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TERRA ET AQUA

Maritime Solutions for a Changing World

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COVER

An aerial photograph of the finished Slufterdam, Plans 1 and 2. These plans extended both the port of Rotterdam as well as the surrounding nature reserves in harmony with each other, following the principles of Integrated Coastal Zone Development through Building with Nature.

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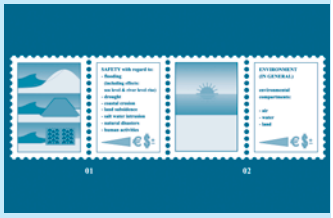


TERRA ET AQUA

EDITORIAL

Dubai, Rotterdam, Mexico City and New Orleans represent a diverse group of major urban conglomerations, both economically and geographically. So why, you might ask, are they being mentioned together here? The link can be found in the principles of *Integrated Coastal Policy through Building with Nature,* developed by Mr. Ronald Waterman. Mr. Waterman's expertise in the fields of land reclamation and maritime infrastructure development is well known, and he has travelled the world as an adviser to various governments. In recognition of his leadership and insights in the development of modern water policies, this issue of *Terra et Aqua* is entirely devoted to his work.

Mr. Waterman's concepts represent a revolutionary departure from conventional wisdom. As was pointed out at a recent conference in Amsterdam by Ms. Ineke Bakker, Netherlands Director-General for Spatial Policy, "…in the past there was often a 'war against water', whereas recent policy has taken a new approach: 'Go with the Flow'. Find integrated solutions which make use of less invasive techniques and are more in harmony with the natural dynamics".

This is the essence of Mr. Waterman's message. Although his principles have quite frequently been applied to the coastal defences of the Netherlands, today they are gradually being implemented in a far wider range of cities, ports and along beaches throughout the world. In recent years, *"Building with Nature"* has steadily gained more acceptance, undoubtedly spurred on by the growing awareness of climate change and the consequent rising sea levels, by the increase in natural disasters like the tsunamis in the Far East and hurricanes in New Orleans, and by the loss of low-lying lands, such as the Sundarban Islands in the fragile delta area near the Bay of Bengal.

In the dredging and maritime construction industry, the growing risks to coastlines and deltas have long been recognised as needing urgent attention. The statistics about burgeoning coastal and delta populations and the stress that this places on land masses are not new to dredging professionals. The international private dredging companies have made a concerted effort to realise innovative, environmentally sound and sustainable solutions. They have translated their awareness into substantial investments in Research & Development. And these investments have multiplied in recent years. The results are impressive: More efficient jumbo trailing hopper dredgers. Specially dedicated environmental equipment like drag and cutter heads. Improved work methods and technologies for site investigations, environmental impact assessments and monitoring. These advanced technologies have made it possible to undertake the enormous land-creation projects in Dubai, Singapore, Hong Kong, and elsewhere in a way that supports responsible socio-economic growth.

All these efforts are indeed in harmony with the lifelong work of Ronald Waterman and his emphasis on soft solutions, working with nature instead of against it. Mr. Waterman's theories, supported by experience, are proving that "an integrated policy through building with nature" is applicable in many settings and provides the best hope for long-term sustainable solutions for the restoration of coastlines and habitats and land reclamation.

Robert van Gelder
President, IADC Board of Directors

Special Issue

RONALD E. WATERMAN

LAND IN WATER, WATER IN LAND, ACHIEVING INTEGRATED COASTAL ZONE DEVELOPMENT BY BUILDING WITH NATURE

ABSTRACT

The article which appears here is excerpted from the soon-to-be-published book, *Integrated Coastal Zone Development via Building with Nature*. Although this approach was first applied in the Netherlands, it has gradually been recognised worldwide as a harmonious means of creating land areas for living, working, tourism & recreation, and infrastructure, whilst ensuring the preservation or expansion of valuable environmental resources, nature and landscape. In addition, climate change resulting in sea-level rise, more frequent and intense storm-surges are taken into account, as well as land subsidence and salt water intrusion.

The most extensive applications are found in The Netherlands, but remarkable examples also exist or are in progress bordering densely populated coastal and delta areas elsewhere in Europe, Africa, the Middle East, Far East, the Americas, Australia, as well as numerous waterfront developments on lakes, rivers and canals.

With approximately 80 percent of the largest population centres in the world situated on coasts and deltas, the need for sound, "integrated coastal zone development via building with nature" is urgent and appropriate. The flexible integration of land-in-water and of water-in-land, using materials and forces & interactions present in nature is an environmentally friendly and economically advantageous system which is gaining more and more acceptance worldwide. In implementing this method a new flexible dynamic equilibrium coastline is created using sand from the sea, consisting of a new primary range of dunes with a new beach in front and with a minimum of solid sea-wall elements. The emphasis is no longer on inflexible solid bulwarks against the sea, like dams & dykes, but instead on flexible soft structures in harmony with the sea, like dunes & beaches.

INTRODUCTION

Implementing *Integrated Coastal Policy* by adhering to the principle of *Building with Nature,* using the soft solution of dunes & beaches with a minimum of "hard" elements such as rocks and jetties, or dykes & dams, about 1050 hectare of land have been reclaimed along the coastline of the Netherlands. In the coastal zones stretching from Hoek van Holland to Scheveningen, the extension of the Port of Rotterdam, and near the extension to the ports of IJmuiden/Amsterdam, integrated coastal projects have been successfully completed. And more are planned. In addition, the principle has also been applied, albeit to a lesser degree, on most other continents including Asia, Africa and the Americas. Even in the thinly populated Australia the principle has gained popularity because it not only addresses the issue of local shortage of space for urban, industrial, residential and recreational development, but *Integrated Coastal Policy* and *Building with Nature* also represent long-term, environmentally and economically sustainable solutions.

