



Think of mega containerships traversing oceans and canals,
carrying products that boost the quality of life for populations everywhere.
Or cruise ships with thousands of passengers, young and old, enjoying holidays at sea.
Or airports that service millions of travellers, both for business and pleasure, in nearby bays
close to urban centres but far enough away to avoid congestion and noise hindrances.
Or restored habitats of mangroves and bird islands that create safe havens for nature.
Or storm surge barriers and replenished coastlines with dunes and beaches offering
millions of people protection from flooding.

'Beyond Sand & Sea' represents the work of thousands of employees in the private
dredging industry that make the world better, safer, more sustainable for millions of people.
The International Association of Dredging Companies on the occasion of its 50th
anniversary is proud to present the work of the crewmembers, engineers and
scientists who make this possible.

IADC stands for the 'International Association of Dredging Companies' and is the global
umbrella organisation for contractors in the private dredging industry. As such the IADC is
dedicated to not only promoting the skills, integrity and reliability of its members, but also the
dredging industry in general. IADC has over a hundred main and associated members.
Together they represent the forefront of the dredging industry.



1965 – 2015

SAND
& SEA

50 YEARS OF
MARITIME
MASTERPIECES



1



1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon

FOREWORD

BEYOND BELIEF: 50 YEARS OF MASTERING THE SEVEN SEAS

From its inception in May 1965, when 38 companies from 12 countries gathered to launch the International Association of Dredging Companies until the present day, 50 years later, the IADC has aimed to support its members – major contractors in the private dredging industry – and through those efforts to service the entire dredging industry.

Although this basic mission has remained the same, much has changed over the years. Many of the original members have merged to form larger companies with a diversity of skills and expertise. They have re-emerged into more than 100 affiliated members, with regional offices and joint ventures that are active on every inhabited continent and in every ocean and sea – from the Atlantic to the Pacific, from the North Sea to the Mediterranean from the Indian Ocean to the Arctic. These major contractors have helped realise huge infrastructures in myriad countries in Europe, Asia, Africa and the Americas.

The scope of the operations of the IADC members has also broadened. Straightforward maintenance dredging has been transformed by increased attention to the environment. Large maritime projects have grown into 'mega' maritime infrastructure constructions – monumental works that represent a collection of activities from land reclamation, to

port enhancement, to offshore pipelaying and energy platforms to remediation and environmental restoration projects.

To make these complex projects a reality demands imagination, flexibility and extensive investments in R&D to improve technologies and vessels and to educate engineers and crewmembers. The IADC companies are always ready to meet new challenges and the modern world presents many: global trade, overpopulation, energy, climate change and sea level rise. Deploying their vessels across the seven seas, wherever the need may be, is a given. Seeking maritime solutions for a changing world is an intrinsic value.

Whilst some dredging operations take place invisibly deep underwater, the results of these works are concrete and quite visible – ports and airports, oil and gas platforms and offshore wind farms, restored wetlands, beaches and secure coastlines.

These testaments to the industry's ingenuity have been photographed extensively: from shore and from ships' bridges, from the air and via satellites in space. In the next pages you will find intriguing pictures of the most remarkable dredging projects realised over the last five decades.

'The IADC companies are always ready to meet new challenges and the modern world presents many: global trade, overpopulation, energy, climate change and sea level rise. Deploying their vessels across the seven seas, wherever the need may be, is a given.'

But as you view these images of incomparable infrastructure works, remember that these projects are also intimate endeavours. Ones that involve numerous stakeholders: investors, port authorities and government agencies, workers in the dredging and related industries, and, most importantly, individuals whose daily lives are deeply impacted by these achievements. For ultimately, in the end, these projects contribute to improving the social and economic well-being of millions of people.

These photographs taken over the last 50 years tell the story.

Mr. Peter de Ridder
President, IADC



50 YEARS OF MARITIME MASTERPIECES



Suez Canal
Egypt / P13



Jubail Industrial Harbour
Saudi Arabia / P17



Jebel Ali Port
Dubai (UAE) / P18



Zeebrugge Harbour
Belgium / P19



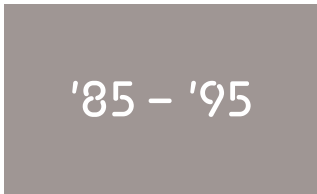
West Coast
Denmark / P22



Colombo Port
Sri Lanka / P23



Jurong & Tuas
Singapore / P25



P27



Kansai Airport
Japan / P29



Laem Chabang & Map Ta Phut
Thailand / P31



Maeslantkering
The Netherlands / P33



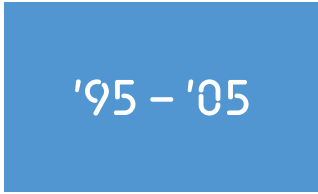
Chek Lap Kok
Hong Kong / P35



Central Reclamation
Hong Kong / P38



Pasir Panjang
Singapore / P40



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Pulau Semakau
Singapore / P43



Haneda International Airport
Japan / P44



Río Paraná & Río De La Plata
Argentina / P45



Saemangeum
South Korea / P46



Qarin Al Aysh
Abu Dhabi (UAE) / P48



Penny's Bay
Hong Kong / P49



The Palm Islands
Dubai (UAE) / P50



Melbourne Channel
Australia / P53



Sakhalin Island
Russia / P54



P56



Panama Canal
Panama / P58



Taparura Project in Sfax
Tunisia / P62



Port of Durban
South Africa / P63



Manifa Oil Field
Saudi Arabia / P65



Port of Duqm
Oman / P68



Thornton Bank Wind Farm
Belgium / P70



ADCOP Fujairah
Abu Dhabi (UAE) / P72



Manzanillo LNG Terminal
Mexico / P73



Maasvlakte 2
The Netherlands / P74



Cai Mep International Terminal
Vietnam / P76



Corniche Beach
Abu Dhabi (UAE) / P77



Barrow Island
Australia / P79



Upper Zakum Artificial Islands
Abu Dhabi (UAE) / P81



London Gateway
United Kingdom / P83



Airport Reclamations
Maldives / P84



Boubyan Sea Port
Kuwait / P86



Sand Motor
The Netherlands / P87



Esbjerg Eastern Port Extension
Denmark / P89



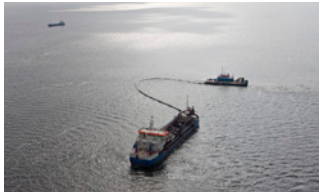
Eastern Mangrove Area
Abu Dhabi (UAE) / P90



LLX Açú Super Port
Brazil / P91



Punta Pacifica
Panama / P92



York Gas Reservoir
United Kingdom / P95



SARB Artificial Islands
Abu Dhabi (UAE) / P97



Eneco Luchterduinen Wind Farm
The Netherlands / P99



Malampaya
The Philippines / P101

'65

- 1 THE NETHERLANDS / DELTA WORKS
- 2 THE NETHERLANDS / MAASVLAKTE 1
- 3 BELGIUM / PORT OF ANTWERP

'75

1965 – 1975



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1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon

1965 – 1975

CHANGING TIMES: RENEWAL, PROTECTION, AWARENESS

The 1960s and 1970s represent a time of political upheaval and revolutionary social changes. For the dredging industry the times were also changing. The crisis of the war years were over and the future was looking outward toward world trade and increased prosperity. The global population grew and so did the standard of living and demand for energy. The world was witnessing extraordinary economic growth.

Ports, harbours and industrial areas worldwide were rebuilt and their container terminals, refineries and shipyards were expanding. Rotterdam became the busiest port in the world in the 1960s surpassing New York. But Antwerp, Hamburg, Dunkirk and Felixstowe were also dynamic and their harbours and access channels needed deepening. The need for oil and the price thereof skyrocketed, resulting in the construction of the new Port of Mina Zayed in Abu Dhabi, UAE. In the Far East, Japan and Korea, peacetime economies also led to unprecedented economic growth and allowed both these seafaring nations to compete on a world stage.

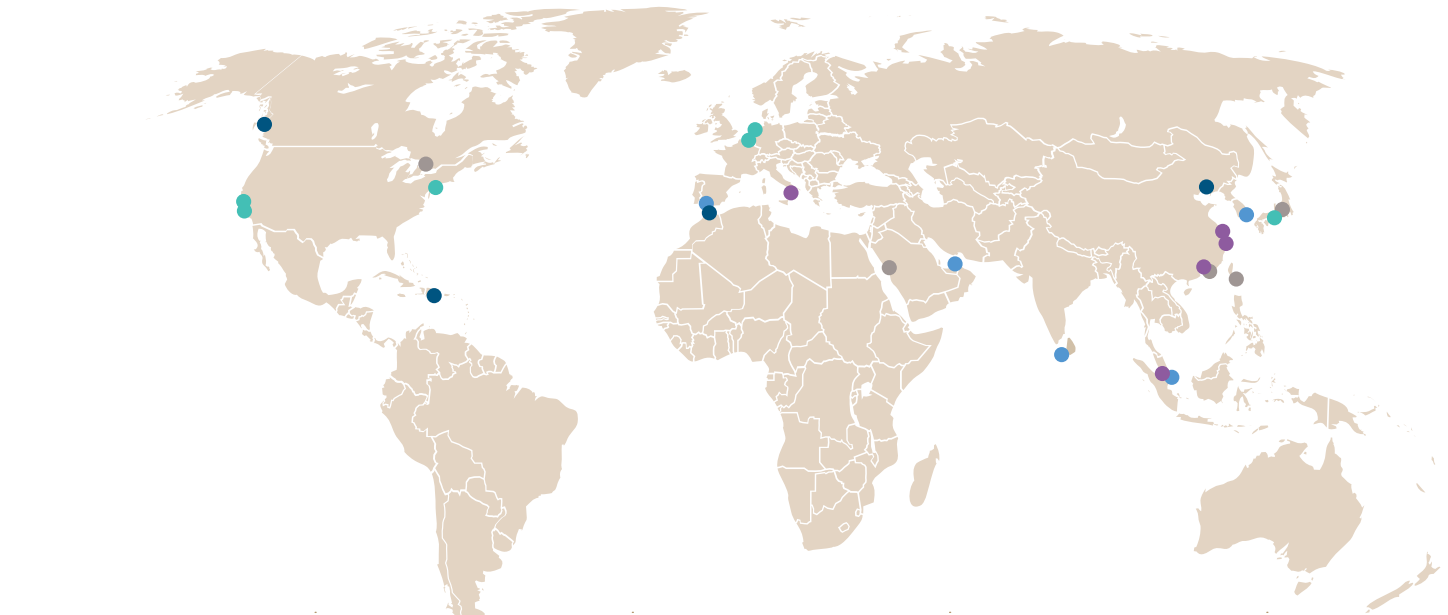
Simultaneously in Europe another driver of dredging was appearing: Coastal protection became a buzzword. The infamous floods of 1953 had wreaked havoc in the Netherlands, Belgium, Denmark and the UK, wiping away towns and farms, people and animals. The response came after careful preparation in the form of the Delta Plan (the Netherlands), the Sigma Plan (Belgium) and the Thames Flood Barrier to protect

London. France and Denmark also began implementing protective measures. The Eastern Scheldt /Delta Works, which took some forty years to complete, began in the 1960s and represent one of the most innovative projects of the decade. The technologies developed to build this storm surge barrier were unique and confronted the growing attention to the environment. These innovations laid the groundwork for major coastal protection projects today when climate change, has once again, brought the challenges of coastal defence front and centre.

And yes, in keeping with the mood of the '60s and '70s, environmental-ists were on the move. Dredging projects were confronted with many a protest, but behind the scenes researchers and engineers were seeking answers to remediation of a century's worth of industrialisation. In the rush for economic growth, most industries had not given much thought to the chemicals that were deposited into waterways and rivers. Here too the times were changing. Clean-ups of harbours and new means of monitoring were implemented and long-term plans were developed for the removal of contamination and restoration of nature. Expansion projects such as Maasvlakte 1 were not only about the port, but included specialised confinement areas for contaminated sediment. Spurred on by rulings from the IMO and the UNEP*, the dredging industry rose to the occasion and gave a new meaning to environmental awareness, one based on pragmatic solutions.

*IMO = International Maritime Organization and UNEP = United Nations Environment Programme.

The Waves of Containerisation



	Period	Overview	Driver	Representative ports
FIRST WAVE	1956 (1965) – 1975	Pioneer ports setting containerised operations in the economic triad (North America, Western Europe and Japan).	Early trade substitution.	Rotterdam, Antwerp, New York, Los Angeles, Oakland, Nagoya
SECOND WAVE (1 & 2)	1970 – 1980 (1) 1975 – 1985 (2)	Expansion of the triad and its trade partners (Caribbean, Mediterranean, Asian Tigers).	Adoption of containerisation.	1) Tokyo, Hong Kong 2) Kaohsiung, Jeddah, Kingston
THIRD WAVE	1980 – 1990	Large diffusion in new international markets (Latin America, Middle East / South Asia, Southeast Asia).	Setting of global supply chains. Setting of transshipment hubs.	Singapore, Colombo, Busan, Dubai, Algeciras
FOURTH WAVE (1 & 2)	1995 – (1) 2000 – (2)	The container becoming the standard transport support of the global economy.	Expansion of global supply chains. China and trans-shipment hubs.	1) Shanghai, Shenzhen, Gioia Tauro 2) Ningbo, Tanjung Pelepas
FIFTH WAVE	2005 – to the present	Peak growth and the setting of niches.	Spillover effect and new transshipment hubs.	Tangier Med, Caucedo, Yingkou, Prince Rupert

Source: Based on David Guerrero, Jean Paul Rodrigue, 'The waves of containerization: shifts in global maritime transportation,' International Association of Maritime Economists Conference, July 2013, France. 26 p, 2013.





THE NETHERLANDS / DELTA WORKS

A MONUMENTAL DEFENCE

51°37'49.21" N 3°41'52.40" E

In 1953 the Netherlands was struck by a disastrous flood of its southernmost provinces, resulting in enormous loss of human and animal life and property. In response the government launched a major flood control programme to analyse the costs and risks of protecting the low-lying country. In 1958 the construction of the Delta Works was begun. Ultimately the construction of dams, sluices, locks, dikes and storm surge barriers lasted almost forty years till 1997. Dikes were reinforced and, by blocking the mouths of several estuaries, the total length of the dikes was shortened by 700 km. Both reduced the dangers of flooding.

CLIENT
The Dutch Government

CATEGORY
Coastal Protection

PERIOD
1958 – 1997

1965 – 1975



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**1965 – 1975**

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



BEYOND SAND & SEA

Google Earth, DigitalGlobe

1965 – 1975

→ Parts of the Delta Works – Haringvlietdam, Maeslantkering (barrier), Western Scheldt (Wester-schelde) tunnel and Eastern Scheldt (Oosterschelde) barrier – are open to visitors.

↓ 'Closing the gate', the barrier's last link: an exciting but tense moment as ships battle against the strength of the currents.



Google Earth, DigitalGlobe

- Maeslantkering / 1
- Hollandse IJsselkering / 2
- Hartelkering / 3
- Haringvlietdam / 4
- Brouwersdam / 5
- Volkerakdam / 6
- Grevelingendam / 7
- Philipsdam / 8
- Oosterschelddedam / 9
- Veersegatdam / 10
- Zeelandbrug / 11
- Zandkreekdam / 12
- Oesterdam / 13
- Bathse Spuisluis / 14



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1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



THE NETHERLANDS / MAASVLAKTE 1

PORT SETS A NEW TREND

51°57'54.30" N 3°58'48.10" E

The first Maasvlakte extension at the Port of Rotterdam was built by a combination of dikes and sand suppletion reaching west into the North Sea. This expansion made it possible to receive larger ships and build numerous container terminals directly connected by train lines to the hinterlands of the rest of Europe, especially Germany. The extension also created space for the storage of toxic waste and polluted sand in an area called the Slufter and provided better protection for the environment.

CLIENTRijkswaterstaat/Dutch Ministry of
Infrastructure and the Environment**CATEGORY**

Reclamation

PERIOD

1965 – 1973

1965 – 1975



THE NETHERLANDS / MAASVLAKTE 1



8

**1965 – 1975**

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon

GATEWAY TO 500 MILLION CONSUMERS

Since the 1960s when the Port of Rotterdam became the largest port in the world, it has continually grown. Today Rotterdam remains one of the world's top ports and is the gateway to the European market of more than 500 million consumers. With its deep-water berths and access channel, the port is accessible 24/7 to container vessels of every imaginable size.





BELGIUM / PORT OF ANTWERP

A TIDAL DOCK ROCKS

51°16'13.40" N 4°20'12.48" E

Originally on the right bank of the River Scheldt, increasing container traffic after World War II led the Port of Antwerp to expand to the left bank where a sea lock and multiple docks were built and are still being built at Waaslandhaven. This was followed by the construction of a huge, new dock (the Deurganckdok) which has an open connection to the Scheldt and accommodates container traffic. It is the world's largest tidal dock: 2,600 metres long and 450 metres wide.

