

MARINAS

COWI



THINK MARINE

COWI's history in civil engineering dates back to 1935 when the company was founded. Since then, COWI has pushed the boundaries of marine design through our involvement in more than 3,000 marine projects worldwide. These projects range from large and technically challenging LNG terminals, container ports and waterfront developments to cooling water systems, offshore wind farms, flood protection, locks and dams and marinas.

Today, we are a world leader in marine and coastal engineering. It is a position we have achieved by diligently pushing the development of new technologies to stretch the limits of what is possible.

We are driven by innovation and by our ambition to work closely with our clients to deliver world-class marine structures. Our services cover the entire life cycle of a marine structure, from the initial ideas to the operation phase, decommissioning or rehabilitation.

With a full set of world-class competencies within marine and coastal engineering combined with local presence and experience, we are ready to take on the most complex projects anywhere in the world – no matter how large or small.

Together, we will take you there.

WHY CHOOSE US?

We offer a broad range of services for every project phase in the development and lifespan of a marina. Our 360° approach requires expertise and diversity and we have the staff to support this approach.

Developing, extending, reconfiguring and managing marinas to today's high standards is a complex matter requiring a wide range of engineering and environmental inputs, with many hours of forethought and planning needed for a successful outcome.

We provide specialist expertise for working in the coastal foreshore, one of the most aggressive and unforgiving environments. Hence, as elsewhere, successful design depends on a clear understanding of the prevailing conditions, coastal processes and loads and impacts from the surroundings to be withstood by the marine structures.

We work as lead consultants, as lead project managers coordinating the work of multidisciplinary team or as specialists as part of a wider project team.

Our consulting services cover master planning, studies, conceptual, basic, and detailed design, construction engineering, independent design reviews, construction management, site supervision, operation & maintenance, re-evaluation and rehabilitation, and decommissioning. We are familiar with all the technical disciplines required for a complete marina: geotechnical, geophysical, bathymetric and topographic investigations, metocean data collection and evaluation, assessment of design parameters, wave disturbance assessments, navigation and manoeuvring assessments, marina layouts, breakwaters and slope protection, dredging and earthworks, slipways, roads and car parks, buildings, service areas, storage facilities and utilities, and operation and maintenance.

We give special attention to the environmental aspects and conservation interests, leading to the innovative technological approaches required to address tightening environmental legislation.

Development and use of traditional building methods and use of local resources make it possible to integrate even large marinas aesthetically into the surrounding landscape.

We have developed our business to meet these challenges.