Above, A young seal moulting on the shore. When coastal zone development is done in harmony with nature, a revival of wildlife occurs, as was the case in the area of West Voorne near Hoek van Holland where seals returned to the coastal waters. © *Norman D. van Swelm & courtesy of Rob Cloosterman.*

I. SUSTAINABLE COASTAL ZONE DEVELOPMENT

Many civilisations originated and developed in the border zone of land-water, in coastal and delta regions. These border zones were and still are very attractive for living,

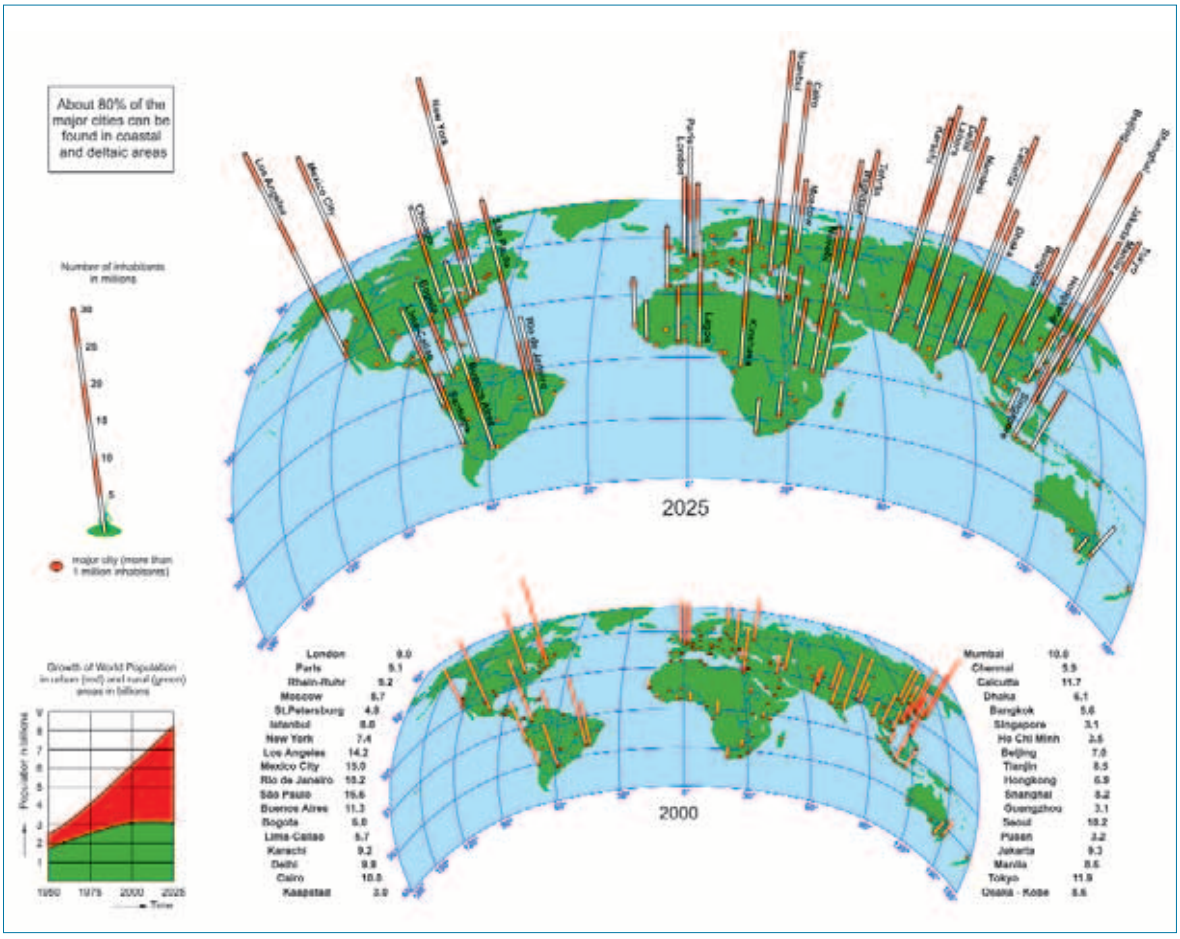


Figure 1. Development of major cities in the world: Eighty percent of major cities in the world are situated on coastal or delta areas. for instance, Tokyo-Kawasaki-Yokohama, Osaka-Kobe, Seoul-Inchon, Pusan, Shanghai, Hong Kong, Guangzhou, Taipei, Kaohsiung, Manila, Jakarta, Mumbai, Calcutta, Chennai, Karachi, Dhaka, Bangkok, Singapore, Sydney, Rio de Janeiro, Buenos Aires, Caracas, Lima-Callao, Montevideo, New York, Los Angeles-Long Beach, San Francisco, Vancouver, Alexandria-Cairo, Lagos, Cape Town, Istanbul, Saint Petersburg, London, Randstad Holland.

working, tourism & recreation, transport, water resources and food supply. They are also attractive for the development of valuable nature areas, because of the presence of gradients from wet to dry, from high to low salt, calcium compound and other mineral concentrations, differences in height & micro-climate. These gradients are often guarantees for a large variety of species.

With this in mind, it should be no surprise that at the beginning of the 21st century, around 80 percent of the largest population centres in the world are found in coastal areas. Striking examples of coastal urbanisation can be found on nearly all continents (Figure 1). In these densely populated coastal areas there are many existing and future problems in need of solutions, but they also present challenging opportunities to create added value.

The Netherlands is a good example of this situation. The Netherlands have a high population density, as well as a high motorcar density, a high waste production and a high energy usage per capita. The need for new building sites for living, working, recreation & tourism, for an adequate infrastructure, for a continued town renovation process is clear; at the same time the need for preservation and expansion of valuable environment, nature and landscape are present. In short, limited space is available for living, working, transport and recreation, while at the same time the need to preserve or even enlarge natural coastal and delta habitats is growing. This lack of space is specifically apparent in Randstad Holland or "Rim-City Holland", a rim of cities in the western part of the Netherlands, which includes Amsterdam, The Hague, Rotterdam, Utrecht and Almere. A Blue-Green Heart on the landward inner side, and the Coast on the other side border this so-called "Polycentric Network Delta-Metropolis".