CLIENT

1) Ministry of the Flemish Government
2) Antwerp Port Authority

CATEGORY

Ports and Waterways

PERIOD

1) 1965 – 1975
2) 1999 – 2006

1965 – 1975



BELGIUM / PORT OF ANTWERP



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**1965 – 1975**

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon

'75

'85

- 1 EGYPT / SUEZ CANAL
- 2 SAUDI ARABIA / JUBAIL INDUSTRIAL HARBOUR
- 3 DUBAI (UAE) / JEBEL ALI PORT
- 4 BELGIUM / ZEEBRUGGE HARBOUR
- 5 DENMARK / WEST COAST
- 6 SRI LANKA / COLOMBO PORT
- 7 SINGAPORE / JURONG & TUAS

1975 – 1985



1975 – 1985

OIL EXPORTS FROM THE MIDDLE EAST: FROM CRISIS TO CONSTRUCTION

Oil, oil, oil ... that became the driving force in the industrialised countries. Analysts report that from 1949 to 1972 the demand for oil increased 5.5 times in the US, 15 times in Western Europe and 137 times in Japan. No wonder that when the oil crisis of 1973 hit, the world suffered an economic dip. Luckily the worldwide economy lived through the shortages and learned from them. From crisis came construction. The global dredging companies deployed their vessels all over the Middle East to expand old harbours and reclaim land for new ones.

In Saudi Arabia four port cities were developed, Yanbu's King Fahad Industrial Port and Jeddah Islamic Port both on the Red Sea and on the Arabian Gulf, at Damman the King Abdul Aziz Port and at Jubail the King Fahad Industrial Port, which mainly handles petrochemicals, and the Jubail Commercial Port which handles everything else. With a total dredging volume of over 40 million m³, dredging of the Commercial Port involved almost all the major international contractors.

Port construction in the United Arab Emirates as well was booming. The original work for the new ports of Jebel Ali and Port Rashid in Dubai were begun in 1976. In Iran, in just 3 years (1976 to 1979) 11 million m³ of sediment were dredged to transform the fishing village of Bandar Abbas into a major port and industrial city. As a logical consequence of this growth spurt of petroleum ports, the Suez Canal also required attention.

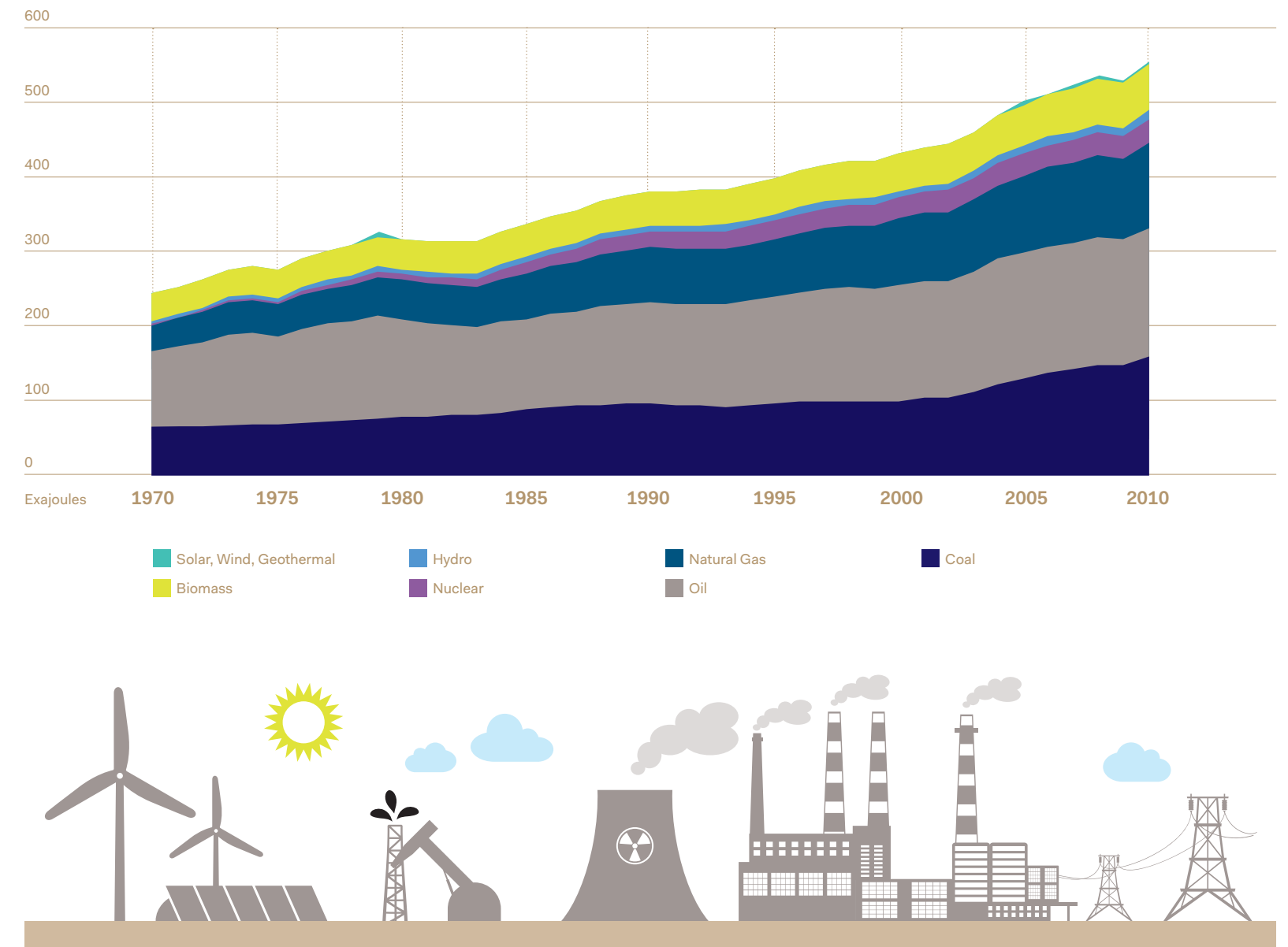
From 1976 to 1980 the Suez Canal Expansion Project utilised some 18 hydraulic dredgers to improve the canal. More work meant more efficient working methods were required. This led contractors and shipbuilders to seek advances in dredging technologies. The hard rock at Middle Eastern harbours resulted in the development of heavy rock cutter dredgers which became known as the 'work horses of dredging'. At Jebel Ali a new self-elevating dredger Al Wasl Bay was especially designed to carve out the some 15-kilometre approach channel.

Japan too was pushing forward, looking to develop its economy and grow its large industrial centres. Despite more petroleum price increases in 1979, the strength of its economy was obvious, as was the need for room to grow. The combination of highly populated urban areas and a scarcity of land made reclamations an ideal solution. Land was reclaimed in Tokyo Bay. Innovative technologies made it possible to extract sand from depths exceeding 80 metres. The deep-suction dredger Dejima was the first of its kind able to work in open seas using a newly implemented swell compensation system.

With an abundance of oil and an enduring prosperity, international tourism also took a leap forward. This is best illustrated by Singapore's decision in 1975 to abandon its old congested airport and construct a new one on an enormous land reclamation. A historic choice, for since Changi's development started, it has never stopped.

Energy consumption

Global Primary Energy Consumption 1970 – 2010 in exajoules
(1 exajoule = 10¹⁸ joules)





EGYPT / SUEZ CANAL

CONNECTING EAST & WEST

30°34'55.45" N 32°18'12.20" E

The first modern initiatives to improve the Suez Canal, which is a sea-level waterway, occurred in the 1950s. These improvements were followed by the largest widening and deepening works from 1975 to 1980 when a huge dredging fleet of 12 cutter suction dredgers dug out 225 million m³ for the 63 kilometres between Lake Timsah and the Great Bitter Lake. The third intervention occurred from 1992 to 1994 when, as part of a plan to handle fully loaded tankers, the canal was widened by 45 metres and the channel deepened to -25 metres. Some 17 million m³ of bedrock material – 5 times harder than normal concrete – were dredged.

CLIENT
Suez Canal Authority

CATEGORY
Ports and Waterways

PERIOD
1975 – 2015

1975 – 1985



EGYPT / SUEZ CANAL



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1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

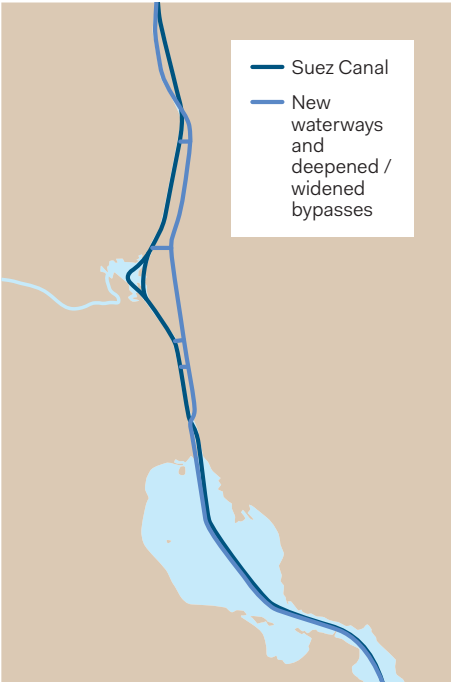
2005 – 2015

Foreword Members Colofon



← In the second half of the 20th century, dredging operations at the Suez Canal have been done in 3 phases: the first in the 1950s, then in 1978 when 42 million m³ were dredged between Lake Timsah and the Great Bitter Lake.

↓ The third phase: from 1992 to 1994 a cutter suction dredger deepening and enlarging the Canal, even as container ships traverse the Canal.



- ↑ Because much of the bedrock was 5 times harder than normal concrete, the cutter teeth had to be repaired and replaced frequently.
- ←← The Suez Canal runs 190 kilometres from Port Said in the north on the Mediterranean Sea through the Great Bitter Lake to the Red Sea in the south.
- ← In the last year the old Suez Canal (dark blue) has been widened and deepened and a new 35-kilometre-long branch was added (all indicated in light blue). In its totality the new work measures 72 kilometres.





Utilising the expertise of six large contractors, the monumental task of constructing a new Canal from km 60 to km 95, parallel to the existing Canal, as well as deepening and widening the Great Bitter Lakes by-passes and Ballah by-pass, was accomplished in one year's time. The improvements maximise the efficiency of the present Canal and its by-passes and double the longest possible parts of the waterway to facilitate traffic in two directions. This minimises waiting time for transiting ships.

A fleet of cutter suction dredgers (far left and left) was used to dig and cut up the hard rock on the seabed. This was followed by trailing suction hopper dredgers (below) dredging softened, smaller material. This two-step process made the logistics as efficient as possible.



UNLOCKED FOR GLOBAL SHIPPING

After almost 150 years the Suez Canal remains one of the most important transportation links ever built. Unlike many canals the Suez is at sea-level and does not need locks. In August 2014, the construction of a second channel to allow 2-way traffic in part of the canal – to reduce transit and waiting times – was launched. Never before has so much equipment been deployed on a dredging project as during the expansion of the Suez Canal. Never have the time pressures on a project been so enormous, and never has there been a project with such high production volumes. The goal: dredging a 35-kilometre-long and 24-metre-deep shipping route in a year.





SAUDI ARABIA / JUBAIL INDUSTRIAL HARBOUR

LARGE TANKERS WELCOME!

27°04'52.05" N 49°43'12.90" E

The Jubail Industrial Harbour Project was one of the largest construction projects in Saudi Arabia at the time. It encompassed a multitude of operations including dredging 422,100 m³, building a breakwater and seawall-length quarry, with a quay wall 2,880 metres long and with 954,000 m³ of earth filling. This was designed to create an open-sea tanker terminal with a berthing capacity of 4 berths capable of receiving up to max. 300,000 DWT (deadweight tonnage). An access road and pipe track were also constructed.

CLIENT

Saudi Ports Authority, Riyadh

CATEGORYPorts and Waterways / Coastal
Protection**PERIOD**

1976 – 1980

1975 – 1985



SAUDI ARABIA / JUBAIL INDUSTRIAL HARBOUR



17



1965 – 1975

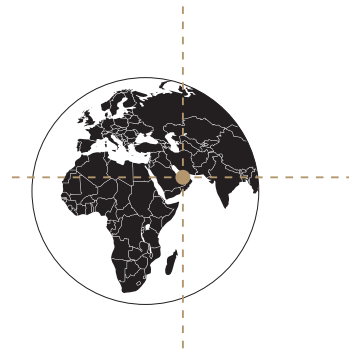
1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



DUBAI (UAE) / JEBEL ALI PORT

THE HUB OF THE MIDDLE EAST

25°00'41.27" N 55°03'39.71" E

One of the oldest, most prominent projects in the early days of the UAE was the construction of Jebel Ali Port in Dubai. It was, by far, the biggest dredging project in the world in the mid-1970s and is still the biggest human-made port in the world. In total 10 cutter suction dredgers, 2 booster stations, 4 trailing suction hopper dredgers, a grab dredger, 6 self-propelled hopper barges and a fleet of auxiliary equipment were deployed.

The port's development marked the emergence of Dubai as an economic hub.

CLIENT

H.H. Sheikh Rashid bin Saeed Al Maktoum, The Ruler of Dubai

CATEGORY

Ports and Waterways

PERIOD

1976 – 1982



↑ Cutter suction dredgers, trailing suction hopper dredgers, a grab and self-propelled hopper barges and a fleet of auxiliary equipment at work in the main basin of Jebel Ali Port.

→ The completed land reclamation for Jebel Ali Port: a very important economic step that boosted the growth of Dubai to its current levels.





BELGIUM / ZEEBRUGGE HARBOUR

BUILT FOR CARGO & CRUISE SHIPS

51°20'58.06" N 3°12'03.50" E

Maritime extension works at the Port of Zeebrugge began in 1977 and continued for some nine years. New breakwaters, improved slope protection, a sea lock and an LNG terminal at the port's eastern side were added. More than 30 million m³ of sand, silt and clay were dredged to create soil-substitution trenches, to reclaim terminal areas and to deepen the port basin for container, Ro-Ro, general cargo and cruise terminals. Finally, in 1999 the Albert II container quay wall and platform at the port's western end were constructed for a new container terminal, which is now improved to berth and handle Ultra Large Container Carriers (ULCCs).

CLIENTMinistry of Public Works, Coastal
Department**CATEGORY**Ports and Waterways / Coastal
Protection / Reclamation**PERIOD**

1977 – 1999

1975 – 1985



BELGIUM / ZEEBRUGGE HARBOUR



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1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



↑ Aerial view of the breakwater and reclamation works.
← 11 million tonnes of quarried rocks and 60,000 concrete armour units were installed for the rock revetments and breakwaters at Zeebrugge.

HARD ROCK HARD WORK

Cutting through hard rock to deepen and widen Middle Eastern harbours was no easy matter. It demanded innovations. Working together dredging contractors and shipbuilders developed special heavy rock cutter dredgers – which became known as the ‘work horses of dredging’.





DENMARK / WEST COAST

FIGHTING THE SEA'S POWER

55°30'45.46" N 8°12'47.43" E

Pounded by the North Sea's waves, the dunes and property on Denmark's West Coast are continually threatened by erosion. Every year since 1982, sand nourishment and slope protection with materials dredged from the North Sea are used to defend the 110-kilometre coastline from recession of up to 8 metres per year. Shallow draft trailing suction hopper dredgers discharge dredged material in front of the dunes and dikes by either pumping sand ashore through a submerged pipeline system, rainbowing it nearshore or split dumping it.

CLIENT

The Danish Coastal Authority

CATEGORY

Coastal Protection

PERIOD

1982 – 2014

1975 – 1985



DENMARK / WEST COAST



22



1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



SRI LANKA / COLOMBO PORT

THE PIVOT OF SOUTH ASIA

6°57'15.50" N 79°50'57.56" E

Already in the 1980s the strategic importance of the Port, located on the Indian Ocean, was recognised. To facilitate a major transformation to handle containerised cargo, new container berths and quay walls were constructed with 99,000 m² of land reclamation, 94,000 m² of yard pavement and 1,200 metres of port road as well as the construction of many buildings including a Container Freight Station. The port remains a busy commercial hub and a crucial worldwide trade link to and from South Asia.