REHABILITATION

MASTER PLANNING

STUDIES

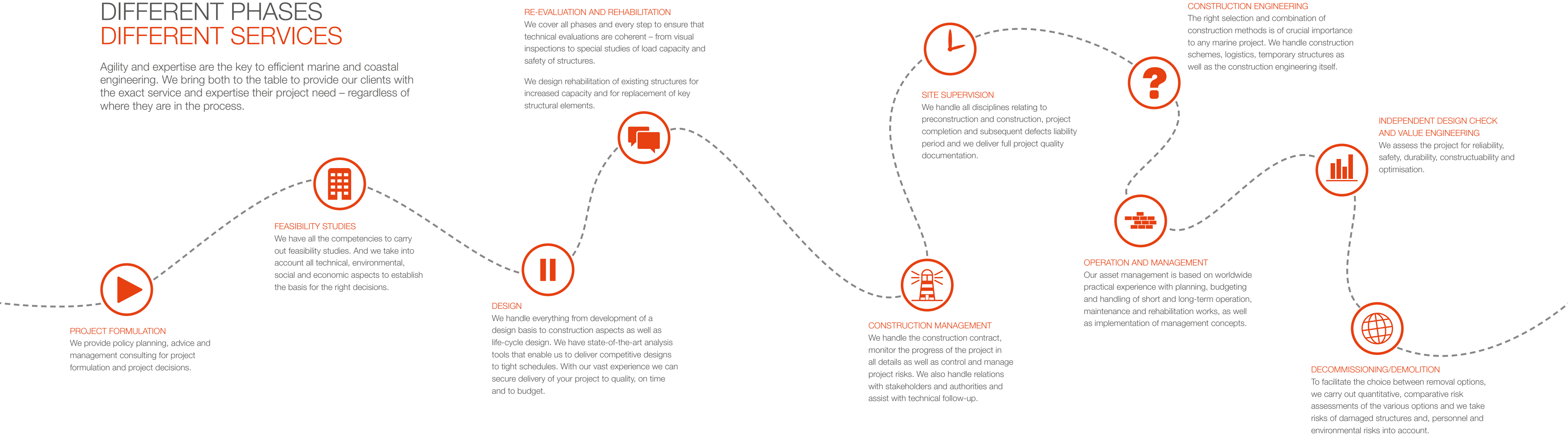
FULL CIRCLE
SOLUTIONS
FOR MARINAS

CONSTRUCTION MANAGEMENT

DESIGN

DIFFERENT PHASES DIFFERENT SERVICES

Agility and expertise are the key to efficient marine and coastal engineering. We bring both to the table to provide our clients with the exact service and expertise their project need – regardless of where they are in the process.



MASTER PLANNING

The field of master planning and urban marina design requires a wide range of knowledge to suit local conditions and visions. There is an interdependence of urban systems and communities as well as global issues that create the social infrastructure of integrated urbanism, and only truly multi-disciplinary consultants like COWI can successfully deliver solutions in this environment.

Each project site is having a unique environment base and requirements, and needs taking into consideration the local conditions and the client's vision and requirements. COWI can select an international cross-disciplinary team of marine and environmental specialists, urban planners, architects, experts in traffic, retail and commercial, cultural heritage, business plans and economic and financial strategists. The mix of skills will enable the project team to develop a sustainable and attractive marina and urban area to meet the expectations and demands of its customers, inhabitants and visitors.

COWI is experienced in master planning spans from small private facilities to 1,100-berth marinas with commercial and residential developments seamlessly merging into the surrounding urban area.

Our services range from independent consultancy of the master plan to technical assistance during the planning phases and can include the following activities and subjects:

- › Socio-economic analyses and visions for commerce
- › Complete master plans for buildings, transport system, landscaping and marina works
- › Local, regional and international legal expertise
- › Analyses of financial opportunities and constraints, including market demand assessments
- › Master plan reviews and peer reviews
- › Regional and strategic planning
- › Support of development applications
- › Production of site development briefs
- › Development of tourism
- › Stakeholder consultation
- › Transport and access linkages
- › Environmental requirements
- › 3D modelling, both video and still photo visualisation.



STUDIES

Understanding the environment in which the project is to be constructed requires knowledge obtained from various sources and various types of information. The quality of the project depends on the accuracy and details of information obtained through surveys, studies and investigations. Project requirements may change or be refined as it moves through its lifecycle of studies, design, construction and operation.

COWI manages all design requirements through programming, planning, supervising and post-processing of surveys and investigations in wind, wave, current, geotechnical engineering, geophysics and bathymetric and topographic surveys.

Our regional offices have intimate knowledge of the local area and environment and they ensure that the project is placed in its cultural, historical, geographical, environmental, social and economic context whilst integrating the latest in methodology and technological thinking.

The surveys and investigations typically involve:

- › Geotechnical and geophysical investigations
- › Infrastructure and utilities surveys
- › Metocean data collection
- › Bathymetric and topographic surveys
- › Urban design and landscape studies
- › Archaeological and cultural surveys
- › Seismic and tsunami studies
- › Waterfront integration
- › Groundwater conditions
- › Boat mix analysis
- › Service life design
- › Cold climate design
- › Environmental assessments
- › Navigation and manoeuvring studies.



DESIGN

The design of each marina is unique. No two locations have the same project vision or environmental and geographic conditions.

COWI offers complete marina and waterfront design services and whether we create a new marina or extend or refurbish an existing one, we will create unique marina design solutions. Working globally, COWI is conversant with all relevant standards, international codes of practice and conventions.