Apart from the necessity of population stabilisation in due time, in principle three spatial solutions exist to cope with this scarcity of space:

- Making better use of the 3rd dimension (sky-scraping & underground development) and of the 4th dimension (recycling of functions) and multifunctional use within the present available space;
- Using space in the existing hinterland;
- The seaward option with flexible integration of land in water (sea, estuary, lake and/or river) and of water into the new and old land (tidal lagoons, lakes, harbour basins, canals, waterways and/or fresh water lenses under dunes), making use of materials and forces & interactions present in nature, with special attention to the intensive relation water-land.

Worldwide, all these options are applied solely, or in combination. In this publication the emphasis is put on the seaward option, while taking into account the other options.

RONALD E. WATERMAN
is the longest-serving Member of Parliament of the Province of South-Holland, as well as Senior Adviser to numerous ministries in the Netherlands including: the Ministry of Transport, Public Works & Water Management, the Ministry of Economic Affairs, the Ministry of Housing, Planning & Environment. He is also a Senior Adviser to the Municipality of Rotterdam and the Rotterdam Port Authority, the Municipality of The Hague, and an Adviser to WL|Delft Hydraulics, TNO-NITG Netherlands Institute of Applied GeoScience, GeoDelft, the Delta Institute Deltares - Delft, and Netherlands Water Partnership (NWP). He is a visiting lecturer/professor at various universities including the UNESCO-IHE Institute for Water Education and is an adviser to 34 countries on the subject of land reclamation.

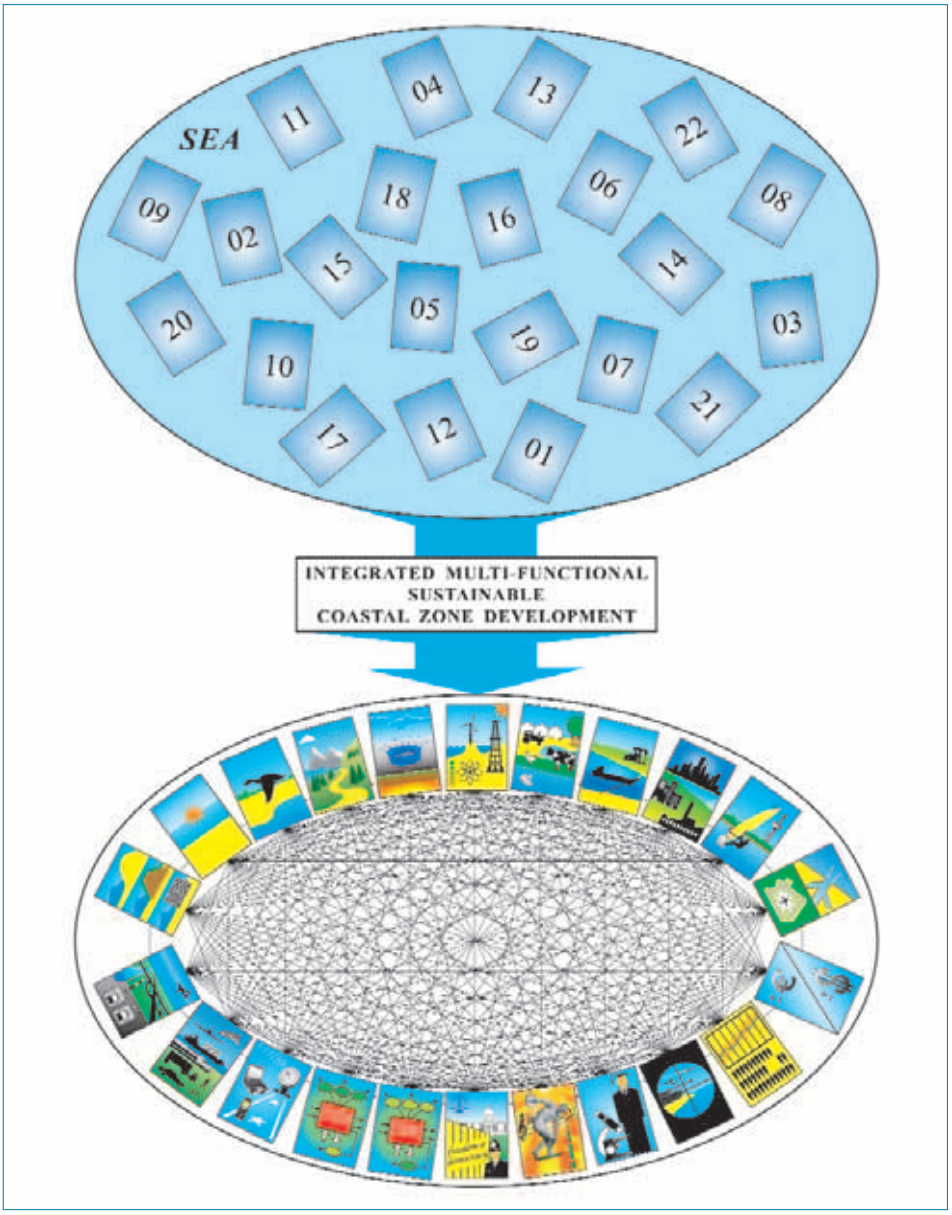


Figure 2. Integrated multifunctional sustainable coastal zone development: The numbers in the "Sea" relate to the specific functions in the coastal zone which are listed in the text. © *R.E. Waterman 1992/2006*

The seaward option gives unique possibilities for the application of multi-functional use. Sustainable coastal zone development is therefore an important multi-faceted instrument to give an adequate answer to the scarcity of space, while it offers at the same time unique opportunities for an improved water resources system.

In addition, given the present concern for climate change, which results in rising sea levels and increased frequency and intensity of storm surges, this method provides an essential instrument for improving coastal safety.

The seaward option is based on two important principles: *Integrated Coastal Policy* and *Building with Nature*.

INTEGRATED COASTAL POLICY

Integrated Coastal Policy answers the question: "When considering coastal and delta regions, how can the multitude of existing and future problems be solved in relation to each other and in relation to the hinterland on the interior and the bordering sea on the other, while creating added value?"