CLIENT

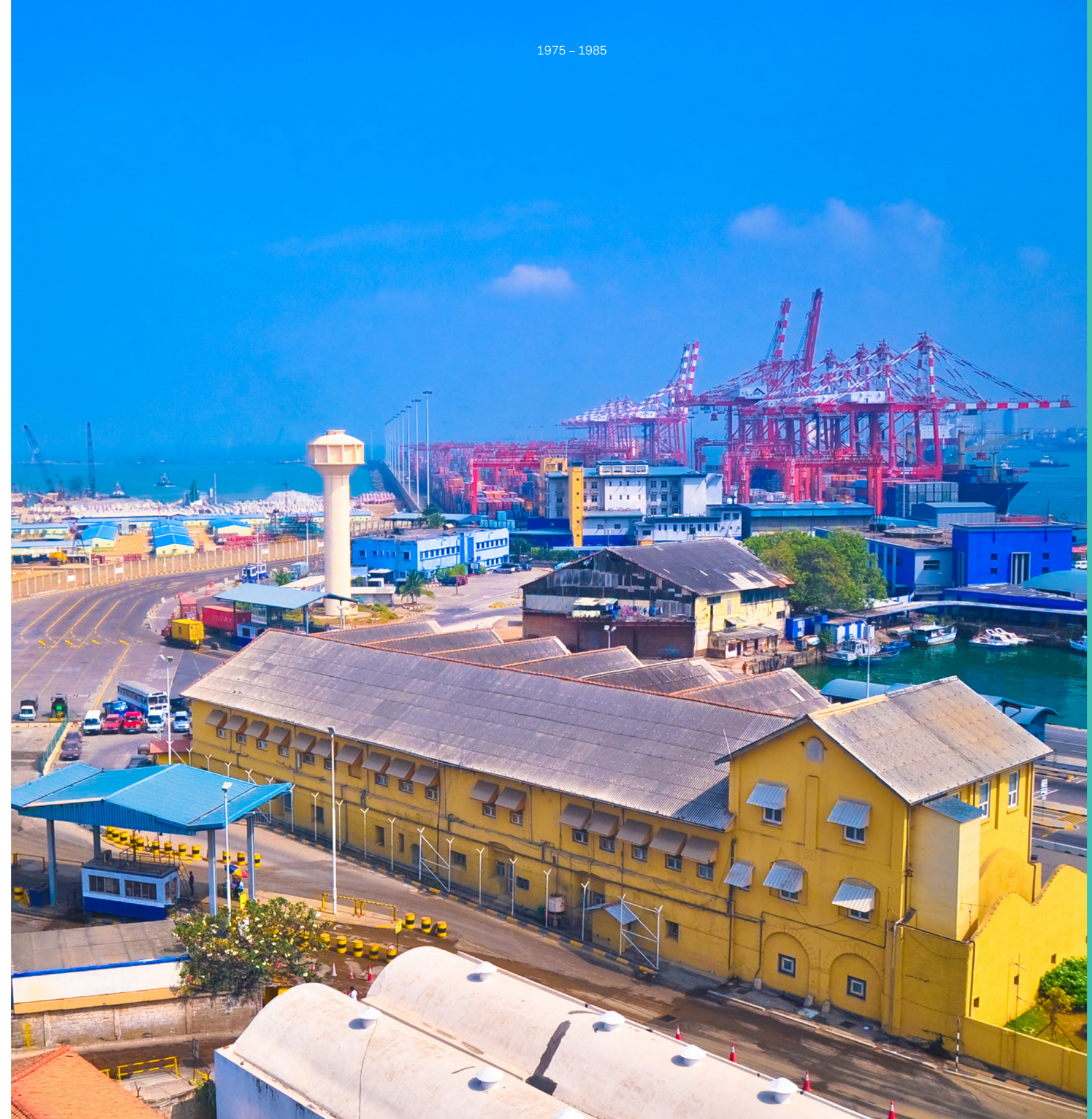
Sri Lanka Ports Authority

CATEGORY

Ports and Waterways

PERIOD

1983 – 1985





↑ Strategically located on the Indian Ocean, the Port of Colombo, is a vital hub for container traffic and the largest port in South Asia.

← Dredging for container berths, quay walls and land reclamation transformed Colombo into one of the busiest ports in the world.



SINGAPORE / JURONG & TUAS

SAND IS THE SOLUTION

1°13'26.34" N 103°37'39.91" E

By the 1980s, after a decade of rapid industrialisation, property on Singapore's mainland was scarce. A solution was found in the Jurong Island reclamation and Tuas extension projects. For 30 years since 1984, dredgers developed new land there. A plan to unite the 7 islets off Singapore's southwestern coast to form one island was implemented in stages. Started in 1995, Jurong Island was officially opened in autumn 2000, tripling the land surface of the original little islands. Together Jurong and Tuas form the new industrial zone of Singapore, with 987 hectares for the construction of a petrochemical complex.

CLIENTJTC Corporation (formerly Jurong
Town Corporation)**CATEGORY**

Reclamation

PERIOD

1984 – still ongoing

1975 – 1985



SINGAPORE / JURONG & TUAS



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1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

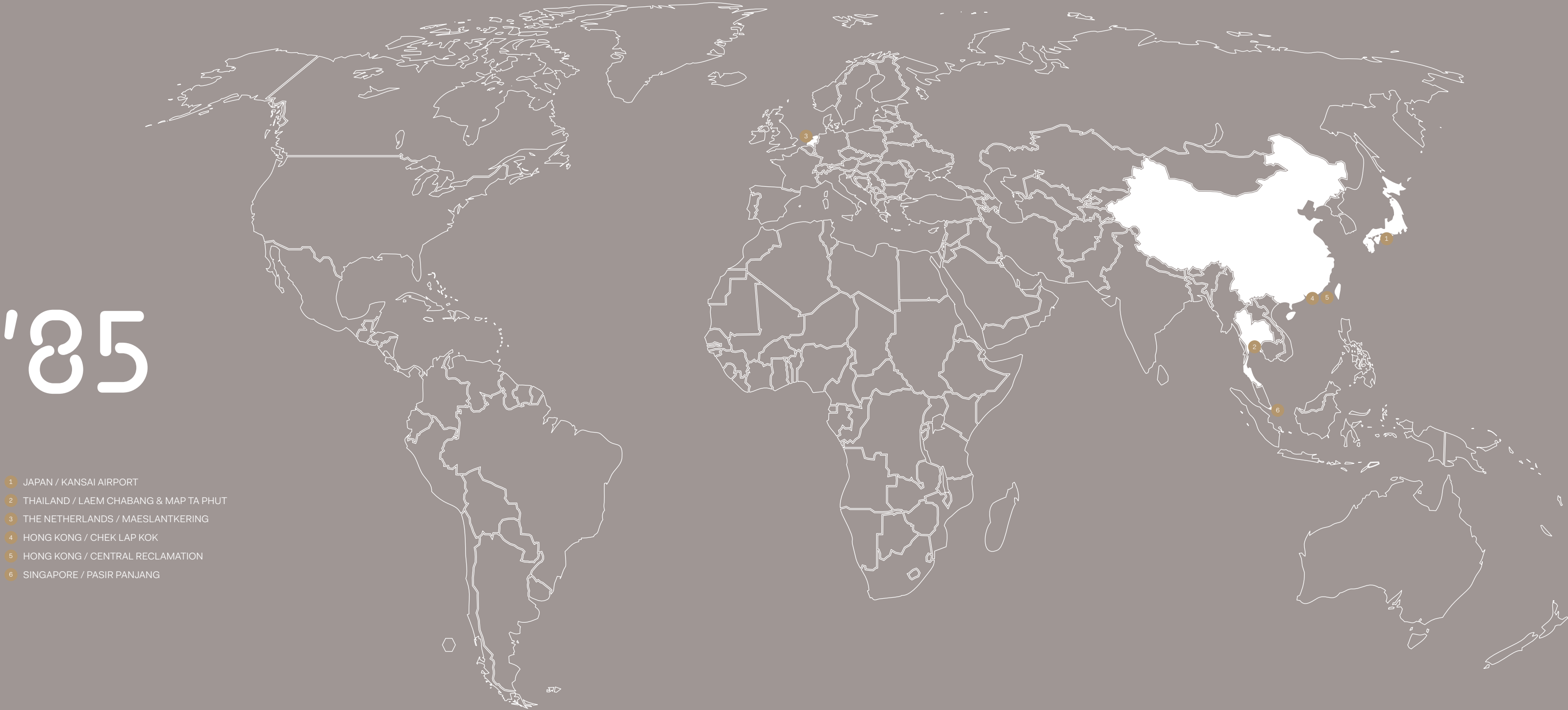
Foreword Members Colofon



- ↑ Tuas, a peninsula on the western coast of Singapore adjacent to Jurong, has been significantly extended.
- ← The Jurong Island land reclamation included roads, drains, bridges and soil improvement work.
- About 300 million m³ of material were dredged and used for fill in the Jurong project's first three phases. The fourth phase used another 700 million m³ of material.

Photo courtesy of BAM International bv





- 1 JAPAN / KANSAI AIRPORT
- 2 THAILAND / LAEM CHABANG & MAP TA PHUT
- 3 THE NETHERLANDS / MAESLANTKERING
- 4 HONG KONG / CHEK LAP KOK
- 5 HONG KONG / CENTRAL RECLAMATION
- 6 SINGAPORE / PASIR PANJANG

1985 – 1995



1985 – 1995

AN ECONOMIC BOOM FOR ASIA AND THE DREDGING INDUSTRY

No doubt about it: The place to be in the years from 1985 to 1995 was Asia. First of all, Hong Kong whose proactive Government had taken decisions earlier to expand the port. By 1986 with the construction of Container Terminal 6 (CT 6), followed by CT 7 in 1990 and CT 8 in 1993, the Port of Hong Kong was topping the list of container ports worldwide. And of course, the land reclamation for a new airport to replace the overcrowded Kai-Tek, dangerously squeezed in between downtown's high-rises, was also at the core of this explosion of activity. Built offshore by joining two existing islands with dredged fill, Chek Lap Kok, dubbed 'the dredging project of the decade', would keep the major dredging contractors from Europe, Japan and the US busy.

But when talking about airports and artificial islands, Japan had been first, with the opening in 1994 of Kansai Airport built in Osaka Bay to relieve overcrowding at the existing airport. Singapore's vision for land reclamation was not far behind: Expansions at Changi Airport started in 1975 were ongoing, and plans for Jurong and Tuas and other reclamations fostered a boom in the Asian economies.

Other countries in Asia were also ready to compete. On the eastern side of Mumbai, India, a new terminal was built to lessen congestion at the docks on the western side. In Thailand, Laem Chabang was selected as a site for a new port to accommodate large container ships and bulk carriers. Shortly thereafter work on a new deep-water seaport began at

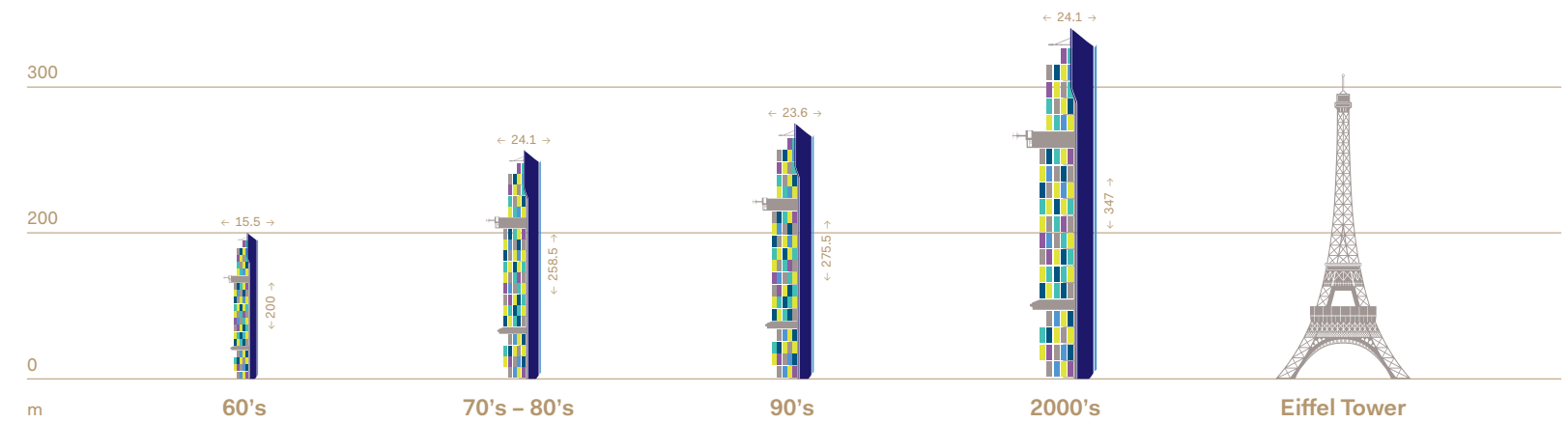
Map Ta Phut. Malaysia would soon follow. Australia saw an expansion of its airports from the reclaimed swamps at Brisbane to Sydney's Kingsford Smith airport where a third runway was added on reclaimed land. In fact, new runways in the water became the go-to solution. Far from crowded cities, with more room for potential growth, less hindrance to roadways and less noise for residents living nearby, airports-in-the-water offered a practical solution to the increase in air traffic for both commerce and tourism.

Shipping is indeed the most economical, cleanest means of cargo transportation and remains the most popular vehicle for world trade. But maritime transport also makes demands: Bigger cargo ships need bigger and better ports, longer quays, deeper access channels. These infrastructures required new dredging technologies including environmental monitoring methods like Acoustic Doppler Current Profilers and remote sensing by satellites. Economies of scale were another part of the equation and that applied to dredging equipment as well as to mega-cargo ships. In 1994 the dredging industry saw the introduction of the 'jumbo' trailing suction hopper dredger with a hopper capacity of 17,000 m³, a 40% increase in capacity with the next largest trailer.

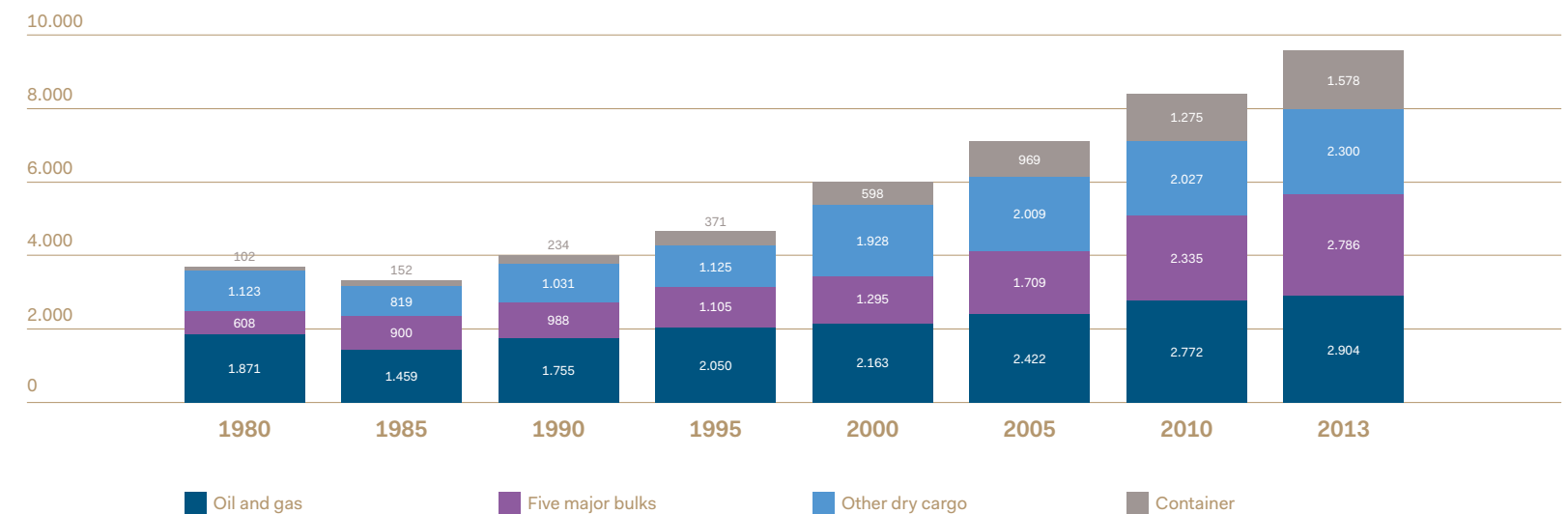
The dredging industry was booming worldwide, joint ventures were abounding, and the old adage, 'build and they shall come' was definitely coming true.

Container ships

Container ships getting bigger



Global Seaborne Trade 1980 – 2013 in mln tonnes





JAPAN / KANSAI AIRPORT

FIRST AIRPORT IN THE WATER

34°25'57.79" N 135°13'50.42" E

Built 5 kilometres off the coast in Osaka Bay, on a 400-hectare artificial island, the Kansai International Airport construction started in 1986 and opened in 1994. It was the first airport project to address a complex, large-scale reclamation work. With an average water depth of 18 metres and a soft clay seabed, reclaiming a surface area 4.4 kilometres long and 1.3 kilometres wide with more than 11 kilometres of seawalls required some 180 million m³ of fill material. Three mountains were excavated for 21 million m³ of landfill. Ten thousand workers and 80 ships were employed to place a 30-metre layer of earth over the sea floor and inside the sea wall.

CLIENT

Kansai International Airport Co., Ltd.

CATEGORY

Reclamation

PERIOD

1986 – 1994

Aerial view of the completed airport showing the runways and double-decker bridge for trains and vehicles to the mainland.