As designers, we collaborate closely with our clients to ensure a smooth integration of ideas and expertise, resulting in the development of economical and innovative designs that utilise available plant and materials to suit the specific conditions.

COWI specialises in the design of durable marine structures and is continuously developing techniques to prolong their lifespan while minimising initial investment. Furthermore, we consider global effects on the marina design including climate change and consider its carbon footprint and sustainability.

Optimisation to suit construction equipment requirements and simplicity of construction processes are important considerations in the design process.

We can deliver the full range of services for yacht and motor boat marinas, including:

- › Protective coastal structures such as breakwaters and revetments
- › Design of marina components, pontoon arrangements, anchoring systems, marina access
- › Design of all landside infrastructure including buildings and maintenance facilities, slipways and shiplifts, landscaping and foreshore
- › Mechanical, electrical/ICT and hydraulic services
- › Infrastructure upgrade programmes
- › Super yacht harbour development
- › Phasing of the development
- › Dredging and reclamation earthworks
- › Security and safety.



UTILITIES AND SERVICES

Marinas have special requirements for utilities and services. Boat owners expect to find supporting services provided at their berth. The extent of services provided can vary from basic to luxurious.

COWI designs utilities and services, whether underground, suspended, or contained within ducts for maximum protection from the elements, water and mechanical damage and consider their accessibility for repairs and maintenance.

We design the full range of utilities and services required for marinas and small boat harbours including:

Electrical:

- › Power, single and 3-phase
- › Lighting, general, berth, safety and feature.
- › Information and Communications Technology (ICT).

Systems:

- › Telephony
- › Internet, cable, wireless
- › Cable TV, cable, satellite
- › Computerised berth monitoring systems.

Mechanical:

- › Potable water and firefighting water
- › Sewage, pump-out, vacuum
- › Liquid waste and oily water treatment
- › Solid waste disposal
- › Flushing systems
- › Fuel supply
- › De-icing systems
- › Marina basin flushing systems
- › HVAC.

Security:

- › Closed-circuit TV (CCTV)
- › Card access security gates, fencing and patrol requirements
- › International Ship and Port Security Code (ISPS).

Safety:

- › Safety and rescue equipment
- › Navigation aids.



CONSTRUCTION MANAGEMENT AND SUPERVISION

Construction management and supervision is the overall planning, co-ordination and control of the physical execution of a project from its beginning to final completion with the aim of achieving the client's vision and requirements to produce a functional and financially viable project.

COWI has a long track record in construction management and supervision ranging from small boat harbours and marinas to large multidisciplinary marine projects throughout the world. COWI's widespread and varied experience in both design and construction methods facilitates planning, identification of potential problems and innovative solutions to them.

Some of the typical activities undertaken are:

- › Review of contractor's programme, method statements and quality assurance system
- › Tendering and contracting assistance
- › Review and approval of as-built drawings
- › Review and approval of maintenance and operation manuals
- › Review of design variations
- › Inspection and testing
- › Certification of payments
- › Supervision of commissioning
- › Certification of completion
- › Progress reporting.





RECOGNITION OF COWI'S DESIGN

Our excellence in marina design has been recognized worldwide. Cooperation with leading architects has matched technical excellence with aesthetic quality.

In 2007 the Pearl Marinas in Qatar were awarded CNBC's International Award for Best Marina in 2007.

In 2012 at the World of Yacht and Boat Recognition Awards in Qatar, the Lusail City Marina was awarded the "Excellence and Innovation Award". And in December 2013 it won Boat Owners Middle East's "Most interesting Marina Development" award.

In 2016 the Crescent City Harbour Inner Boat Basin Reconstruction Project in USA received an "Honor Award" at the American Council of Engineering Companies 2016 Engineering Excellence Awards.