A sustainable, integrated approach is of vital importance for many coastal and delta regions worldwide, and to achieve this, many functions, using many different disciplines, have to be considered carefully. The final development should be such that the overall economy is strengthened and the environment is improved. The many specific functions in the coastal zone which

A Functions 01 / 08

B Functions 09 / 16

are of great importance can be seen in Figure 2 and Figure 3:

01. Safety
02. Environment in general
03. Nature
04. Landscape & Seascape
05. Water Resources Management
06. Energy
07. Agriculture & Aquaculture & Fishery
08. Mining & Storage
09. Construction Sites for Living and Working
10. Recreation & Tourism
11. Transfer/ Distribution Centres & Related Activities
12. Infrastructure
13. Transport Modules
14. Information & Communication Technology
15. Environment in Particular (Air/Water/Soil Quality Improvement)
16. Environment in Particular (Waste Reduction & Usage)
17. Government/ Non-Government Organisations & Citizen Participation
18. Public Health & Welfare, Culture & History
19. Education & Research
20. Defence, Safety & Security
21. Economy & Employment
22. Finance

C Functions 17 / 22

Figure 3. Pictograms A, B, and C illustrate each of the twenty-two functions which comprise the development of integrated and sustainable coastal areas.

II. BUILDING WITH NATURE

The second basic principle in the seaward option, in addition to *Integrated Coastal Policy*, is *Building with Nature*. Where nature allows it, the principle of *Building with Nature* should be applied as much as possible in the realisation of new land. The essence of this principle is: flexible integration of land-in-sea and of water-in-the-new-land, making use of materials, and forces & interactions present in nature, taking into account existing and potential nature values, and the bio-geomorphology & geo-hydrology of the coast and seabed.

Materials

These include: Loose mobile material sand and silt (varying in size, structure and composition) and the forces & interactions to which they are exposed.

Forces & Interactions occurring are:

01. Tidal action (ebb & flood);
02. Wave action (specifically in the breaker zone) and swell action;
03. Sea currents other than tidal currents;
04. River outflow (as force and as supplier of freshwater and sediment);
05. Gravity;
06. Wind;
07. Rain;

08. Solar radiation;
09. Interaction dunes-vegetation (root systems of the vegetation hold together sand and silt); Interaction coastal zone-mangroves;
10. Complex interaction marine organisms – sand / silt / coral.

Bio-geomorphology & geo-hydrology of coast and seabed

Regarding the land reclamation application, the method of *Building with Nature* should be emphasized, both from the viewpoint of nature as from a viewpoint of cost-effectiveness. Human activities should be incorporated as much as possible in the system of natural cycles. The emphasis is on sustainable development in densely populated coastal and delta areas. In this method a new flexible, dynamic equilibrium coastline is created using sand from the sea, consisting of a new primary range of dunes with a new beach in front and with a minimum of solid sea-wall elements.

The emphasis is no longer on inflexible solid bulwarks against the sea, like dams & dykes, but instead on flexible soft structures in harmony with the sea, like dunes & beaches.

In the new flexible dynamic equilibrium coastline accretion and erosion are more or less balancing each other, with a limited maintenance factor through periodic beach nourishment. Only in those places where erosion strongly dominates accretion solid seawall elements are applied. The overall principle is applicable in many of the world's coastal regions and has been applied with success, adapted to local situations.

Figure 4. Satellite picture of The Netherlands (1982) with its three coastal types:

- Wadden Island coast, northern islands of The Netherlands
- Segmented dune coast, Den Helder to Hoek van Holland
- Estuarine coast in transition between Hoek van Holland and Belgium

The coastal zones are:

1 Scheveningen to Hoek van Holland;
2 Rotterdam/ Maasvlakte to Westvoorne;
3 near IJmuiden;
4 Island Noorderhaaks in relation to Texel;
5 between the panhandle peninsulas of Goeree and Schouwen-Duiveland;
6 Katwijk to Noordwijk;
7 Island Neeltje Jans in the storm-surge barrier Zeeland;
8 Western Scheldt Container Terminal.

The method takes into account all the forces and interactions acting on the loose mobile material sand and silt, being the action of tides, waves (specifically in the breaking zone), swell, river outflow (as force and as a source of fresh water and sediment), estuarine and ocean currents, gravity, wind, rain and solar radiation, seeing to it that the net resulting force acting on the sand/silt – averaged in time – is relatively small. Use is also made of the interaction vegetation-sand. Another factor to be considered is the complex interaction between marine organisms and sand/silt/clay particles in beach and near shore. In all cases the bio-geomorphology & geo-hydrology of the region, referring to coast and seabed have to be considered.

Building with Nature also takes into account the present geomorphology and the historic development of these coastal and delta areas, soil & subsoil characteristics, land subsidence, plate tectonics, marine /river & terrestrial environment, monera & protista, flora & fauna, ecosystems, climate & climate change with all its implications like sea-level rise, higher frequency and intensity of storm surges and rainfall, as well as periods of drought.

A low maintenance factor of the new coastline is taken into account, through periodic beach nourishment. Only in those cases where erosion is clearly and strongly dominating accretion, solid seawall elements are to be preferred, but only then. In those cases a marriage between soft and tough coastal defence can be realised, leading to a concave coastline between an existing soft coast and a solid seawall element or a concave coastline between two solid seawall elements.

COASTAL ZONE DEVELOPMENT & SUSTAINABILITY

In all cases of integrating land in water and of water in land through *Building with Nature,* of and above a certain scale, multi-functional master concepts are developed in such a way that nature reserve areas are included and that net nature gain is achieved and that careful zoning regarding all functions is applied. These coastal zone developments can be carried out phase after phase, segment after segment, all fitting in a flexible master plan, leading not only to cost-effectiveness and flexibility but also to environmental improvement.

The environment, including nature, has four important basic functions:

1. *Carrier Function,* providing space and habitat/substrate for all living organisms and other organic as well as inorganic matter, landscape & seascape, energy systems and all human and non-human induced processes.
2. *Production Function,* through exploration, exploitation, harvesting of inorganic & organic materials in the environmental compartments air-water-soil and by the use and conversion of all forms of energy.
3. *Regulatory Function,* maintaining essential eco-systems as well as other systems and processes, including the bio-geochemical cycle, the climate & hydrological cycle, the carbon & sulphur & nitrogen & phosphor cycle.
4. *Information Function,* providing information in many forms for many known and unknown purposes. Some of the known purposes are science; research & development; education; culture & history; recreation & experience; insight; inspiration.