29



1965 – 1975

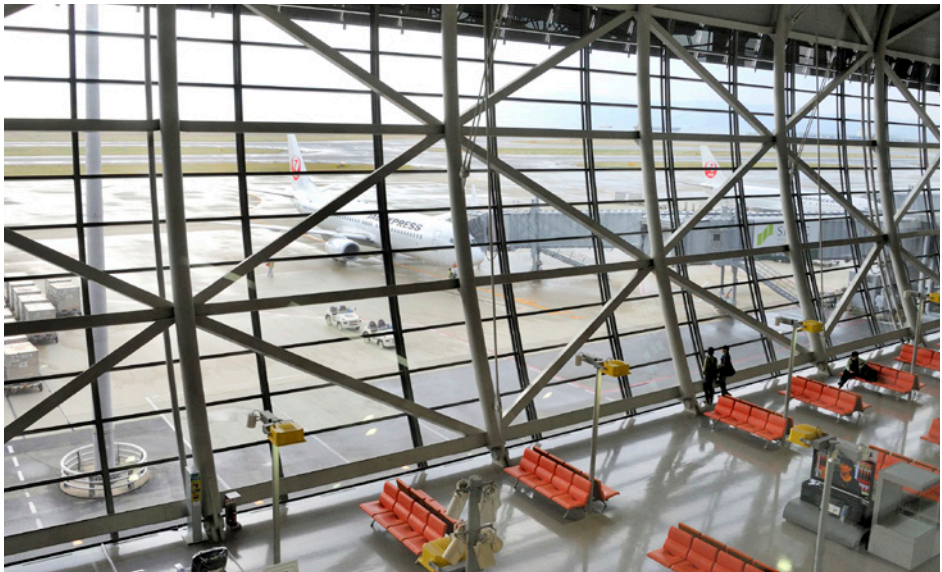
1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon

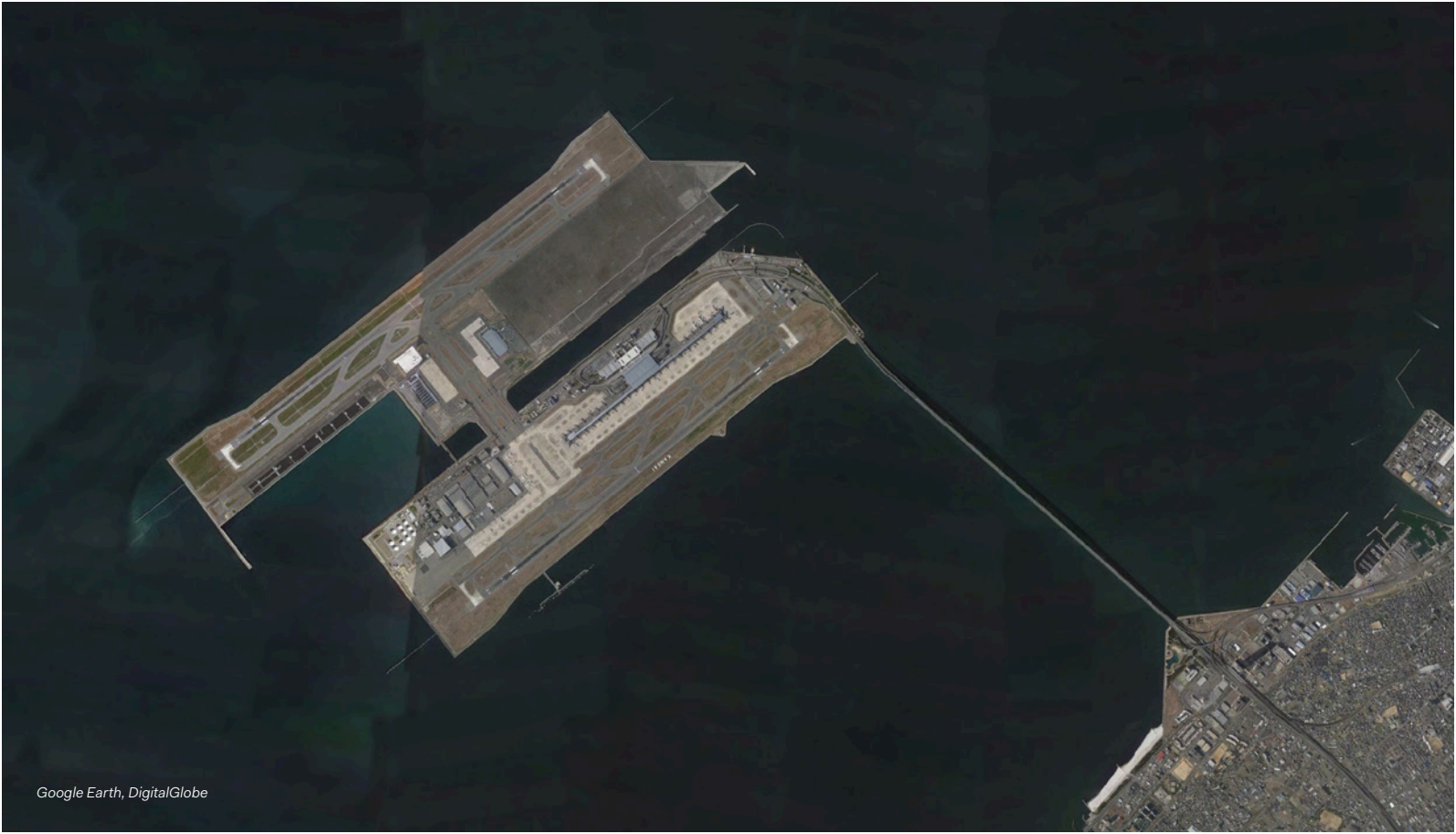


← Inside the terminal: Kansai International Airport opened in 1994 to accommodate the rising demand for air travel. By 2003 the airport was at its limit and construction of a second runway was begun. With its opening in August 2007 the airport grew to 10 km² and 24-hour a day operations.

↓ Satellite photo of Kansai airport with the newest addition, a second runway which opened in 2007.



Early stages of the land reclamation for Kansai airport in Osaka Bay.



Google Earth, DigitalGlobe



THAILAND / LAEM CHABANG & MAP TA PHUT

DEEP-SEA PORTS PAY OFF

LAEM CHABANG: 13°03'42.89" N 100°53'04.15" E / MAP TA PHUT: 12°39'07.81" N 101°09'29.06" E

To remain competitive in the global economy, the Thai government saw the urgency of investing in deep-water seaports as Bangkok's port was too shallow. A study indicated that a port at Laem Chabang, 2 hours south of Bangkok, would be deep enough to accommodate large container ships and bulk carriers. In 1988 construction began. A year later dredging operations moved further southwards to Map Ta Phut for a second deep-sea harbour. Today Laem Chabang is Thailand's largest port for shipping as well as a large cruise ship harbour and Map Ta Phut and its port are important industrial assets.

CLIENT

Port Authority of Thailand

CATEGORY

Ports and Waterways / Reclamation

PERIOD

1988 – 1989



↑ In the late 1980s, two major port construction projects were commissioned in Thailand, first at Laem Chabang, south of Bangkok.

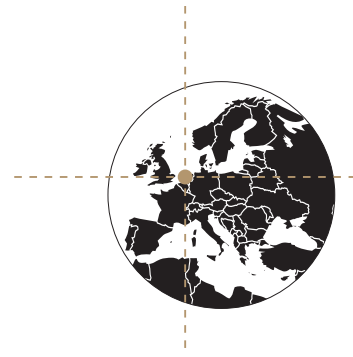
← Deep-sea port Map Ta Phut was built a year later further south on the Gulf of Thailand.



SEEKING SAND

Not all sand is equal. Finding the right sand and choosing the right dredging equipment are crucial to a viable project. To achieve a stable, secure land reclamation demands site investigations of the sand at both the reclamation and borrow areas, environmental impact assessments and ongoing monitoring.





THE NETHERLANDS / MAESLANTKERING

GATES TO STOP A STORM

51°57'17.02" N 4°09'51.09" E

The Maeslantkering, an innovative storm surge barrier, is built in the waterway connecting the Port of Rotterdam with the North Sea, a heavy shipping route. The barrier, comprised of two large floating gates attached to the waterway's dikes, required 3.6 million m³ of dredged sand and 400,000 tonnes of stone works. Only in an emergency will the barrier close, protecting the area from flooding. In this way shipping traffic is undisturbed and yet a region where millions of people live is defended.

CLIENT

Bouwcombinatie Maeslantkering

CATEGORY

Coastal protection

PERIOD

1990 – 1996

1985 – 1995



33



1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



- ↑ Satellite photo of the opened gates of the Maeslantkering in the Nieuwe Waterweg which connects the Port of Rotterdam with the North Sea.
- ← The storm surge barrier is built to withstand waves of 5 metres above NAP (Normaal Amsterdams Peil).
- The Maeslantkering barrier, the final stage of the Dutch Delta Works, is the world's largest moveable barrier. A computer system determines if the high water is threatening – above 3 metres NAP – and then, automatically, independent of human involvement closes the gates.





HONG KONG / CHEK LAP KOK

IT'S SAFER IN THE SEA

22°18'31.80" N 113°55'28.14" E

Aptly named 'dredging contract of the 20th century', Hong Kong's airport-in-the-water is legendary for the skill and speed with which it was built. Started in 1991, a global consortium of dredging companies united a small, hilly island, Chek Lap Kok, with a smaller nearby island, Lam Chau. Using 237 million m³ of reclaimed sand the islands were transformed into a mammoth 1,250-hectare platform. At the time it was the largest reclamation project ever executed with 14 trailing suction hopper dredgers, 4 cutter suction dredgers, 7 grab dredgers and some 20 hopper barges deployed from all over the world.

CLIENT
Provisional Airport Authority

CATEGORY
Reclamation

PERIOD
1991 – 1992

1985 – 1995



HONG KONG / CHEK LAP KOK



35



1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



1985 – 1995



- ← Satellite photo of the Hong Kong area, with the Chek Lap Kok land reclamation airport platform in the centre.
- ↑ Large numbers of dredging vessels at work on land reclamation which connected two islands to create a 1,250-hectare platform to be used as a base for the Chek Lap Kok airport.
- An aerial view of the new airport's two runways and space for the terminal buildings.



100 AIRLINES FLYING TO OVER 180 CITIES

The change from the cramped, overcrowded Kai Tak Airport stuck between high-rises couldn't have been greater. Hong Kong's spacious new airport in the sea transformed air transportation to the city. Chek Lap Kok officially opened in 1998 and provided a boost to tourism, international trade and local employment – and a much safer airport. In 2015, plans were initiated for another runway to be built on reclaimed land.





HONG KONG / CENTRAL RECLAMATION

PIERS UNDER PRESSURE

22°17'16.32" N 114°09'31.64" E

More than 26 hectares of land in the Central district were reclaimed to improve transportation at the ferry piers. This included demolition of existing piers, dredging, rock filling, reclamation, disposal of unsuitable material and the construction of some 1,200 metres of external seawalls, as well as road works, an immersed tube rail tunnel, electrical main plant buildings and a variety of associated works. Reclamation has long been used to increase the land mass for this densely populated city.

CLIENT

Mass Transit Railway Corporation

CATEGORY

Reclamation

PERIOD

1993 – 1997

1985 – 1995



HONG KONG / CENTRAL RECLAMATION



38



1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



The ever-growing waterfront of the city of Hong Kong: Part of the burst of activities in the 1990s in Hong Kong was also evident at the expansion of the Central business area. Land reclamation projects took place in phases, with about 26 hectares of land north of Central being reclaimed. That extended the waterfront up to 350 metres beyond the then-existing shoreline. Central Reclamation Phase 2 reclaimed 5.3 hectares of land at Tamar and further reclamations have followed.





SINGAPORE / PASIR PANJANG

MEGA MARINE TERMINAL

1°16'00.52" N 103°46'30.34" E

Shipping is the cornerstone of Singapore's economy. In 1993, the Port of Singapore Authority (PSA), started work on Phases 1 and 2 of a new mega container terminal at Pasir Panjang. To create a reclamation area of 130 hectares for Phase 1, 20 million m³ of sand were reclaimed. Dredging included 4,5 million m³ of clay, 500,000 m³ sand, 500,000 m³ silt stone and 200,000 m³ rock that required underwater blasting. The reclamation was an immense expansion of the port's capacity. The terminal officially opened in March 2000. Phase 2 became fully operational in June 2005.

CLIENT

Port of Singapore Authority (PSA)

CATEGORY

Reclamation

PERIOD

1993 – 2005



1985 – 1995



Photo courtesy of PSA Corporation Ltd.

↑ Work for the first reclamation in 1993 for Pasir Panjang, one of Singapore's premier container terminals.

← In 2015 the Port of Singapore Authority (PSA) embarked on the Phases 3 and 4 development of Pasir Panjang Terminal to meet the future growth of global trade and long-term needs of customers. When fully completed the new terminals will boost Singapore's total container handling capacity to 50 million TEUs per year.



'95

'05

- 1 SINGAPORE / PULAU SEMAKAU
- 2 JAPAN / HANEDA INTERNATIONAL AIRPORT
- 3 ARGENTINA / RÍO PARANÁ & RÍO DE LA PLATA
- 4 SOUTH KOREA / SAEMANGEUM
- 5 ABU DHABI (UAE) / QARIN AL AYSH
- 6 HONG KONG / PENNY'S BAY
- 7 DUBAI (UAE) / THE PALM ISLANDS
- 8 AUSTRALIA / MELBOURNE CHANNEL
- 9 RUSSIA / SAKHALIN ISLAND

1995 – 2005



1995 – 2005

LAND RECLAMATIONS YOU CAN SEE FROM SPACE

The age of mega land reclamations had dawned in full force – and for a variety of reasons. Where population density is high, land is both scarce and expensive. That was true in Singapore, Hong Kong, Japan and The Netherlands.

But other regions had other reasons. Like tourism. A good climate and long stretches of beaches can also be a motivation to reclaim land. Such was the case in the Middle East where the oil-rich nations had money to invest and the foresight to want to diversify. The results: Visionary artificial islands like the Palm Islands, the World and Deira were designed to provide land for residences, beaches and entertainment clusters, making Dubai a popular tourist destination.

Simultaneously, Asia saw a reclamation renaissance. First Singapore re-awoke with its long-term plans for the reclamation of Jurong and the adjacent Tuas Extension. In 1995 the work started to link up seven tiny islands off the coast. By October 2000, Jurong Island was officially opened. Dredging in Hong Kong also resumed with the work for Disneyland at Penny's Bay and Container Terminal 9. In this second Asian boom the quantities of dredged material far exceeded those of the Chek Lap Kok Airport – which at the time seemed mythical in size. Now even greater maritime megastructures were possible stimulated by the advancements and investments in dredging vessels.

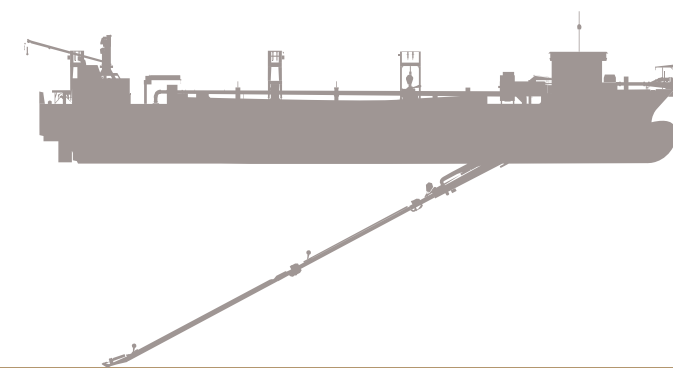
These investments were a clear statement that the contractors saw the industry's potential. After the first jumbo trailer in 1994, eight more of these huge trailing suction hopper dredgers were built in the next 6 years. Yet these jumbos were only the beginning.

By 2000, 33,000 cubic metre so-called 'mega' dredgers were operational, with a carrying capacity in excess of 70% compared to the largest jumbo dredger. The economy of scale in dredging ships was making the construction of mega maritime infrastructure even more economically feasible.

Globalisation had also become a watchword. An interconnected world meant that the international dredging contractors were working everywhere. Causeways, bridges and tunnels also in Europe were being built. In Scandinavia the Storae belt link between Denmark's islands was followed by the Øresund Fixed Link between Sweden and Denmark. Both were part of a trans-European road and rail plan from the European Union to connect the northernmost nations to the rest of Europe.

But even more was happening. Since the oil crisis in the 1970s, offshore exploration in Europe had increased. By 1996 work was started on the Norfra pipeline project, the first of many offshore energy projects. A door to a new market for the major international dredging companies had opened – offshore energy.

