cost effective and constructable seawall designs required high damage level profiles utilizing smaller (10-15 tonne) armor rock sizes, achievable in reasonable yields from nearby quarries. Physical scale modelling of these designs was undertaken to confirm the hydraulic and structural performance of the seawalls during extreme storm conditions.



Project: Rudderham Drive Seawalls

Customer: Fremantle Port Authority

Phases: IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

This project included preliminary investigations, detailed design and documentation, and construction supervision of the reclamations, future basin area and seawall works at Rous Head, Fremantle. Staging of the seawalls connectable with the harbour deepening works were required for successful instrumentation of the project. WorleyParsons was commissioned by the Fremantle Port Authority to complete concept selection and personal detailed designs for the for the Rudderham Drive development at the port of Fremantle.





Marinas, Canals and Marine Leisure

From residential canal estates to ocean-side aquariums, WorleyParsons has the right mix of knowledge and experience to suit all marine leisure, tourism and land development needs.

Marina and canal developments are becoming more prevalent to enhance land developments. Waterfront precincts, canal estates, boating marinas and ocean-side entertainment facilities are in demand, and often service large proportions of the community. It is important to plan them carefully to optimize land use while minimizing whole-of-life costs and maximizing long term returns.

WorleyParsons provides our customers with complete planning, approvals, engineering and project delivery solutions for marinas and canals, aquariums, sub-sea viewing platforms, fishing jetties and all other types of marine leisure facilities including:

- Siting studies, master planning and layout design for canals, marinas and leisure facilities
- Design criteria establishment and boating assessments
- Environmental assessment/approvals management, geotechnical/ geological investigations and hydrogeological surveys
- Land and water-based subdivision design
- Wharf, jetty, pen and pontoon design
- Design of walling and edge treatments, scour protection systems and entrance stabilization structures
- Structural design for facilities
- Bridgeworks, roads and drainage design
- Water quality and flushing assessments and monitoring for compliance
- Construction supervision

5+

years consecutive awards for best marine based urban canal development

300+

boat capacity marine projects



Project: Sebana Cove Marina**Customer: Netcoin Sdn Bhd****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE**Malaysia**

WorleyParsons was appointed as project manager and engineers for the design of all marine works for this prestigious 1,000 hectare tourism and land development.

WorleyParsons provided our customer with the business case at project establishment for this prestigious marina and canal development. Our scope included master planning, geotechnical, hydrological and hydrographic surveys, numerical modelling of harbour sedimentation, assessment of maintenance dredging requirements and optimization of canal flushing. The detailed design and project management role was inclusive of earthworks, revetments, slope protection, entrance works, sheet-piled breakwater and boating facilities for the marina and mega-yacht basin.

**Project: Port Mandurah Stages 2-5 Canal Estate - Detailed Design****Customer: Cedar Woods Properties Ltd****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE**Australia**

WorleyParsons provided specialist coastal and marine engineering advice during the detailed design phase of this project. Detailed design and documentation of the canal walling, navigable waterways, southern canal estate entrance layout and the hydraulic/flushing characteristics of the Canal Estate were performed. Water quality and flushing characteristics of the completed canal estate were examined to optimize the number and size of several road bridges, without affecting the hydraulics of the canal system.

**Project: Busselton Underwater Observatory****Customer: Doric Building and Busselton Shire Council****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE**Australia**

Environmental conditions and design criteria were researched and specified for operational and survival conditions. The structural and architectural concepts for the underwater observatory, entrance building and interactive displays were developed in conjunction with architects and presented to the customer for review and comment. Detailed design and specification of the foundations, observatory, building and jetty modifications were then completed and documentation as part of a design and construct team.

**Project: Nanjing Underwater World****Customer: Oceanis Australia****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE**China**

WorleyParsons carried out the civil and structural design for the foundations and structures for a five-level building housing the Underwater World aquariums, water treatment facilities and recreation and entertainment areas for this \$22 million project. Reinforced concrete raft and pad foundations and retaining walls were used to suit the soil conditions and water table level. The structure comprised reinforced concrete slab, beam and column construction for floors and roofs. The design was carried out in consultation with the Nanjing engineering authorities.





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Specialist Support Areas

Select - Front-End Services

Decisions made during the initial stages of a project have the greatest impact on the ultimate business outcome.

Select is an integral part of WorleyParsons and provides customers with specialist front-end services delivering the optimal solution and bankability of the project in early project definition. Specialist Select marine capabilities that are an integral part of our overall service include: coastal and ocean modelling and analysis, coastal geology, marine ecology, dredging approvals, permitting and monitoring, seismic analysis, and simulation

Program Management

WorleyParsons is one of the world's largest providers of program management consultancy (PMC) services and EPCM services for large multi-disciplinary projects.

WorleyParsons has an outstanding track record as a PMC contractor integrated with the customer's team. As program manager, we form a working partnership to ensure that customer interests and business objectives are met in the most cost effective manner. This operational methodology produces a quality program that is safe, cost effective, technically sound, environmentally compliant and deliverable in a minimum timeframe.

Improve Asset Management Services

WorleyParsons values long-term service contracts as a mechanism for supporting and improving the ongoing operations of our customers developed assets.

Long-term service contracts enable our customers to focus on their core competencies. These contracts also establish close working relationships with our customers that result in more efficient project delivery and allow WorleyParsons to share in both risks and rewards. Our success is dependent on our customers being successful.

500+

specialist front-end services personnel

US\$36b

in facilities managed in 20 years

100+

long term service contracts worldwide





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Our Vision

WorleyParsons will be the preferred global provider of technical, project and operational support services to our customers, using the distinctive WorleyParsons culture to create value for them and prosperity for our people.

Leadership

- Committed, empowered and rewarded people
- EcoNomics™ – Delivering profitable sustainability
- Integrity in all aspects of business
- Energy and excitement
- Minimum bureaucracy

Agility

- Smallest assignment to world-scale developments
- Local capability with global leverage
- Responsive to customer preferences
- Optimum solutions customized to needs

Relationships

- Rapport with all stakeholders
- Open and respectful
- Collaborative approach to business

Performance

- Zero harm
- Results for our customers and other stakeholders
- World-class resources, capability and experience



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EcoNomics™

**For further information about
our global capability please email:
marine@worleyparsons.com**

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