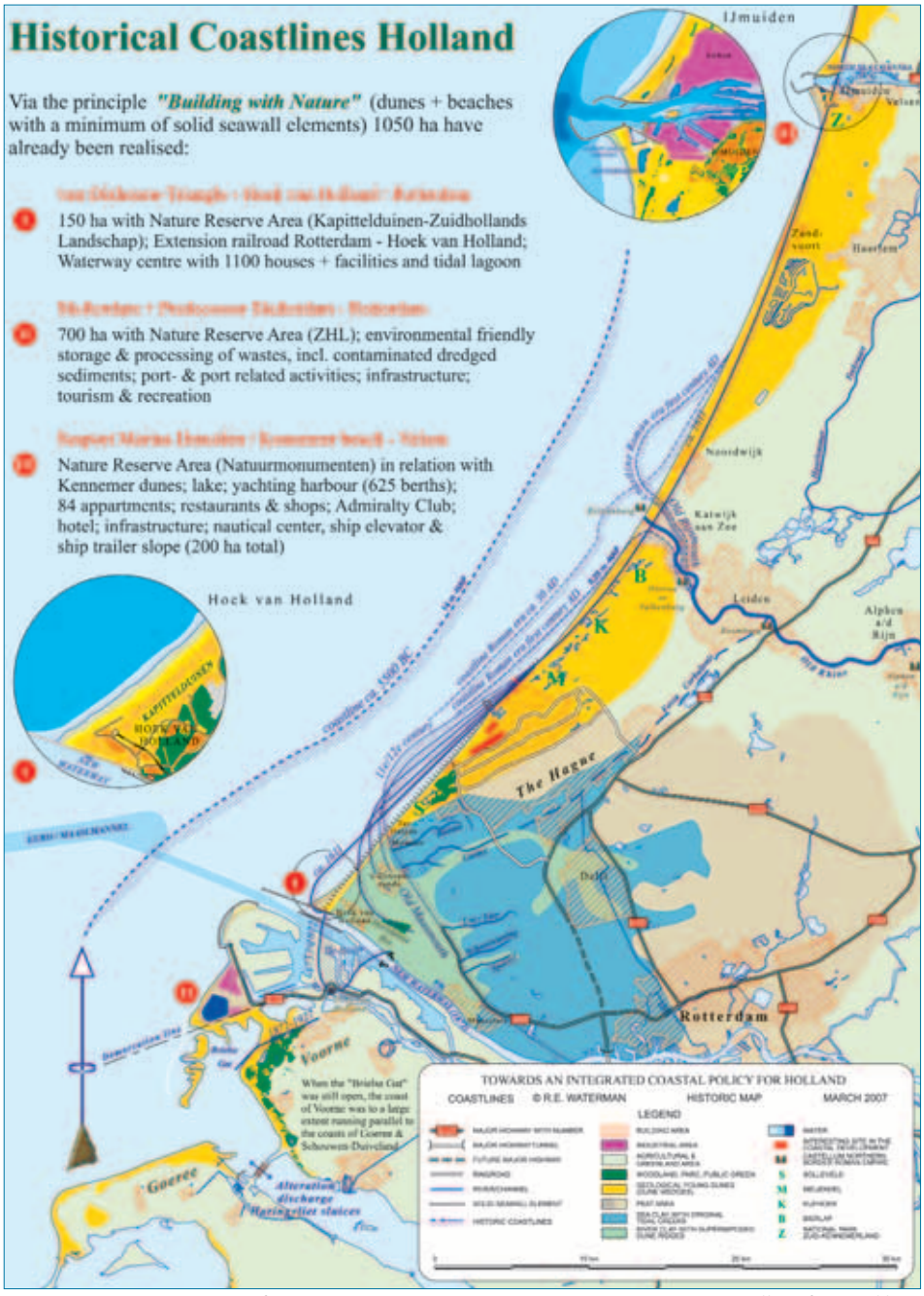


Figure 5. The historic coastlines of North and South Holland, including the van Dixhoorn Triangle (I), Slufterdam (II) and Seaport Marina IJmuiden / Velsen (III).

TRIPLE-C APPROACH

Strengthening the economy and improving the environment are achieved through the application of the method of *Building with Nature,* the creation of new nature reserve areas, careful zoning of the various functions and the introduction of a Triple-C approach: *Clean Technology, Clean Products, and Cleaning-up Technology.*

With regard to the first, *Clean Technology,* it must be realised that in each coastal zone there are always existing and newly human-induced conversion processes in the field of industry, in power stations for energy-supply, in agriculture & aquaculture, in transport & distribution, in the services sector, as well as in the domestic sector. In the direct future, those conversion processes should be developed and implemented, so that with fewer raw materials and with less energy, products at a higher yield are produced, with less hazardous emissions to air, water and soil, and with fewer waste products.

Clean Products should be relatively environment-friendly during their lifetime and thereafter. In case waste products are formed, they should be recycled or