MARINA WEST HARBOUR, CA, USA

The San Francisco Marina is composed of two harbours, known as East Harbor (Gashouse Cove) and West Harbor. The West Harbor consists of the West Harbor marina, the Saint Francis and Golden Gate Yacht Clubs, the Harbor Office Building, and parkland that includes restrooms, a concession stand, and four parking lots.

COWI, acting as designer of record, was responsible for all engineering aspects of the West Harbor renovation. Design responsibilities included the new concrete floats, pre-stressed concrete guide piles, fibreglass separator piles, a floating concrete breakwater, fixed sheet pile wall breakwater, pedestrian gangways and ramps, access platforms, dredging, seawall repairs, and renovations of the existing harbour master building. COWI also provided coordination for compliance with the Americans with Disabilities Act, new mechanical and electrical systems, and other landside improvements.

Working with the client to optimize the number and distribution of the berths, COWI prepared the final layout of the marina. The final arrangement consisted of 385 berths, including 44 with access for disabled persons. A coastal analysis was performed to verify the design criteria and various options were reviewed for the floats. Also, on-site inspection was provided during the construction of the concrete floats.

Two sub-consultants were responsible for developing the designs for various landside site repairs and amenities. They also assisted with permit amendments and resource agency approvals and technical expertise on sediment characterization, dredging and capping.



THE PEARL MARINAS, QATAR

The Pearl Qatar is a new Riviera-style man-made island constructed 10 km north of Doha offering a unique living and cultural experience with a great diversity of living areas based on the best of various architectural styles.

The island includes residential, commercial and recreational facilities, covers an area of 5 km by 3 km, and is home to 40,000 residents. At the eastern end of the island lie a string of private islands.

Qatar and the greater Gulf area have a rich marine heritage from pearl diving and fishing to oceangoing trading ships. To continue this relationship with the sea and meet the demands of yachting three marinas were developed in separate coves, each catering to differing needs. Porto Arabia, the largest marina, is a premium megayacht marina. Viva Bahriya serves the more popular smaller boats and includes the maintenance facility, and Costa Fayrouz has a dedicated sailing yacht marina. The Qanat Qartier district, designed with a network of canals reflecting the style and characteristics of Venice serves very small boats.

All marinas have been designed with pile-guided floating pontoon systems in accordance with the highest international standards for marinas. They include the full range of services and utilities and a fully equipped maintenance facility with dry storage for boats up to 8 m in length.

The main marina work included:

- › Hydraulic modelling studies including wave climate impact, current velocity and water level, flushing and water quality, shoreline evolution, and beach stability and sedimentation
- › Surveys and investigations including bathymetry, geotechnical investigations and environmental management plan
- › Feasibility study of water taxis and ferry services
- › Concept and basic design considering marina locations, layouts, boat mix, dredging, and navigation and manoeuvring
- › Basic design of the marinas including services and utilities together with fuel docks, maintenance facilities, ferry and water taxi berths
- › Full tender documentation.

The marina design and materials selection considered operation and maintenance requirements as well as sustainability and environmental impacts.



TUBORG SOUTH WATERFRONT DEVELOPMENT, DENMARK

Tuborg Syd is a new neighbourhood developed in the area of the former Tuborg factory and the old industrial port in Hellerup.

The development comprises 210.000 m² of buildings including housing, offices, a shopping centre, a public school, and other public institutions. The new district is located in a coastal environment with new canals, a new marina and buildings with sea views to Øresund.

COWI was responsible for the master plan developing the area and provided multidisciplinary consultancy services covering marine works, traffic planning, roads, bridges, utilities, buildings and subterranean parking facilities. A close cooperation was maintained with the architects from Vilhelm Lauritzen A/S to ensure that aesthetic requirements of the project were fulfilled.

The marina work included:

- › Planning of the marine layout
- › 450 m of new canals providing berthing for smaller yachts and motor craft. Irregular basins are provided for larger yachts. The quay walls, retaining up to 8 m, were designed as anchored sheet piled structures

- › 1600 m of wooden and granite promenades along the quay walls in up to three levels separated by retaining walls in precast, sand-coloured concrete
- › A marina with approximately 350 ultra-modern and luxurious berths with water, electricity, TV and internet connection. Shore facilities such as a yacht club building and service quay
- › New breakwaters and a new pier head to minimise wave disturbance in the harbour basin
- › 700 m of new reclaimed coast line south of the harbour entrance.