Dredging Vessels



Trailing Suction Hopper Dredgers

Based on hopper capacity in cubic metres

Mega	30,000 m³ and over
Jumbo	15,000 – 30,000 m³
Large	8,000 - 15,000 m³
Mid-Size	4,000 – 8,000 m³
Small	under 4,000 m³



Cutter Suction Dredgers

Based on total installed power

Mega	23,000 kW and over
Heavy Duty	13,000 – 23,000 kW
Large	9,000 – 13,000 kW
Mid-Size	3,000 – 9,000 kW
Small	under 3,000 kW



Backhoe Dredgers

Based on total installed power

Mega	2,000 kW and over
Large	1,000 – 2,000 kW
Medium	500 – 1,000 kW
Small	under 500 kW





SINGAPORE / PULAU SEMAKAU

FROM WASTE TO NATURAL WONDER

1°12'24.93" N 103°46'07.46" E

Waste disposal is a challenge which most populous urban areas must confront. The Pulau Semakau Offshore Landfill, located 10 kilometres south of Singapore, links two islands, Semakau and Sakeng, via a 7-kilometre bund enclosing 350 hectares. By creating embankments with stone revetments and a sea sand-pitched jetty, several compartments were made for different types of waste. Another part of the project was to restore the natural ecology by replanting mangroves over a large area and these are flourishing.

CLIENTMinistry of Environment and Water
Resources, Government of Singapore**CATEGORY**

Reclamation / Sustainable

PERIOD

1995 – 1998

1995 – 2005



Photo courtesy of DHI Singapore.





JAPAN / HANEDA INTERNATIONAL AIRPORT

FOURTH RUNWAY ADDS FLIGHTS

35°32'58.83" N 139°46'49.83" E

Tokyo's Haneda Airport has seen many expansions over several decades. Beginning in 2007, to increase its international flight capacity and enhance tourism, a new fourth runway was constructed adjacent to the existing runways. The reclamation area was 856,480 m² and the volume of reclaimed material, 8 million m³. Extensive soil improvement and placement of cement-treated piles as well as sand compaction, sand drains and concrete block revetments were necessary to stabilise the reclamation platform for the runway.

CLIENT

Kanto Regional Development Bureau,
Ministry of Land, Infrastructure and
Transport

CATEGORY

Reclamation

PERIOD

1995 – 2015



↑ Tokyo's Haneda International Airport has seen many land reclamation expansions. In 2010 the airport opened a fourth runway which allowed Haneda to strengthen its role as an international air transport centre for business travellers to Japan.

← The airport will continue to play a very important role in furthering Japan's development as a tourism-oriented nation and in strengthening air transport hub functions in Japan.





ARGENTINA / RÍO PARANÁ & RÍO DE LA PLATA

DIGGING DEEP IN MUD

RÍO PARANÁ: 31°41'50.8" S 60°32'45.1" W / RÍO DE LA PLATA: 34°10'22.1" S 058°17'10.5" W

A twenty-six-year-long deepening and maintenance dredging contract over a distance of 1,200 kilometres on the Río Paraná and 240 kilometres on the Río de la Plata has improved the navigability of these rivers which are major shipping routes. This has increased transport and trade for the regions bordering the rivers. The contract also includes the modernisation and maintenance of the navigational aids from the Atlantic Ocean through the Canal Emilio Mitre up to Santa Fe, and since 2010 the extension from Sante Fe to Confluencia.

CLIENT

Ministerio del Interior y Transporte,
Secretaría de Transporte, Sub-secre-
taría de Puertos y Vías Navegables

CATEGORY

Ports and Waterways /
Sustainable

PERIOD

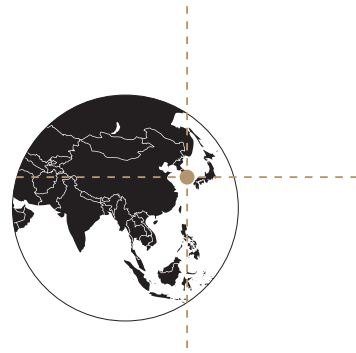
1995 – 2021

1995 – 2005



ARGENTINA / RÍO PARANÁ & RÍO DE LA PLATA





SOUTH KOREA / SAEMANGUEM

THE LONGEST, STRONGEST LINK

35°45'07.21" N 126°30'42.07" E

The 33.9-kilometre-long Saemangeum Sea Dike – the longest dike in the world – links the cities of Gunsan in the north and Buan in the south. Before construction of the dike, two rivers, the Mangyeon and Dongjin, discharged directly into the Yellow Sea. Now these rivers flow into a 400-km² reservoir created by the dike. In the future this reservoir will be transformed into land equal to two thirds the area of Seoul to be used for agricultural, industrial, business, residential, wetlands and ecotourism.

CLIENTKorea Rural Community
Corporation**CATEGORY**

Sustainable

PERIOD

1996 – 2010



OUT OF THIS WORLD

Dredging projects have become so large that they are visible from space. Whilst these satellite photos are impressive they are also useful. Satellite imagery has added a new dimension to improving the accuracy and efficiency of dredgers by mapping water depths, tidal movements and dredging plumes.





ABU DHABI (UAE) / QARIN AL AYSH

ISLAND PRESERVE FOR WILDLIFE

24°07'53.95" N 53°08'31.01" E

To protect unique Arabian wildlife and species, 10 million m³ of sand, sandstone and rock were dredged to form a 29-kilometre-looped inland channel. This created an island off the sea front along the Arabian Gulf with two deep-water fish breeding farms. The dredged material was used to reclaim surrounding low-lying sabkha (salt flats) along the channel for future developments. Other local contractors excavated the canal's embankments and constructed 2.2 million m² of tidal zone land for mangrove plantations.

CLIENT
Abu Dhabi Municipality

CATEGORY
Ports and Waterways

PERIOD
1998 – 2002





HONG KONG / PENNY'S BAY

FUN IN THE FAR EAST

22°18'46.48" N 114°02'28.63" E

The Penny's Bay land reclamation was designated as the site for the creation of Hong Kong Disneyland. It included the reclamation and ground treatment of about 200 hectares of land protected by 2 kilometres of seawalls, temporary access roads and drainage. The removal of 45 million m³ of unsuitable clay and soil and the delivery of 65 million m³ of sediment were done with extensive environmental monitoring. The project is part of Hong Kong's efforts to accommodate its ever-growing tourist industry.

CLIENTCivil Engineering Department of the
Government of Hong Kong**CATEGORY**

Reclamation

PERIOD

2000 – 2002



- ↑ Sand from borrow areas was delivered in various ways to Penny's Bay land reclamation site in Hong Kong. Above, multiple trailing suction hopper dredgers rainbow sand ashore.
- ← A large trailing suction hopper dredger pumps sand through a floating pipeline. Hong Kong Disneyland opened to visitors in September 2005 and has been attracting large crowds from all over Asia ever since.





DUBAI (UAE) / THE PALM ISLANDS

TOURISM PAR EXCELLENCE

25°07'09.41" N 55°08'02.84" E

To transform Dubai into a world-class tourist venue, a genial plan was developed: Build artificial islands shaped like palm trees for businesses, hotels, villas and leisure facilities. Dredging contractors also had to be innovative. Working in shallow waters, smaller hopper dredgers and other light vessels first brought sand to the surface. Thereafter millions of cubic metres of sand were rainbowed and rock and limestone were placed by cranes.

The artificial islands add many kilometres to Dubai's coastline and were the most ambitious reclamation projects of all time in terms of size, concept and engineering.

CLIENT
Nakheel

CATEGORY
Reclamation

PERIOD
2002 – 2008

1995 – 2005



DUBAI (UAE) / THE PALM ISLANDS



50



1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



Google Earth, DigitalGlobe, CNES / Astrium

↑ Satellite photo of the coast of Dubai. Reclamation projects from the top: the World, Palm Jumeirah and Palm Jebel Ali.

→ A trailing suction hopper dredger with its powerful pumps reclaims land by rainbowing. In the background the skyscrapers of Dubai.

↓ A trailing suction hopper dredger pumping dredged materials through a floating pipeline onto the island. The island's fronds are visible in the background.



← Aerial view of Palm Jebel Ali, which is 50 percent larger than Palm Jumeirah.

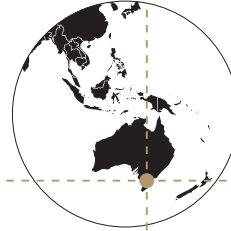
↓ An extensive breakwater protects Palm Jumeirah against strong currents and the powerful shamal, the Arabian Gulf's north-westerly wind.



A CRESCENT OF PROTECTION

The Palm Islands with their kilometres-long tree trunk and 17 fronds have been developed into luxury residential waterfront properties and beaches attracting millions of tourists. But without the rocky revetments of semi-circular protective breakwaters these islands would not exist. The complex design of the crescent-shaped breakwaters was executed with great precision using an advanced GPS system to place the millions of tonnes of rocks. They shield the islands from tides and heavy seas.





AUSTRALIA / MELBOURNE CHANNEL

COOPERATION CONQUERS ALL

37°50'51.4" S 144°54'07.2" E

In a risk-sharing alliance contract between the contractor and client, the deepening of the port's navigation channel took place in a highly sensitive environment containing two marine national parks and a Ramsar site*. Innovative dredging equipment, extensive monitoring, transparent communication with the community and early contractor involvement led to the overall success of the project, which was honoured with the '2010 Project of the Year' award by Infrastructure Partnerships Australia.

*The Convention on Wetlands of International Importance, called the Ramsar Convention, is the intergovernmental treaty that provides the framework for the conservation and wise use of wetlands and their resources.

CLIENT

Port of Melbourne Corporation

CATEGORY

Ports and Waterways / Sustainable

PERIOD

1) 2003 – 2008 (preparation)
2) 2008 – 2009 (execution)

1995 – 2005



AUSTRALIA / MELBOURNE CHANNEL





RUSSIA / SAKHALIN ISLAND

OIL & GAS BURIED IN ICE

50°08'32.69" N 143°14'30.94" E

Thanks to its enormous oil and natural gas reserves Sakhalin Island, located in Russia's Far East, rapidly developed over the past two decades. All major oil and gas companies investing in the area rely on the expertise of the dredging industry to execute on- and offshore developments. Trenching and backfilling, subsea rock installation, cofferdam installation, cable installation and scour protection, dry excavations, all performed in the remote environment and harsh climate for which Sakhalin Island is so well known. With developments continuing for years to come, the dredging industry will face the island's challenges head-on.

CLIENT

Sakhalin I: Exxon Neftegas Ltd /
Sakhalin II: Sakhalin Energy Invest-
ment Company Ltd. / Sakhalin III:
Gazprom Dobycha Shelf LLC

CATEGORY

Energy

PERIOD

2003 – 2013

1995 – 2005





- ↑ A self-propelled fall pipe vessel installing scour protection near the Molikpaq Offshore Platform.
- The weather conditions at Sakhalin were harsh and yet work continued no matter how high the snow.
- ↓ The design and construction of an LNG loading jetty was an important part of the Sakhalin energy project.

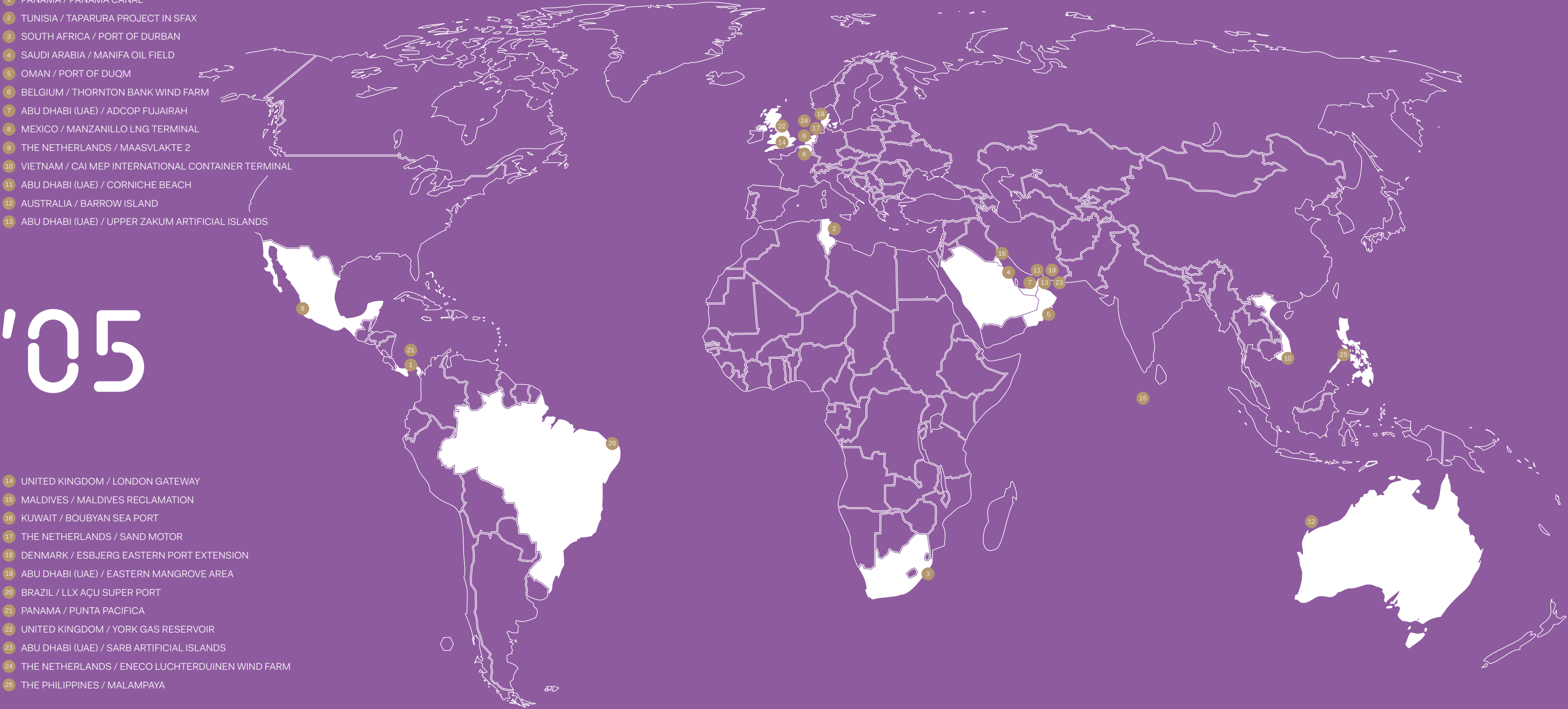


- ← Bringing a pipeline from an underwater oil well onshore required that a trench be dug for the landfall of the pipeline. To secure the trench, a cofferdam that comprises two parallel walls of sheet piling perpendicular to the coast was constructed. Whilst this is a well-established technique, at Sakhalin the extreme weather made the job challenging.
- ↓ A self-propelled cutter suction dredger executing bund wall dredging for dry dock flooding at Vostochny for the Concrete Gravity Base Structure (CGBS).



- 1 PANAMA / PANAMA CANAL
- 2 TUNISIA / TAPARURA PROJECT IN SFAX
- 3 SOUTH AFRICA / PORT OF DURBAN
- 4 SAUDI ARABIA / MANIFA OIL FIELD
- 5 OMAN / PORT OF DUQM
- 6 BELGIUM / THORNTON BANK WIND FARM
- 7 ABU DHABI (UAE) / ADCOP FUJAIRAH
- 8 MEXICO / MANZANILLO LNG TERMINAL
- 9 THE NETHERLANDS / MAASVLAKTE 2
- 10 VIETNAM / CAI MEP INTERNATIONAL CONTAINER TERMINAL
- 11 ABU DHABI (UAE) / CORNICHE BEACH
- 12 AUSTRALIA / BARROW ISLAND
- 13 ABU DHABI (UAE) / UPPER ZAKUM ARTIFICIAL ISLANDS

- 14 UNITED KINGDOM / LONDON GATEWAY
- 15 MALDIVES / MALDIVES RECLAMATION
- 16 KUWAIT / BOUBYAN SEA PORT
- 17 THE NETHERLANDS / SAND MOTOR
- 18 DENMARK / ESBJERG EASTERN PORT EXTENSION
- 19 ABU DHABI (UAE) / EASTERN MANGROVE AREA
- 20 BRAZIL / LLX AÇU SUPER PORT
- 21 PANAMA / PUNTA PACIFICA
- 22 UNITED KINGDOM / YORK GAS RESERVOIR
- 23 ABU DHABI (UAE) / SARB ARTIFICIAL ISLANDS
- 24 THE NETHERLANDS / ENECO LUCHTERDUINEN WIND FARM
- 25 THE PHILIPPINES / MALAMPAYA



2005 – 2015

ONSHORE AND OFFSHORE: PORTS, PIPELINES AND COASTAL PROTECTION

The 'open' secret in this last decade is: Dredgers do everything, everywhere, simultaneously. The IADC members remain the world's major international dredging contractors. They are intensely diversified and capable of an incredible variety of maritime infrastructure construction projects – projects which are more and more inter-related. Port development, LNG harbours, container terminals, coastal protection and environment are part and parcel of just about every project.

With global markets and energy exploration growing worldwide, the dredging industry is in demand on every continent and in multiple oceans. From Ras Laffan in Qatar to Gorgon near Australia to Sakhalin, Russia, offshore projects have been providing more oil and gas. That means dredging for platforms, pipelaying and port development. Artificial islands have found new uses in places like the Manifa and SARB oil fields (United Arab Emirates) and port extensions such as Maasvlakte 2 at Rotterdam, London Gateway and the development of Boubyan Sea Port in Kuwait.