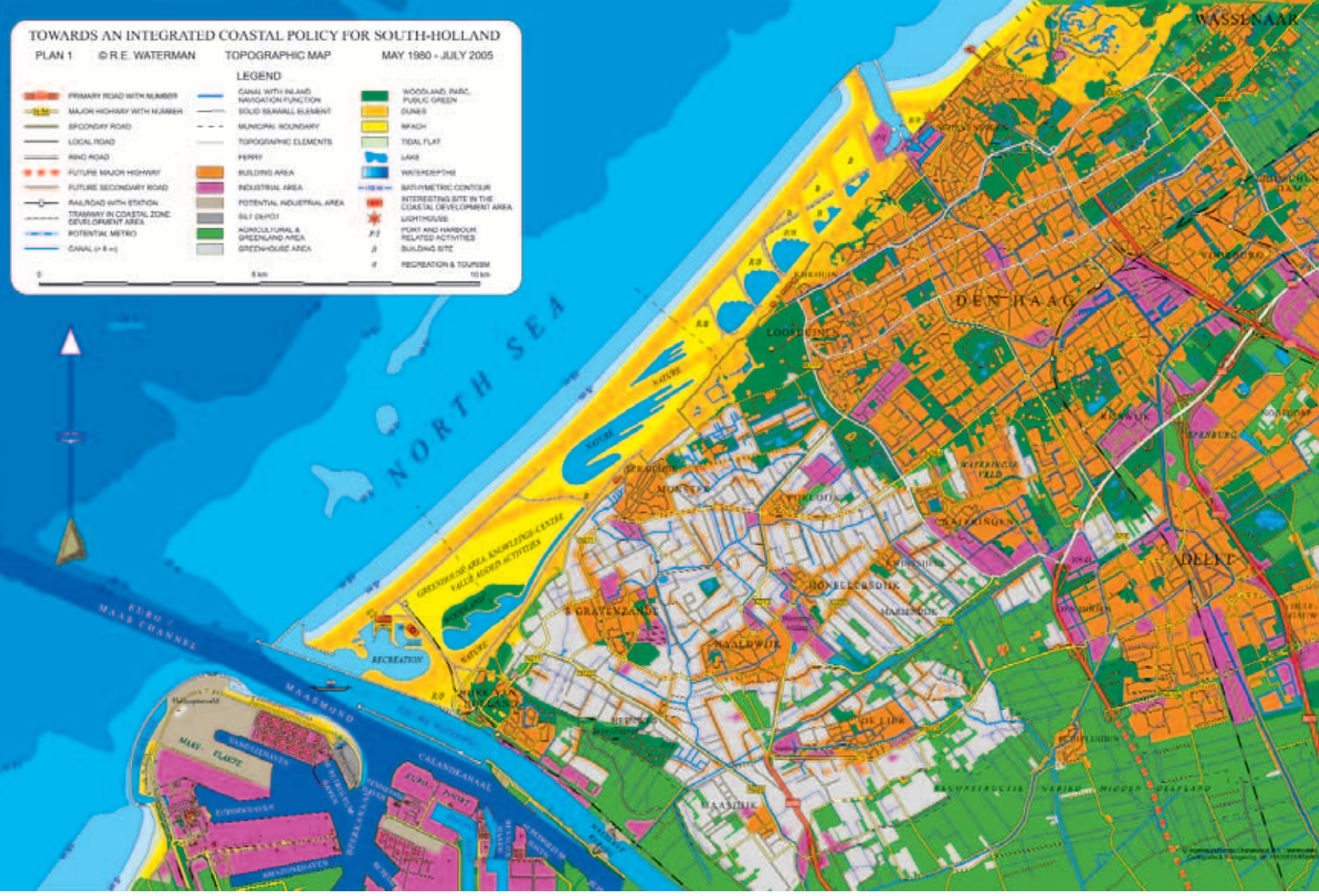


Figure 6. Plan 1 is for a wedge-shaped land reclamation between North Scheveningen and Hoek van Holland, circa 21 km in length and its width is gradually increasing from a few metres near North Scheveningen to approximately 4 km near Hoek van Holland.

converted to environment-friendly products, or, when this is not possible, be safely stored.

Cleaning-up Technology should be applied in order to improve or remove existing situations that are harmful to the environment.

Clean Technology (process-integrated clean technology), Clean Products (useful products that during their lifetime and thereafter are relatively environment-friendly) and Cleaning-up Technology, embodied in the Triple-C approach, are useful instruments to achieve – in due time – sustainable development.

Harmonious co-operation with all the relevant authorities at the various government levels and with non-governmental organisations and citizen groups is an essential prerequisite to achieving integrated multi-functional and sustainable coastal zone development.

Detailed, illustrated examples of sustainable coastal zone development, which are applicable worldwide and can be adapted to local circumstances, will be given.

III. BUILDING WITH NATURE IN THE NETHERLANDS

The Netherlands has three coastal types: the Wadden Island coast in the North; the segmented dune coast from Den Helder to Hoek van Holland, and the estuarine coast in a transition state lying between Hoek van Holland and Belgium. From a coast morphological viewpoint a number of interesting developments and plans for reclamation are in progress. The satellite photo (Figure 4) gives an overview of these coastal zones and of the development plans. Figure 5 shows the historical coastlines of Holland where restoration of 1150 ha have already been realised.

Plan 1

Plan 1 is a wedge-shaped land reclamation between North Scheveningen (coastal area of The Hague) and Hoek van Holland, circa 21 km in length and its width is gradually increasing from a few metres near North Scheveningen to approximately 4 km near Hoek van Holland (see Figure 6). This area is known as the Delfland coast. The new land has an area of circa 3,250 hectares and the volume of sand required, amounts to approximately 360 million m^3. This amount of sand can be obtained by widening and deepening the Euro-Maas Channel and by dredging from the seabed of the North Sea beyond the 20 m – MSL depth line, thereby keeping intact the coastal seabed foundation up to this 20 m – MSL line. This land reclamation has two parts: A smaller part with a short new hollow coastline from North Scheveningen to the extended northern harbour mole of Scheveningen, and a much larger part with a new hollow arched coastline

Figure 7. The first realised segment of Plan 1 from Hoek van Holland to Scheveningen, the so-called Van Dixhoorn Triangle, completed with a primary protective dune running parallel to a major thoroughfare in The Hague, the Laan van Meerdervoort. The coast orientation is good and the Delflandse heads have disappeared under the sand. This is a land reclamation of ca. 150 ha with a splendid natural reserve, the Kapittel Dunes. South of this the train route Rotterdam to the Hoek van Holland will be lengthened and further roadways will be constructed, as well as 1100 homes and other buildings. In the next phase a tidal lagoon will be realised for a yacht harbour and hotel conference centre, together with the already existing passenger-ship connection to the U.K.