Earth moving logistics was of prime importance to the development, with large quantities of contaminated soil to be handled in a cost-effective manner and with due consideration to environmental requirements.

The marina and approximately 1600 m of quay were designed and tendered in phases to enable designated packages to be completed as early as possible.



AL ZORAH DEVELOPMENT, AJMAN, UAE

Life comes naturally to the Al Zorah Development, a new project straddling the 3 km long beach foreshore and the existing mangrove creek area where residents and visitors can enjoy a relaxing lifestyle in total harmony with nature.

Stretching along the coast of Ajman this mixed-use development is envisaged as the ultimate getaway for residents and visitors. It covers an area of 7 km by 3 km with a peninsula created by two large nearshore islands, and is home to 157,000 residents. The Al Zorah Development, divided into five key districts titled The Gateway, Beachfront, Peninsula, Creekside and Golf Course includes all residential, commercial, recreational, educational and healthcare facilities as well as a golf course, hotels and marinas.

COWI's input to the project was environmental and engineering services related to the marine works. The design services cover conceptual, preliminary and detailed design followed by supervision of the marine construction activities.

COWI carried out numerical modelling of water levels, current and wave conditions as basis for its design and subsequent studies including beach stability, wave disturbance in marinas, and sediment spill from dredging

operations. Furthermore, flushing and eutrophication were modelled to achieve acceptable water quality in the area. The studies were made using the advanced modelling systems MIKE 21 and LITPACK.

The environmental impact assessment considered both terrestrial and marine aspects and included studies of air pollution, noise and cooling water from a nearby power plant.

COWI supplied inputs to the development of the master plan, dredging, reclamation, edge treatment structures, marinas, canals, and a mechanical flushing system. The edge treatment structures are rock revetments, concrete block walls, mangroves, and beaches.

The concept design of six marinas and five berthing facilities included boat mix development, layout options, navigation and manoeuvring, marina utilities, maintenance facility and fuel berth requirements, and marina building requirements.



CRESCENT CITY HARBOR, CA, USA

The popular fishing port of Crescent City is located in the area of the West Coast most vulnerable to tsunamis. The occurrence of two tsunamis in 2006 and 2011 caused about 40 million dollars worth of damage to the waterfront structures. This emphasises the importance of including tsunami resistance in the design of the marina. Today the tsunami resistant marina is at the forefront of resilient design.

COWI was retained to design a more resilient marina with the requirement for a 50-year tsunami recurrence interval design life. The service life of a marina is generally 25-years. Robustness, resiliency and redundancy were key attributes of the dock system. The development of an original design for a more resilient Crescent City Marina was based on a rational approach as when the design for the new harbor was underway, prescribed tsunami standards did not exist. This work was the first of its kind.

With no established design criteria for tsunamis COWI provided the Harbor District with an extensive hydrodynamic model analysis method to develop a cost-effective, resilient design.

Several layouts were reviewed for berth sizes, distribution, sizing, and fairway requirements. The alternative layouts included critical details for floats, fingers, walkways, attenuators and associated electrical, potable water, and firewater requirements. Development of construction cost estimates

of the alternatives assisted the Harbor District's review and selection. This information was used to procure funding for the selected layout. The multi-use conditions of the marina required careful consideration and planning to minimize construction costs. Assistance was provided to the District with public presentations to further project design decisions and awareness.

A crucial aspect of the project was the phasing of construction works to cause minimal disruption to the local fishermen.

COWI provided the detailed planning, structural and coastal engineering design. The work included the layout of floats and finger piers, structural analysis and design of the new concrete floats, walkways, attenuators, accessible gangways, and landings, location of access ramps and access points compliant with the Americans with Disabilities Act, as well as design of rock-socketed pilings, floats, and wave attenuators. The design loads include dead, live, wind, wave, impact, and tsunami conditions.