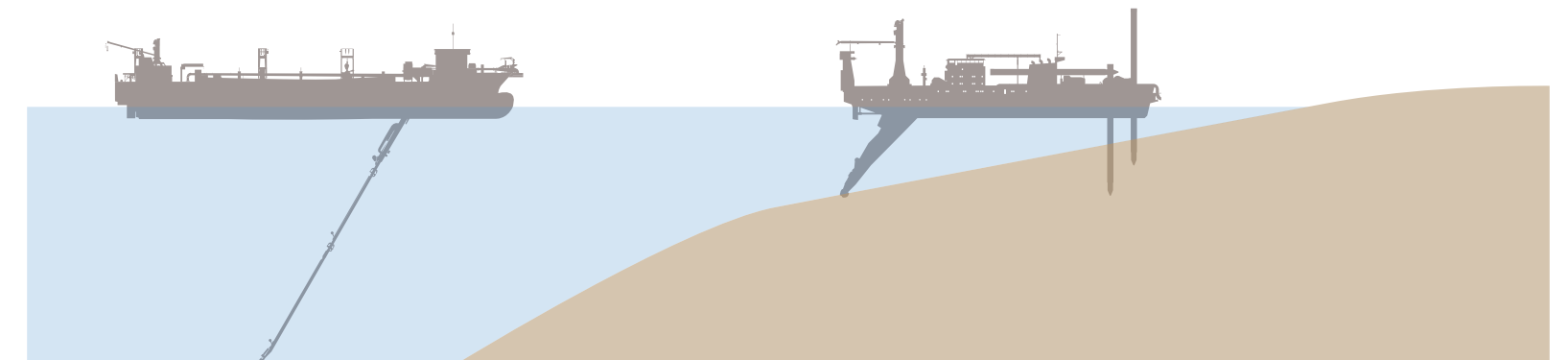
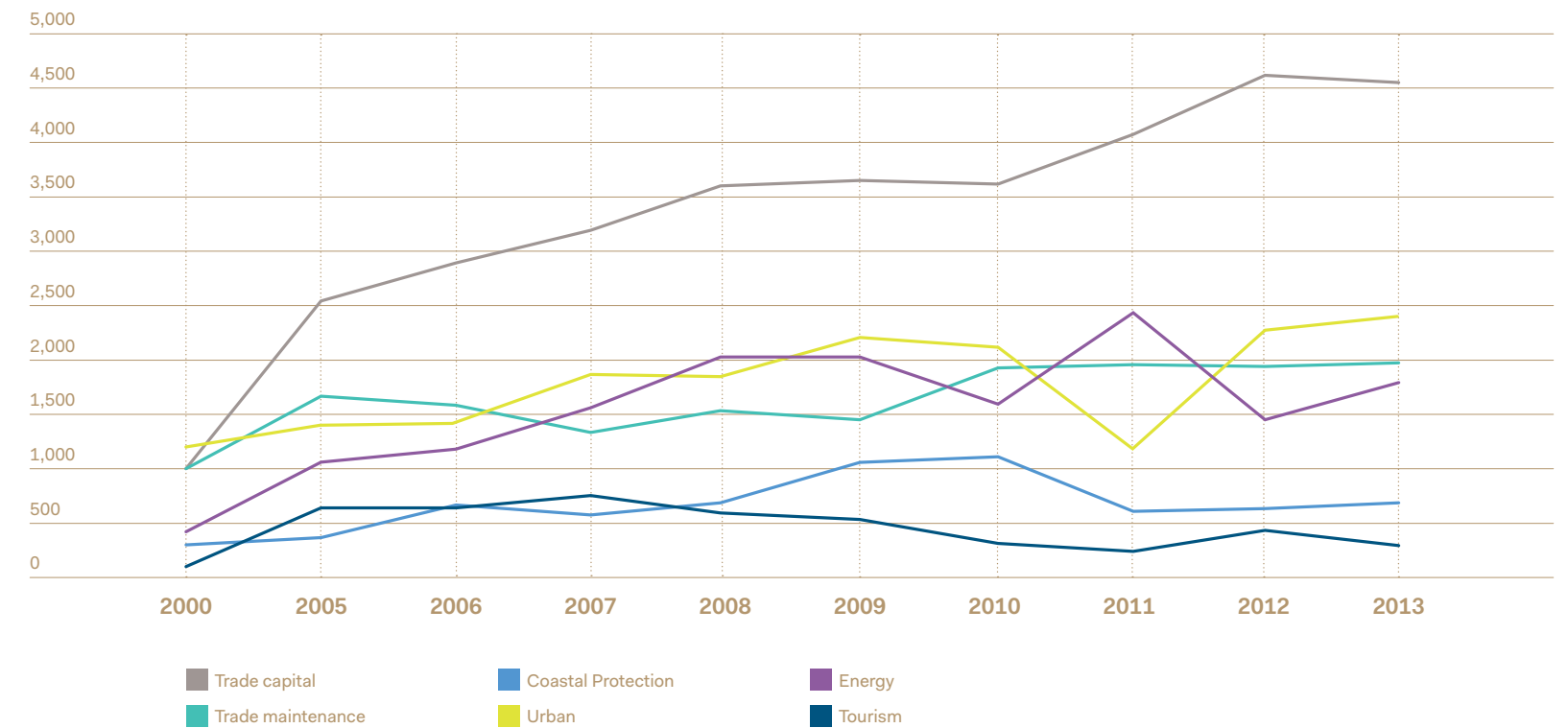
At the same time the concept 'climate change' has become a game-changer. For years scientists warned of the dangers of rising sea levels. In February 2005 the Kyoto Protocol, an international agreement linked to the UN Framework Convention on Climate Change, entered into force. That had a two-fold impact on the dredging industry: First, public awareness of the need for coastal protection took a leap forward.

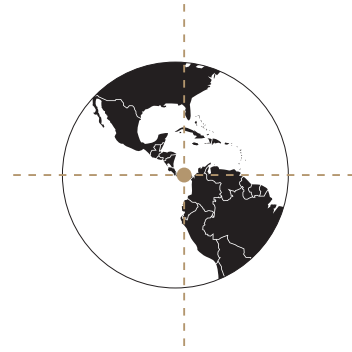
Second, since the protocol sets internationally binding emission reduction targets, the push to find clean energy like wind power and to build more energy-efficient dredging vessels took on added urgency. The major dredging companies jumped into the fray. The Thornton Bank Wind Farm off the Belgian coast and the Eneco Luchterduinen Wind Farm in the Netherlands are two examples. Innovations for coastal protection from London to Tokyo were designed. Design-Construct contracts, Engineering, Procurement and Construction (EPC) contracts and early contractor involvement became more successful ways of approaching mega-infrastructure projects. And dredging vessels were built to be even more environmentally friendly than in the past.

Environmental precautions beyond climate change concerns also continued. The desire to protect and preserve marine fauna and flora led to higher demands for remediation, restoration and less invasive techniques. Coral reefs and indigenous marine life were carefully accounted for in dredging plans. Efforts such as the Sand Motor added to engineering research regarding currents, tides and methods of beach replenishment. Today the IADC contractors are forging ahead with ever more R&D. Connections to learning institutes and involvement with the education of young engineers are top IADC priorities. Fifty years of cooperation amongst the IADC members has bred confidence in their engineering abilities to change the world for the better and a belief in a yet-to-be-imagined future.

Dredging

Development turnover per driver in € mln





PANAMA / PANAMA CANAL

READY FOR THE 21ST CENTURY

9°07'18.22" N 79°43'10.75" W

The hundred-year-old Panama Canal is being reinvented. Whilst improvements have always been ongoing, recent works encompass the construction of two major lock complexes at the Atlantic and Pacific entrances, widening a 14.2-kilometre stretch of canal to 225 metres and deepening it to -16.3 metres, and deepening of the Pacific entrance and southern approach channel. For the new lock complexes alone some 40 million m³ of soil and rock have been excavated and 5 million m³ of concrete poured. The notoriously hard subsoil was drilled and blasted. In total 25 million m³ of Atlantic muck and Gatun rock were dredged.

CLIENT

Autoridad del Canal de Panamá (ACP)

CATEGORY

Ports and Waterways

PERIOD

2005 – 2015





- ↑ Overview of the excavation of the new entrance channel to the Pacific locks with transiting vessels in the Canal visible on the left.
- Maintenance of the Panama Canal goes on whilst large container ships are transiting.





- ← Deepening and widening the Pacific Entrance. The first complete passage of the Panama Canal by a self-propelled, ocean-going vessel took place on January 7, 1914. Since then the 77-kilometre-long Canal, which crosses the Isthmus of Panama and connects the Atlantic and Pacific oceans, has seen hundreds of thousands of ships. It takes about 8 to 10 hours to traverse.
- A cutter suction dredger is pumping the dredged materials through a floating pipeline to the reclamation site at the Atlantic entrance of the Canal. In the background: the Port of Colón.
- ↓ Aerial view of the Atlantic lock complex under construction.



WATER ROUTE TO ECONOMIC GROWTH IN THE 21ST CENTURY

With a more than € 4.5 billion investment for improvements, including new locks that are 60% wider and 40% longer, the new Panama Canal will be able to handle most of the world's container vessels, as well as super-sized tankers and bulk carriers. Expectations are that by 2025 the expansion will triple the Canal's container traffic over the base year 2005 and boost tourism by allowing the passage of larger cruise ships – both of which will lift Panama's long-term economic growth.





TUNISIA / TAPARURA PROJECT IN SFAX

A CLEANER BRIGHTER LIFE

34°44'16.17" N 10°46'25.42" E

The aim of the Taparura project was to rehabilitate the heavily polluted and neglected coastal area of the city and harbour of Sfax, Tunisia's second most populous city. By remediating Sfax's coastline using environmental dredging, selective excavation, sediment treatment and construction of a confined storage for landfill, the city was sustainably re-developed with public and private spaces, residential areas and new beaches, all of which improved the quality of life and encouraged tourism.

CLIENT

SEACNVS – Société d'Etudes et
d'Aménagement des Côtes Nord de
la Ville de Sfax

CATEGORY

Coastal Protection / Reclamation /
Sustainable

PERIOD

2006 – 2009



2005 – 2015



↑ The rehabilitation of Taparura at Sfax was part of a comprehensive package of measures taken by the Tunisian government for the general improvement of the quality of life for residents and for tourism.

← After dredging the contaminated soils, all wet polluted material was stockpiled and dewatered in a specially designated area on top of an existing landfill and then covered with clean sand.





SOUTH AFRICA / PORT OF DURBAN

PORT OF DURBAN DIGS DEEPER

29°52'22.35" S 31°01'28.39" E

Located on South Africa's east coast, bordering the Indian Ocean, Durban is the busiest port in sub-Saharan Africa. By 2007 the port needed an upgrade and enlargement. The enlargement works at Durban, the most extensive ever undertaken on the African continent, involved widening the port's entrance from 150 to 240 metres and deepening both the shipping channel from 12.8 to 19 metres as well as the port itself. More than 10 million m³ of sediment were dredged. Two trailing suction hopper dredgers were deployed and a newly built powerful backhoe dredger which worked below the waterline along the breakwaters.

CLIENT

Transnet National Ports Authority

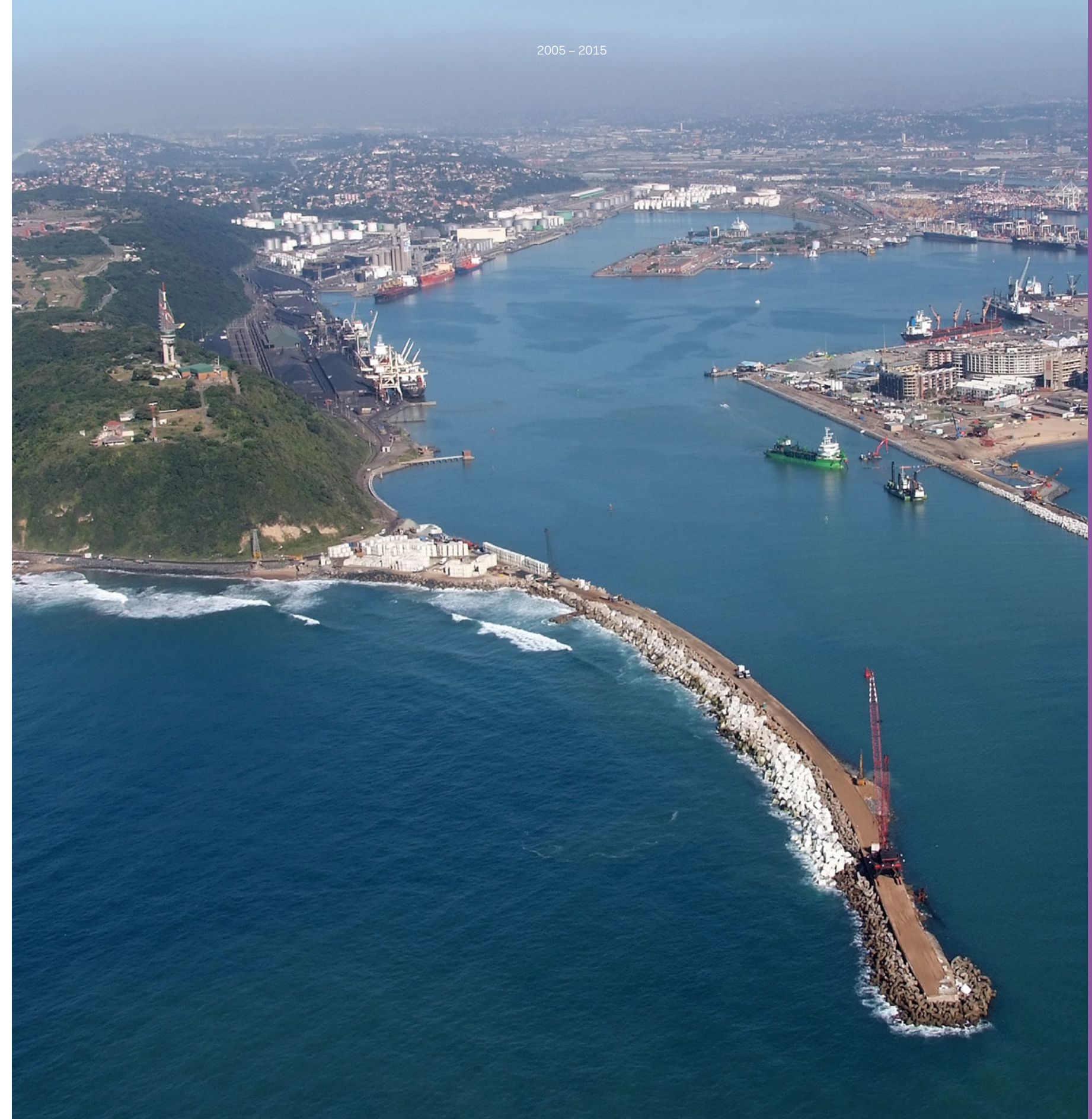
CATEGORY

Ports and Waterways

PERIOD

2007 – 2010

2005 – 2015



SOUTH AFRICA / PORT OF DURBAN



63



1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



- ← Aerial view of the expansion of the Port of Durban, South Africa. Both the access channel and the port were deepened and widened. The work took almost three years and was completed in March 2010.
- One of the trailing suction hopper dredgers rainbowing sand for the construction of new berth areas.
- ↓ The Port of Durban upgrading and modernisation was a multidisciplinary activity: Dredging, beach nourishment, reconstruction of the second breakwater, demolition of several quay walls and the removal of shipwrecks in the approach channel.





SAUDI ARABIA / MANIFA OIL FIELD

CONNECTING 27 ARTIFICIAL DOTS

27°38'46.54" N 49°01'42.35" E

The Manifa Oil Field is one of the most important crude oil fields in the Middle East, but its shallow waters made the use of common offshore oil drilling platforms impossible.

For that reason Saudi Aramco opted for the design and construction of 27 artificial oil drilling islands, 41 kilometres of main and associated lateral causeways, 14 bridges and 3 marine access areas including quay walls, lay-down areas and roll-on/roll-off facilities.

When fully operational, the oil field delivers 900,000 barrels per day.

CLIENT
Saudi Aramco

CATEGORY
Reclamation / Energy

PERIOD
2007 – 2011

2005 – 2015



SAUDI ARABIA / MANIFA OIL FIELD



65



1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



- ↑ Two roll-on/roll-off facilities for supply vessels and the southern berth area at the start of the main bridge connecting it to another island in the distance.
- ← Monitoring and measuring during sand placement operations goes on continuously with the support of computer technology. In the background a trailing suction hopper dredger is rainbowing sediment.
- A side stone installation vessel delivers its rock load to the installation location, whilst large excavators load the rock onto barges for the revetment works. Some 12 million tonnes of rock were brought in by sea from quarries in Oman and from Saudi Arabia over land.



SAFETY FIRST

Nothing matters more than creating a safe, healthy workplace for all employees. Through compliance with safety and occupational health laws, regulations and codes of practice in all countries and through on-the-job safety training, the risks to personnel are kept at the lowest levels possible.