Figure 8. The groynes at Delfland Water Board: Basalt groynes were built perpendicular to the coast to prevent the natural transport of sand along the coast. However, they have a negative impact because they initiate rip tides which transport sand away from the beach. Sand plumes result and literally and figuratively the coast is hollowed out.

between the extended southern harbour mole of Scheveningen and the adapted existing northern harbour mole of Hoek van Holland.

The plan includes a primary range of dunes with a new beach in front, parallel to the new coastline, and secondary ranges of dunes at an angle to the coast, as it were, extensions of historical dune ridges which can still be recognised in the basic street pattern of The Hague.

These secondary dune ranges are not only of interest for reasons of history and landscape, but they also offer the opportunity to create the plan in phases, segment after segment. For this trailer suction hopper dredgers are used to start the construction of the land reclamation from the existing land going in a seaward direction. In addition and in concert, phasing is possible through the three-coastline concept. The essence of this is to establish first of all the primary range of dunes with the new beach in front and behind it while maintaining the existing beach. The new dune territory is sown in and planted with marram grass (amophila arenaria) and pioneer plants. After nature has taken root, the old coast can be connected to the new coast wherever desirable. The new dune territory can therefore be established from existing land to sea or the reverse, while combinations are also possible. The choice depends on the local situation and the future functions of the area. Special attention is needed for properly linking the soft *Building with Nature* solution to the hard solid seawall elements, which means the linkage of the soft dune / beach arch to the existing/ extended or adapted harbour moles of Scheveningen and Hoek van Holland (Figures 6 and 7).

Maintenance of this new Delfland coast is provided for through periodical beach nourishment. Groynes are no longer necessary (Figure 8).

Because of the newly acquired land including the new primary range of dunes, a much safer situation with regard to the sea is created, while at the same time a much larger fresh water lens is realised under the wider dune area. This again improves the protection of the low-lying Westland district with its large greenhouse area and important horticultural activities against salty seawater intrusion.

Considering the cross section of the present land, going from the existing hinterland in the direction of the North Sea we come across polders, ditches and canals – partly below and partly above sea level – present sea-defence dune and present beach and seabed. In this cross section the newly acquired land is superimposed on the old land and consists of the new dune territory with secondary dune and primary dune, the new beach and the new seabed, up to the point where the new seabed meets the old (toe-line). In other words, the plan continues under water and the slope of the foreshore is also related to the grain size of the sand that is used. This sand is extracted from the seabed in the North Sea, not too close to the coast because that would negatively influence the slope of the foreshore, and not too far away because then the transport costs are too high. The so-called coastal foundation up to the 20 m – MSL line, is kept intact. Consequently, the required sand is extracted mainly from the North Sea seabed outside the 20 m – MSL line and also from widening and deepening the Euro-Maas Channel.

Plan 1 fulfils an important role in the coastal defence of the Delfland coast. This coast has several dangerously weak coastal stretches, where the dune range is too narrow. The new primary sea-defence dune complies with the strictest standards of height and width and is taking into account further sea level rise. Furthermore the total dune area is considerably enlarged, leading to a further increase in safety.

The height – with a certain width – of the new primary dune is approximately 14 m + MSL and complies with the new Delta standard. The ongoing sea level rise in the future is taken into account. It is not allowed to build on the new primary sea-defence dune for reasons of safety and nature. An important advantage of this is that – in case of continued sea level rise – this dune can be widened and heightened without destruction of capital. The inner area between the present dune and the new primary range of dune has an average height of 4 m + MSL, but varies from around 5 m + MSL to 0 m MSL; the water level of the water surfaces within the newly acquired land is around sea level and depends on the location and type of the water volumes (fresh water lake, tidal lagoon, waterway, et cetera). The groundwater level in the newly acquired area is related to the surface level. Rain falling in the area percolates through the sand resulting in a gradual formation of a fresh water lens, which in due time will be an instrument in fighting salt water intrusion into the Westland District. In addition, it is possible to regulate the groundwater level in certain