SELECTED REFERENCES



RIJEKA GATEWAY, CROATIA

The 42-acre dilapidated harbour area of Rijeka was to be transformed into a modern foreshore with residential, cultural and commercial districts featuring a new marina and ferry terminal.

- SERVICES:
- › Input to development of the master plan
 - › Technical expertise in environment and traffic analysis
 - › Development of design guidelines
 - › Economic and financial analyses
 - › Process and project management
 - › Legal expertise in international tendering.

FAABORG HARBOUR, DENMARK

The new harbour basin will provide approximately 200 berths. The basin is formed by a 270 m long sheet pile breakwater and a 40 m long rock breakwater protecting a basin with water depths between 3.0 m and 5.5 m.

- SERVICES:
- › Preparation of the master plan
 - › Concept design of the new harbour, numerical modelling of waves and currents, geotechnical investigations, and preparation of draft tender documents.

PALM JEBEL ALI, DUBAI, UAE

COWI prepared a marine master plan for two marinas on Palm Jebel Ali in Dubai. The northern marina comprised 275 berths of up to megayacht size and land facilities including a yacht club, chandlery, convenience store, restaurants, parking and roads. The southern marina consisted of 100 berths and land facilities including boat storage and parking areas.

- SERVICES:
- › Master plan.

SARANDA GATEWAY, ALBANIA

The project was part of the transformation of the port area to facilitate visitors' access to Albania's southern coastal region.

- SERVICES:
- › Geotechnical investigations and geological studies
 - › Bathymetric and topographic surveys
 - › Magnetometer and side-scan sonar surveys
 - › Environmental impact studies
 - › Benthic flora and fauna surveys
 - › Water and sediment quality sampling and analysis
 - › Archaeological survey
 - › Traffic studies
 - › Socio-economic studies
 - › Numerical modelling of waves and currents
 - › Port planning and engineering.

URBAN DEVELOPMENT, AL KHOR, QATAR

The project is a city and foreshore development of 550 ha along 5½ kms of coast along the northern shore of the Bay of Al Khor. The development will provide accommodation for 60,000 residents and 38,000 staff and visitors.

- SERVICES:
- › Geotechnical investigations and testing
 - › Geological definition and soil/rock parameters
 - › Bathymetric and topographic surveys
 - › Environmental studies
 - › Dredging requirements and extent.

EMIRATES PALACE MARINA, ABU DHABI, UAE

Emirates Palace is located 5 km west of Abu Dhabi City with a long open beach on its northern coast and a marina to its northwest. The navigation channel and marina layout needed to be redesigned in order to accommodate larger vessels.

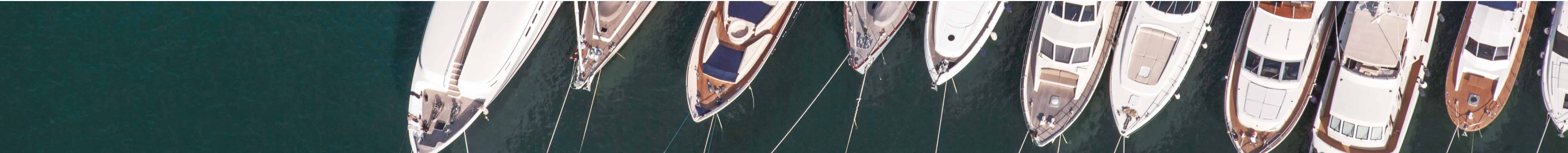
- SERVICES:
- › Definition of navigation channel
 - › Determination of the extreme wave climate at the site using MIKE 21 SW modelling
 - › Design of rockworks required to protect the marina
 - › Definition of marina operational criteria
 - › Determination of normal wave climate using MIKE 21 SW modelling
 - › Numerical modelling of wave climate within the marina
 - › Modelling beach stability using LITDRIFT.