OMAN / PORT OF DUQM

NEWLY BUILT FOR THE MODERN AGE

19°39'34.79" N 57°42'45.30" E

Located on the Arabian Sea, with the Indian Ocean beyond, the Port of Duqm complex was built to provide adequate capacity to cope with future expansions and with the handling of large cargo vessels. The work included the construction of the port's breakwaters and quay walls and the dredging and deepening of an access channel and harbour basin. An extensive dry dock complex was also built. The completely new port has reinforced Oman's strategic position for global trade.

CLIENT

Directorate General of Ports and
Maritime Affairs, Ministry of
Transport and Communications

CATEGORY

Ports and Waterways / Reclamation

PERIOD

2007 – 2012

2005 – 2015



OMAN / PORT OF DUQM



68



1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



↑ Panoramic view of the works in progress for the new port and dry dock complex at Duqm, the first of its kind in Oman.

↓ Panoramic view of Duqm's new port and dry dock complex after the completion of dredging and reclamation works.





BELGIUM / THORNTON BANK WIND FARM

RENEWABLE & REMARKABLE

51° 32' 43.73" N 2° 55' 47.21" E

Belgium has committed itself to generate 13 percent of its electricity from renewable sources of energy by 2020. The C-Power Thornton offshore wind farm set the standard for achieving this and was a world-first in many respects: the distance to the coast, sea depth, capacity of the six 15 Megawatt turbines, bank funding, environmental procedures, severe weather and offshore conditions, the planning in ever-changing political, legal and financial circumstances and the development of specialised equipment.

CLIENT
Belgian Government

CATEGORY
Energy

PERIOD
1) 2007 – 2009
2) 2010 – 2013





BELGIUM / THORNTON BANK WIND FARM



ABU DHABI (UAE) / ADCOP FUJAIRAH

PIPELINE PUMPS CRUDE TO PORT

HABSHAN: 23°47'21.8" N 53°34'22.6" E / PORT OF FUJAIRAH: 25°11'16.6" N 56°21'31.1" E

Starting at Habshan, the Abu Dhabi Crude Oil Pipeline (ADCOP) runs through the emirate Ras Al Khaimah over a distance of 380 kilometres to the Port of Fujairah, making it the longest pipeline in the United Arab Emirates and one of the longest in the Middle East. It can transport 1.5 million barrels of crude per day. The Engineering, Procurement and Construction (EPC) contract involved the offshore installation of three pipelines with a total length of approximately 13 kilometres and three single-point mooring systems.

CLIENTIPIC (International Petroleum
Investment Company)**CATEGORY**

Energy

PERIOD

2008 – 2010

2005 – 2015



ABU DHABI (UAE) / ADCOP FUJAIRAH



72



1965 – 1975

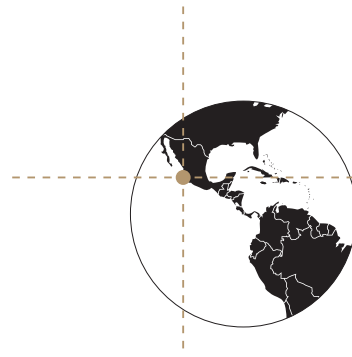
1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



MEXICO / MANZANILLO LNG TERMINAL

POWER FOR PEOPLE

19°00'38.81" N 104°15'41.42" W

The LNG re-gasification terminal in Manzanillo, Colima, Mexico, was a major project that encompasses an 860,000 m² site. It accommodates two storage tanks with re-gasification and distribution facilities with a capacity of 3.8 million tonnes per year. An essential element of the terminal was the construction of an LNG unloading jetty as part of the receiving facilities. The re-gasified gas from the terminal supplies energy to Manzanillo and Guadalajara power plants and to adjacent cities.

CLIENT
Terminal KMS de GNL**CATEGORY**
Energy**PERIOD**
2008 – 2011

2005 – 2015



MEXICO / MANZANILLO LNG TERMINAL



73



1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



THE NETHERLANDS / MAASVLAKTE 2

COMPLEX TO CONSTRUCT

51°57'54.30" N 3°58'48.10" E

Maasvlakte 2 is one of the most complex projects in the history of Dutch hydraulic engineering. Started in 2008, the project covered 2,000 hectares. Twenty-three trailing suction hopper dredgers carried 210 million m³ of sand from the borrow area 12 kilometres away to the reclamation site. Four cutter suction dredgers deepened the entrance and new port basins, pumping 30 million m³ of sand into these new areas. The new land is raised to 5 metres above NAP (Normaal Amsterdams Peil) and the port is -20 metres. It is one of the few ports in Europe accessible to the next generation of deep-draught container ships.

CLIENT

Port of Rotterdam Authority

CATEGORY

Ports and Waterways / Reclamation

PERIOD

2008 – 2013



2005 – 2015





Trailing suction hopper dredgers, cutter suction dredgers, backhoes, side stone dumping vessels, support vessels, dry earth-moving and auxiliary equipment including the unique Blockbuster crane (see previous page) made up the high-tech plant used at the Maasvlakte 2 reclamation.



↑ Panoramic view of the reclamation site. The overall sea defences of Maasvlakte 2 comprise an 11-kilometre-long outer contour constructed of hard rocks and soft dunes covered with a dynamic pebble beach.

→ On 11 July 2012 at neap tide, the signal to start the closing of the final gap in the seawall was given by the Her Majesty the former Queen Beatrix of the Netherlands





VIETNAM / CAI MEP INTERNATIONAL TERMINAL

A BUSY PORT MAKES A MOVE

10°30'36.66" N 107°00'52.14" E

Cai Mep International Terminal is the biggest port project in Vietnam and is part of a key plan of the Government to relocate the port away from the urban area of Ho Chi Minh City and build an improved international container terminal in Ba Ria Vung Tau Province 50 km to the south. The construction works include a container wharf, three approach trestles, mooring and turning basin, soil improvement works, a 40-hectare container terminal yard, buildings, utilities works and other essentials.

CLIENTMinistry of Transport,
Socialist Republic of Vietnam**CATEGORY**

Ports and Waterways

PERIOD

2008 – 2013



↑ The new port under construction: Reclamation and soil improvement work was done for a 600-metre-long container wharf, with two 20-metre-wide and 85-metre-long approach trestles, one 40-metre-wide and 85-metre-long approach trestle, as well as a mooring and turning basin, a container terminal yard and other buildings.

← Vietnam's largest port recently moved its facilities to the new Cai Mep International Terminal, strategically located 50 kilometres south of Ho Chi Minh City.





ABU DHABI (UAE) / CORNICHE BEACH

RECREATION & TOURISM

24°28'25.83" N 54°20'25.14" E

The Corniche Beach is a premier recreation area, enjoyed by residents and visitors alike. First constructed in 2006, the contractor was asked again in 2009 to extend the beach by some 2,700 metres. The new beach is dressed with sand taken from a borrow area in the Arabian Gulf 80 kilometres offshore. A rock sill holds the sand in place and is protected by floating barriers and marker buoys. The popular beach had to be kept open during construction and the fragile ecosystem was continuously monitored.

CLIENT
Abu Dhabi Municipality

CATEGORY
Coastal Protection

PERIOD
2009 – 2010



2005 – 2015



↑ Abu Dhabi's popular tourist attraction, Corniche Beach, was first created in 2006 and three years later was extended by more than 2.5 kilometres.

← The smooth, white sand of Corniche Beach, lined with hotels and shops, is both a tourist attraction and a welcome location for residents.



77



1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

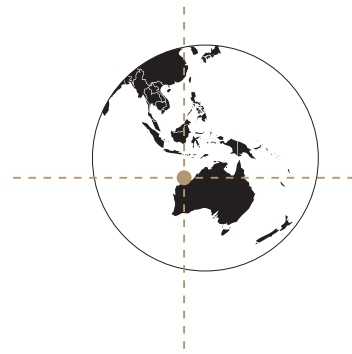
2005 – 2015

Foreword Members Colofon

AN ARTIFICIAL & ARTFUL WATERFRONT

Where there was once a rocky, sandy stretch of coastline, there is now Corniche Beach to add to Abu Dhabi's tourist attractions. The wide, clean Corniche beachfront has given the capital city another delight for international visitors as well as the local population, featuring many high-end hotels and special events.





AUSTRALIA / BARROW ISLAND

NO GUESSWORK IN GETTING GAS

20°46'30.62" S 115°24'17.71" E

Sixty kilometres off Australia's western coast, often threatened by cyclones and a Class A nature reserve as well, Barrow Island is the land base for the Gorgon natural gas fields. This remote and unique location presented huge logistical and environmental challenges for getting people, equipment and the rocks needed for coastal protection to the right place. Extensive measures by the contractor to protect plants and animals were rewarded with an 'Environmental Excellence Award' from the client.

CLIENT

Kellogg Joint Venture – Gorgon

CATEGORY

Ports and Waterways / Energy

PERIOD

2009 – 2013

2005 – 2015



AUSTRALIA / BARROW ISLAND



79



1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



→ The remote location and the limited accommodation on Barrow Island during the work resulted in chartering a Marine Construction Support Vessel to accommodate up to 400 staff and workers.

← Aerial view of the jetty at Barrow Island near the Gorgon LNG fields comprising a material offloading facility, quay walls, mooring dolphins and a roll-on/roll-off facility.





ABU DHABI (UAE) / UPPER ZAKUM ARTIFICIAL ISLANDS

ISLANDS FOR PETROL

25°00'42.79" N 53°29'02.04" E

To increase petroleum production, four artificial industrial islands at Upper Zakum – the second largest offshore oilfield in the world – were commissioned. Dredging, land reclamation, construction of harbours with quay walls and breakwaters were carried out utilising a diversity of equipment. A turn-key, self-sufficient village was also constructed on one of the islands to accommodate 520 employees with housing, offices, a clinic and recreation, as well as power and sewage treatment plants.

CLIENT

ADNOC - Abu Dhabi National Oil Company

CATEGORY

Energy

PERIOD

2009 – 2014



← The construction works for the islands involved 20 million m³ of dredging and levelling and 20 million m³ of ground amelioration, and utilised 7 million tonnes of stones, artificial fabrics and concrete units for beach protection.

↓ Upper Zakum Oilfield, located about 84 kilometres offshore to the north-west of Abu Dhabi islands, covers an area of 1,200 km². Four islands, each measuring 600 to 790 metres in diameter, were constructed of sand and rock transported from quarries in the UAE. The islands are located on water depths ranging between 5 to 15 metres.



DOUBLE OR NOTHING

Where coastal erosion is a threat, it can be double or nothing: If nothing is done, the coastline will recede increasing the chance of floods and loss of life and property. But when sand replenishment is done properly, the restored coast will both offer protection from flooding as well as create a seafront of beaches and dunes for tourism and recreation.





UNITED KINGDOM / LONDON GATEWAY

UK HINTERLAND GETS A HARBOUR

51°30'27.18" N 0°29'58.41" E

London Gateway aims to make London a hub for both international and UK shippers with its connecting inland infrastructure and huge capacity for container ships. The port has 2.7 kilometres of quay, 6 deep-water berths, 24 giant quay cranes with an annual capacity of 3.5 million TEUs. To construct the deep-water port the navigation channel was widened and deepened and a port platform was built with 18 million m³ dredged material for reclaiming 92 hectares of land and raising 80 hectares of existing land.

CLIENTLondon Gateway Port Limited
(DP World)**CATEGORY**

Ports and Waterways

PERIOD

2010 – 2013



↑ Aerial view of the platform for a major deep-water port and logistics park at London Gateway. Works included reclamation, building a 2.7-kilometre-long quay and widening and deepening the navigation channel. A trailing suction hopper dredger and a gravel trailing suction hopper dredger sail in front of berth 1.





MALDIVES / AIRPORT RECLAMATIONS

LINKING A 1000 ISLANDS

4°11'19.7" N 73°31'42.8" E

An island nation on a double chain of twenty-six atolls, the Maldives encompass a territory spread over 90,000 km², making the country one of the world's most geographically dispersed. Its population of some 330,000 inhabits 192 of its 1,192 islands. To increase social and economic benefits for local communities and increase tourism, the Maldives government has launched a programme of airport construction, including Thaa Thimarafushi, Male International and Gan International airports.

CLIENT
Government of Maldives

CATEGORY
Reclamation

PERIOD
2010 – 2014



2005 – 2015



↑ Bulldozers spreading and compacting dredged material at the Gan International Airport project on the Addu Atoll. The upgrade allows larger aircrafts to land and take off. In combination with the extension reclamation of the runway, two seaplane landing runways and a seaplane terminal area were dredged. This meets international status and is expected to boost social and economic activities on the southern atolls of the Maldives.

← Aerial view of the widened runway area at Male International Airport on Hulhule Island, gateway to the Maldives. Some 65 hectares of seaplane runways were dredged and land was reclaimed, expanding the airport facilities by 30 hectares and the existing runway to 50 hectares, which meets the International Air Transport Association (IATA) safety standards.

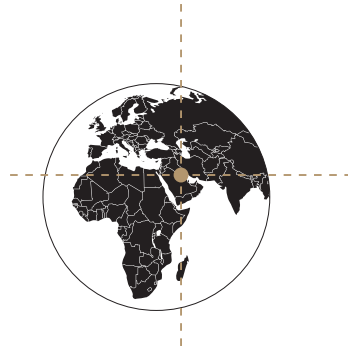


HIGH DEMANDS

FACT

The desire to protect and preserve marine fauna and flora led to higher demands for remediation, restoration, less invasive techniques and more thorough monitoring.





KUWAIT / BOUBYAN SEA PORT

A PORT IN PROGRESS

29°47'00.38" N 48°11'51.10" E

The development of Boubyan Sea Port took place on the eastern side of Boubyan Island, the largest of Kuwait's islands. Phase 2 covered the dredging works for the basin and channel including the construction of a quay wall and reclamation of the rear area for a container terminal with 4 berths. Other noteworthy aspects include data collection, design of the quay wall, basin and reclamation area. The Boubyan Island Development Project aims to enhance Kuwait's standing as a major hub for commerce in the region.

CLIENT

Ministry of Public Works

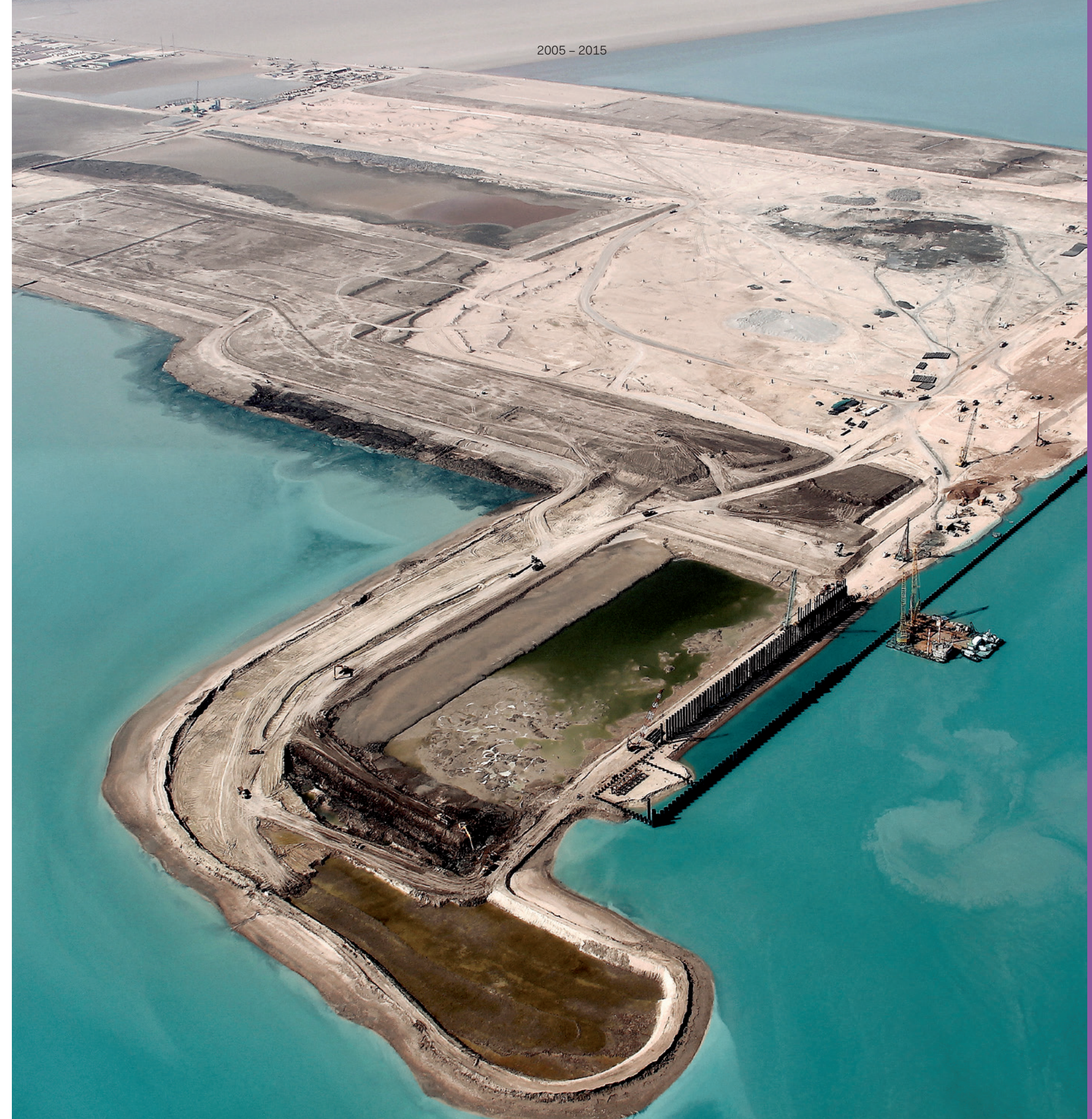
CATEGORY

Reclamation

PERIOD

2010 – 2014

2005 – 2015



KUWAIT / BOUBYAN SEA PORT



86



1965 – 1975

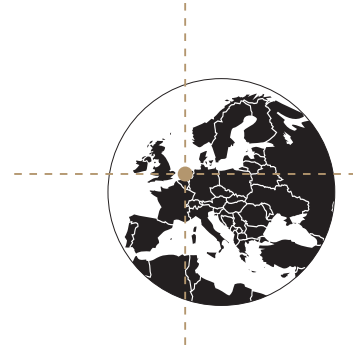
1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



THE NETHERLANDS / SAND MOTOR

SAND SLOWLY ADRIFT

52°03'08.58" N 4°11'05.50" E

Every year the sea erodes sand from the Dutch coast. And every five years, the shortfall is replenished by depositing sand on the beaches – a costly operation. The Sand Motor, an artificial peninsula, is an innovative alternative to protect the coast naturally. To start 'the engine', 21.5 million m³ of sand were placed along a 20-kilometre stretch of coast. Now the wind, waves and currents are gradually doing their work. Over a twenty-year period the sand is expected to transform itself into new dunes and wider beaches, making the need for the five-year replenishment moot whilst protecting the vulnerable hinterland.