THE LAGOONS, DUBAI, UAE

This project is a landmark project located at the end of the Dubai creek comprising seven man-made islands with extensive navigable waterways. It is a mixed-use waterfront development of both high-rise and low-rise residential and commercial buildings, five-star hotels, resorts, a planetarium, theatre and art centre, an iconic opera house and eight marinas.

- SERVICES:
- › Design of excavation, dredging and reclamation works for navigable channels and waterways and eight marinas
 - › Design of several kilometres of concrete block quay wall and revetment
 - › Design of a navigable lock
 - › Hydraulic studies.

SELECTED REFERENCES



EASTERN MARINA, BEIRUT, LEBANON

Beirut's Central District has been developed since the mid-1990s. The development plans for the area were based around a marina. The marina required a breakwater for protection against the waves of the Mediterranean.

- SERVICES:
- › Wave modelling to optimise breakwater stability and arrangement, determining the type of edge protection to minimise waves within the marina basin
 - › Water circulation assessment
 - › All edge treatments and breakwater
 - › A maintenance facility
 - › Mechanical and electrical services including a flushing system for the marina basin requiring a pumping station with pumps
 - › HVAC, power and lighting
 - › Telephone and Internet
 - › Potable water, firefighting, safety & rescue equipment.

AL REEM ISLAND DEVELOPMENT, ABU DHABI, UAE

A man-made island consisting of residential, recreational and commercial developments. The island is located within the intertidal flats of Abu Dhabi City bay. A circular small craft marina and a larger craft berth area were included in this development.

- SERVICES:
- › Wave modelling to optimise platform levels whilst minimising overtopping but preserving amenity and sea views
 - › Water flushing of the channels, waterways and marinas
 - › Minimisation of sedimentation
 - › Lighting and both single and 3 phase power
 - › Potable water
 - › Telephone and internet
 - › Sewage pump-out, waste disposal and refuelling facilities
 - › CCTV and security
 - › Firefighting and safety equipment.

DESIGN OF NEW MARINA, 60 MAIN STREET MARINA, USA, CT

COWI prepared the design and permitting of new marina facilities located in Bridgeport Harbor, Bridgeport for Westport Property Management. The new marina design includes a 380' long by 14' wide access pier that provides 200 permanent berths for boats ranging in size from 40' to more than 100' in length.

- SERVICES:
- › Permitting
 - › Wave modelling
 - › Design.

LUSAIL DEVELOPMENT MARINAS, QATAR

Lusail is the newest planned city in Qatar north of Doha covering an area of 38 sq. km. The “City of Tomorrow” rising out of the desert on a crystal clear sea is seen as a symbol of Qatar’s progress. The waterfront development included three large marinas with 1300 berths for boats ranging from 10 m to 35 m and water depths between 3.5 m and 6.0 m.

- SERVICES:
- › Master planning assistance
 - › Surveys and site investigations included bathymetry and topography, geotechnical investigations and environmental impact assessment and management plan
 - › Hydraulic studies included wave climate impact, current velocity and water level, flushing and water quality
 - › Schematic design for each marina location considered various layouts, boat mixes, utilities, material durability/sustainability and navigation
 - › Basic design of the marinas included utilities together with a fuel dock, operation and maintenance and aids to navigation
 - › Tender documentation and technical specifications.

JUMANA ISLAND, DUBAI, UAE

The project is a mixed-use development on a reclaimed island off the Dubai coastline. The development will have a high-end boutique resort along with low-rise apartment buildings and a marina. It will also allow exclusive homeowners to have their own beach with views to the sea or the Dubai coastal skyline.The development will be a reclaimed land mass of around 570,000 m².

- SERVICES:
- › Dredging and reclamation
 - › Marine edge treatment
 - › Coastal defence and control structures
 - › Geotechnical services
 - › Earthworks
 - › Marina and private docking facilities
 - › Wave transformation modelling
 - › Wave disturbance modelling
 - › Hydrodynamic and water exchange modelling
 - › Sediment transport and morphology study.



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