CLIENTRijkswaterstaat/Dutch Ministry of
Infrastructure and the Environment**CATEGORY**

Coastal Protection / Sustainable

PERIOD

2011 – 2012

2005 – 2015



87



1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

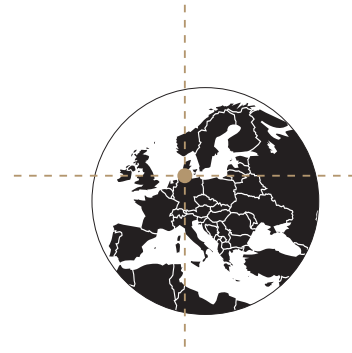
2005 – 2015

Foreword Members Colofon



- ↑ In this aerial view of a trailing suction hopper dredger rainbowing sand the placement can clearly be seen. The Sand Motor has already created an additional 128 hectares of space for natural habitats and recreation and 35 hectares of new dunes in this densely populated area between Rotterdam and The Hague – a unique experiment in sustainable solutions.
- ← A trailing suction hopper dredger prepares the Sand Motor by rainbowing sand at nearshore. Some 21.5 million m³ of sand were placed in this way.
- A crewmember checking sand placement via computer on board a trailing suction hopper dredger on the Dutch coast where the Sand Motor is being tested.





DENMARK / ESBJERG EASTERN PORT EXTENSION

NORTH SEA PORT PREVAILS

55°27'51.4" N 8°26'49.9" E

Esbjerg witnessed the first phase of a major extension to the port in 2011 – 2013. The 'Esbjerg Eastern Port Extension' project included the construction of a 1.3-kilometre new quay, capital dredging to widening the existing navigational channel, capital dredging for a new turning basin as well as a new port basin. As a Natura 2000 site*, all dredging adhered to the strictest environmental precautions. Esbjerg has long served the offshore oil and gas industry in the North Sea and more recently has become a centre for shipping offshore wind turbines.

*A protected area established under the 1992 EU Habitats Directive. The aim is to assure the long-term survival of Europe's most valuable and threatened species and habitats.

CLIENT
Port of Esbjerg

CATEGORY
Ports and Waterways / Reclamation

PERIOD
2011 – 2013



Two aerial views of the land reclamation at Esbjerg Port, a seaport town on the west coast of the Jutland peninsula:

- ↑ The project in process of construction.
- ← The completed port reclamation site.





ABU DHABI (UAE) / EASTERN MANGROVE AREA

THE RETURN OF THE MANGROVES

24°26'53.94" N 54°25'52.26" E

Mangroves are salt-tolerant trees that grow in the shallow tidal waters of Abu Dhabi's coastal areas. The muddy waters, rich in nutrients, are home to a variety of marine life and provide shelter for marine mammals and birds. Rapid coastal developments have put certain mangrove areas under stress. To revive these vital ecosystems, over 1 million m³ of material was dredged and reclaimed, clearing channels and creating additional irrigation. The Eastern Mangrove area is now flourishing and expanding.

CLIENT

Environmental Agency - Abu Dhabi

CATEGORY

Sustainable

PERIOD

2011 – 2014

2005 – 2015



Mangrove forests, with their long roots, are a crucial element in providing protection and shelter against extreme weather events such as storms, winds and floods. During the development of Abu Dhabi's coastline, some mangrove areas have suffered. To remedy this, a purposeful environmental project re-situated the mangroves, reviving these unique shrubs that can survive in saltwater.



90



1965 – 1975

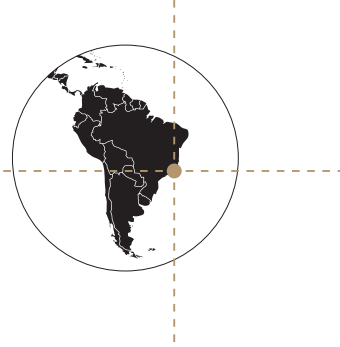
1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon



BRAZIL / LLX AÇU SUPER PORT

A PORT COMPLEX TO REMEMBER

21°51'14.68" S 41°00'49.41" W

The Açu Superport Industrial Complex, located in the north of Rio de Janeiro State, Brazil, covers 90 km² with 17 kilometres of quay – making it the largest, most impressive port-industry enterprise in Latin America. The work includes dredging access and inner channels, turning and harbour basins, land reclamation work and revetments at the entrance of the harbour. The total dredged volume exceeds 43 million m³, some of which was used to reclaim land for constructing the port facilities.

CLIENT
Prumo Logística S.A.

CATEGORY
Ports and Waterways

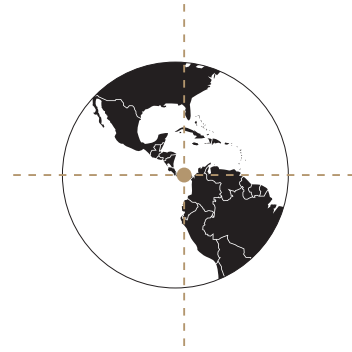
PERIOD
2011 – 2015

2005 – 2015



BRAZIL / LLX AÇU SUPER PORT





PANAMA / PUNTA PACIFICA

CREATING LAND FOR REAL ESTATE

8°58'09.65" N 79°30'24.07" W

As Panama City's shoreline has become more congested, two artificial islands adjoining the city are providing relief. The contractor offered a turnkey solution for the island's design and construction, joining a consortium of banks for the construction loans. Using special high-density rock to form a perimeter and then filling it with compacted, high-density sand enables the island to withstand wind and waves forces with a return period of 100 years and to provide resistance against earthquakes.

CLIENTOcean Reef Islands Inc./Compañía
Insular Americana**CATEGORY**

Reclamation

PERIOD

2011 – 2017





- ↑ Construction of the rock dike and island.
- ← Discharge location of the trailing suction hopper dredger.
- Workers secure the final section of the pipeline through which sand fill will be pumped into the rock-dike perimeter.



- ↑ The shallow waters and flat shore of Panama meant that the high density sand was delivered to the reclamation site through a pipeline from a trailing suction hopper dredger 3 kilometres away.
- ↓ Artist impression of the two islands: The first island is connected to the shore by a bridge and another bridge will connect the second island to the first. There are also plans for a marina between the two islands.



HIGHLY SKILLED

Over 40% of the employees in the dredging industry have obtained a Bachelor's or Master's degree. Companies also invest heavily in in-house training and education as dredging encompasses highly specialised skills and knowledge.





UNITED KINGDOM / YORK GAS RESERVOIR

PLATFORM AND PIPELINE

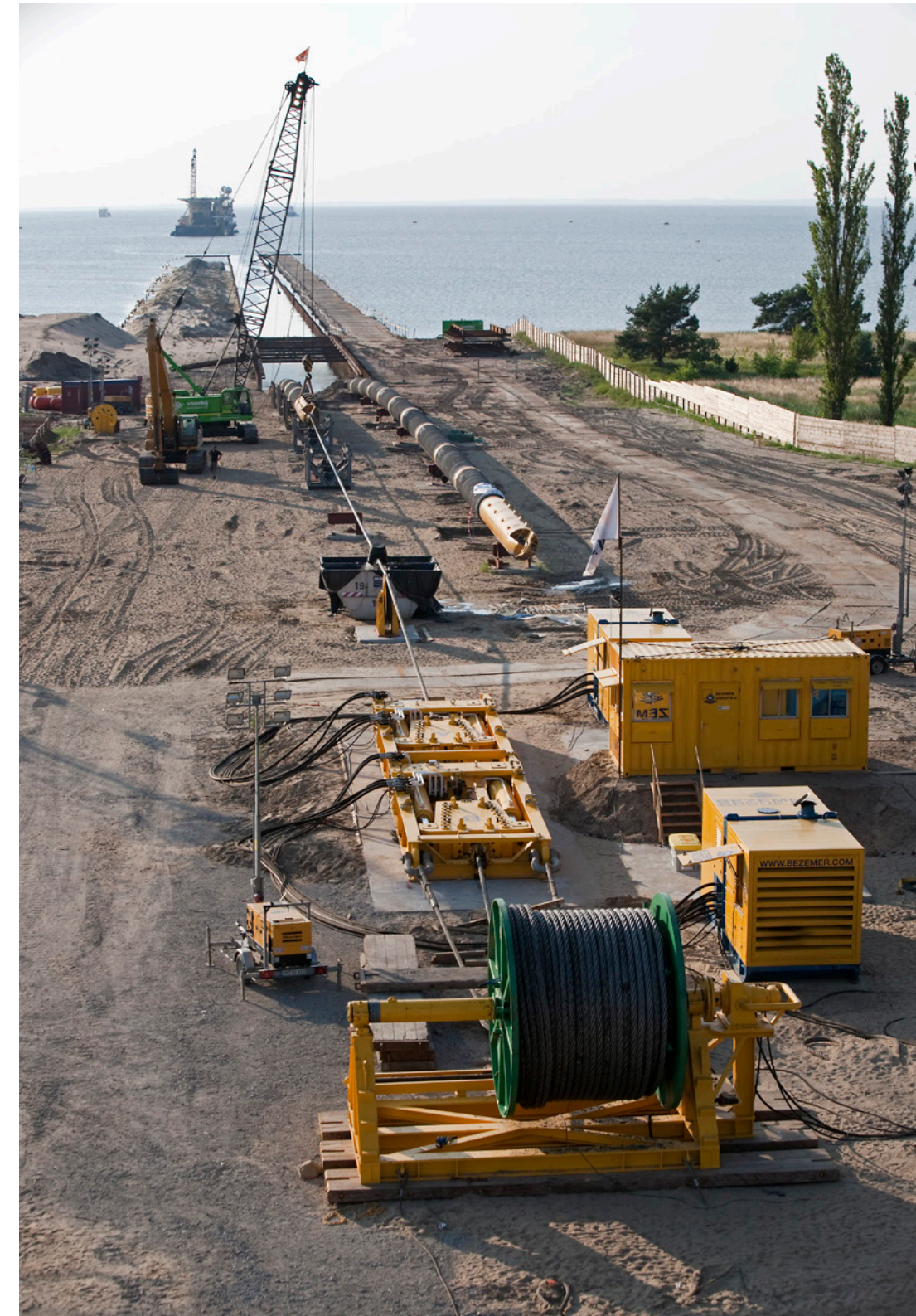
54°00'25.53" N 1°04'50.38" E

To develop the York Gas Reservoir 34 kilometres offshore, a new platform and pipeline had to be installed. A 7-kilometre marine trench from the cofferdam towards the platform was dredged by two backhoe dredgers which side-casted the stiff clay with cobbles and boulders. Two newly built 6,000 m³ trailing suction hopper dredgers pre-swept the underwater gravel/clay dunes. After the pipeline installation, a backhoe dredger backfilled the trench with material that had been side-casted during the original seabed levelling.

CLIENT
Saipem Limited**CATEGORY**
Energy**PERIOD**
2012



Two views of a backhoe dredger trench-dredging and backfilling the pipeline trench to the original seabed level, using material previously casted to the side.



Dredging a 7-kilometre marine trench from the cofferdam installation on the beach towards the offshore at the east coast of England for the York Field Development Project.



ABU DHABI (UAE) / SARB ARTIFICIAL ISLANDS

ROCK SOLID OFFSHORE ENERGY

24°48'57.60" N 53°06'49.93" E

To develop the Satah Al Razboot (SARB) oil field in Abu Dhabi, two offshore artificial energy islands were constructed. This demanded multi-disciplinary activities such as engineering, dredging, reclamation, soil improvement by vibro-flotation and dynamic compaction, prefabrication and construction of quay wall blocks and breakwater and rock revetment.

Whilst the location and weather conditions were challenging, these artificial islands provide a sustainable solution for offshore oil and gas winning.

CLIENTAbu Dhabi Marine Operating
Company (ADMA-OPCO)**CATEGORY**

Reclamation

PERIOD

2013

2005 – 2015



ABU DHABI (UAE) / SARB ARTIFICIAL ISLANDS



97



1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

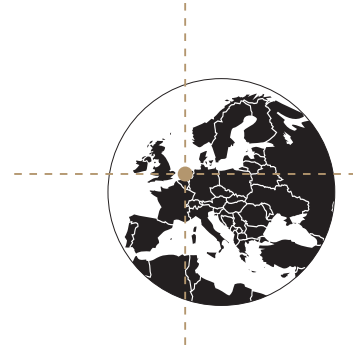
2005 – 2015

Foreword Members Colofon



- The construction of the perimeter shore protection for both islands used 4.5 million tonnes of rock armour and about 40,000 prefabricated Accropode™ II concrete blocks which are visible through the clear water.
- ← The quay wall construction of the harbour of one of the artificial islands at Satah Al Razboot oil field, Abu Dhabi.
- ↓ Tonnes of rock material and concrete Accropodes™ II were used to protect the newly reclaimed artificial islands.





THE NETHERLANDS / ENECO LUCHTERDUINEN WIND FARM

ENERGY TURBINES IN THE NORTH SEA

52°26'13.66" N 4°08'56.60" E

In 2013, the contractor started with the engineering and procurement for the Eneco Luchterduinen Wind Farm in the Netherlands. The wind farm is situated 23 kilometres off the Dutch coast between the cities of Noordwijk and Zandvoort and occupies a 25-km² area at a water depth ranging between 18 and 24 metres. It consists of 43 Vestas V112 wind turbines.

With a capacity of 129 Megawatts, it will supply green energy to 150,000 households.

CLIENT
Eneco**CATEGORY**
Sustainable**PERIOD**
2013 – 2015

2005 – 2015



THE NETHERLANDS / ENECO LUCHTERDUINEN WIND FARM



99



1965 – 1975

1975 – 1985

1985 – 1995

1995 – 2005

2005 – 2015

Foreword Members Colofon

TILTING AT WINDMILLS IN THE WATER

In the search for renewable energy, the major dredging companies embody the idealism and ingenuity of the mythical Spanish hero, Don Quixoté. Through their engineering expertise they have helped find sustainable solutions for an energy-hungry Europe – by transporting and securing massive wind turbines in the North Sea.





THE PHILIPPINES / MALAMPAYA

AN EXTENSION THAT'S ELECTRIC

11°47'26.63" N 118°21'47.48" E

The Malampaya Gas Field off the coast of Palawan Island is the major source of natural gas for the Philippines providing about 30% of the country's electricity requirements. The project to install a Depletion Compression Platform (DCP) is part of the plan to optimise the gas field, leading to an eight-year lifetime extension. The contract is to dredge, install rock, position the platform, connect ballast hoses and inject iron ore into the footings at a depth of 50 metres using only one multi-purpose vessel.

CLIENT

Philippine National Oil Company,
Chevron and Shell Philippines
Exploration

CATEGORY

Energy

PERIOD

2014 – 2015



↑ Rock is being installed to secure the seabed for the construction of an offshore Depletion Compression Platform (DCP) next to the existing production platform visible on the right.

← On the fully computerised bridge, the dredge master and a crewmember direct the dredging and rock installation operations for the preparation of the seabed for the DCP.





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