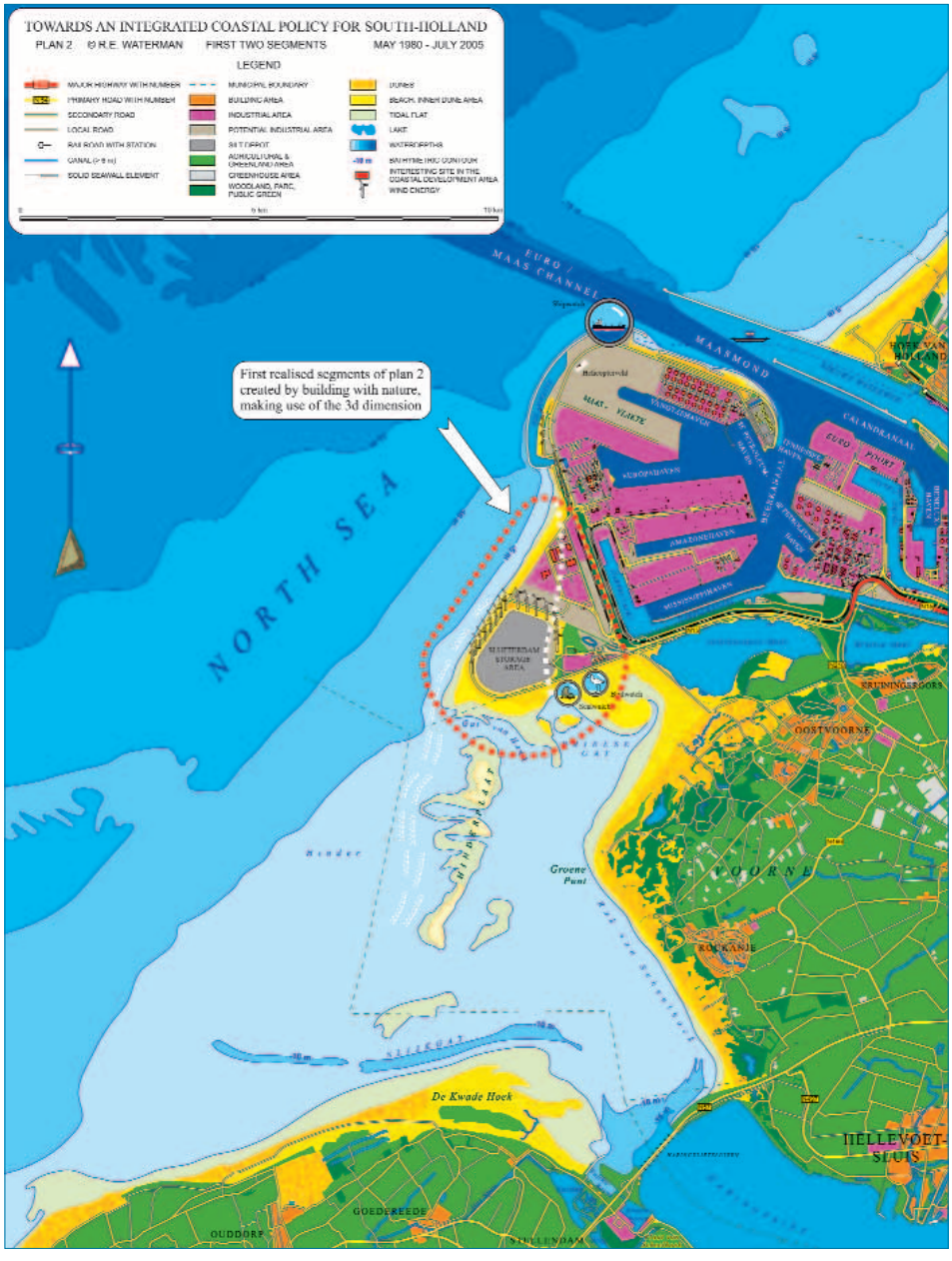


Figure 9. Plan 2, with segments 1 and 2 realized.
© *Ronald Waterman.*

areas – both in the old and in new land – through the creation of waterways and through pumping. The total volume of required sand will be approximately 360 million cubic metres, which is transported by trailing suction hopper dredgers.

Plan 2

Plan 2 is a multi-functional peninsula attached to the Europort-Maasvlakte as an extension of the world-famous Port of Rotterdam (see Figure 4). Its panhandle shape resembles the panhandles of the islands Goeree and Schouwen and its southern axis was purposely designed to run exactly parallel to the coast of Goeree thus conforming to the natural coastal system. Originally two earlier designs were made in 1980 and 1982: One with the longitudinal axis parallel to the coast of Voorne and a second plan with a longitudinal axis parallel to the coast of Goeree. Later on in the period 1990-2004, the final Plan 2 was developed incorporating the advantages of the two earlier plans.

In the final Plan 2, the preferred southern longitudinal axis parallel to the coast of Goeree was designed as a demarcation line and as an inter-municipal boundary. This boundary defines on the north side an area designated for port and port-related activities developed in abidance with environmental standards, under the jurisdiction of the municipality of Rotterdam. This includes a container handling area, chemical factories, roll-on-roll-off, bulk storage and distribution area, absolutely environment-friendly storage and processing facilities for all types of waste, including contaminated sediments, pipeline, railway and road systems, cranes, quay walls and harbour basins.

In developing Plan 2, at first consideration was given to creating a new port entrance for this area. This proved not to be necessary as the present entrance is capable of handling 60,000 sea-going vessels per year, while at present only 30,000 are entering and leaving the port. Therefore Plan 2 utilises the existing entrance of the Port of Rotterdam since it is already able to double its present capacity.

To the south, the area is a triptych of newly designed and existing nature reserves under the jurisdiction of the municipality of West Voorne. Directly along the inter-municipal boundary is a new, narrow elongated nature reserve for terrestrial flora and fauna. Adjacent is a developing seascape, De Slufter, which is an excellent mating, breeding and nursery habitat for marine organisms and birdlife. Next to this is an existing valuable nature reserve with over 700 species of higher vegetation, varying from the pioneer vegetation near the shore to the climax vegetation in the wooded inland area.

In both areas, in Rotterdam and West Voorne, provisions have been made for tourism and recreation facilities.

Figure 10. Aerial photo of the finished Slufterdam project. First 2 segments of plan 2a and 2b, entrance of the Port of Rotterdam with the New Waterway and Caland Channel, Europoort / Maasvlakte, Hoek van Holland, Voorne, Primary Dam, Lake Voorne, Sandbar Hinderplaat, Haringvliet Dam with sluices and Goeree.

Figure 11. In the distance at the top of the photograph, the hollow Rhineland coastline – without any solid seawalls – can be seen. This coast has shown slight accretion since 1611. Where the hollow Rhineland coast meets the slightly convex attacked Delfland coast, the range of 68 Delfland Groynes commences. At the constructed Van Dixhoorn Triangle, north of Hoek van Holland 11 of these groynes are buried under sand and they are totally unnecessary.
Below, in front of and west of the motorway A15 the first 2 segments of Plan 2 are visible, with dunes and beach protecting them according to the principle of *Building with Nature*.

Plan 2 started with the creation of the first two segments (see Figures 9 and 10). Sand needed for the realisation of these two segments was obtained by widening and deepening the Euro-Maas Channel and through internal dredging of 35 million m^3 within the second segment by the creation of a storage basin with an internal depth of 28 m – MSL and a surrounding dune with a height of 24 m + MSL. The storage basin within the Slufterdam has an internal storage capacity of 90 million m^3 for contaminated sediments (Figure 11).

The second segment was created from May 1986 to September 1987. Using the method of *Building with Nature*, a dune-beach perimeter as a natural sea defence was created, as was segment 1 earlier.

The third segment within Plan 2 will be the so-called Rhine Plain or Second Maasvlakte. This segment covers 2000 ha (1000 ha land area & 1000 ha harbour basin area) and requires approximately 400 million m^3 sand, which is transported by trailing suction hopper dredgers (Figure 12).

A fourth segment is already being considered (Figure 13). Figure 14 (see pages 18-19) shows an artist's rendering of the whole Plan 2 with terrestrial and marine nature reserve area West Voorne.

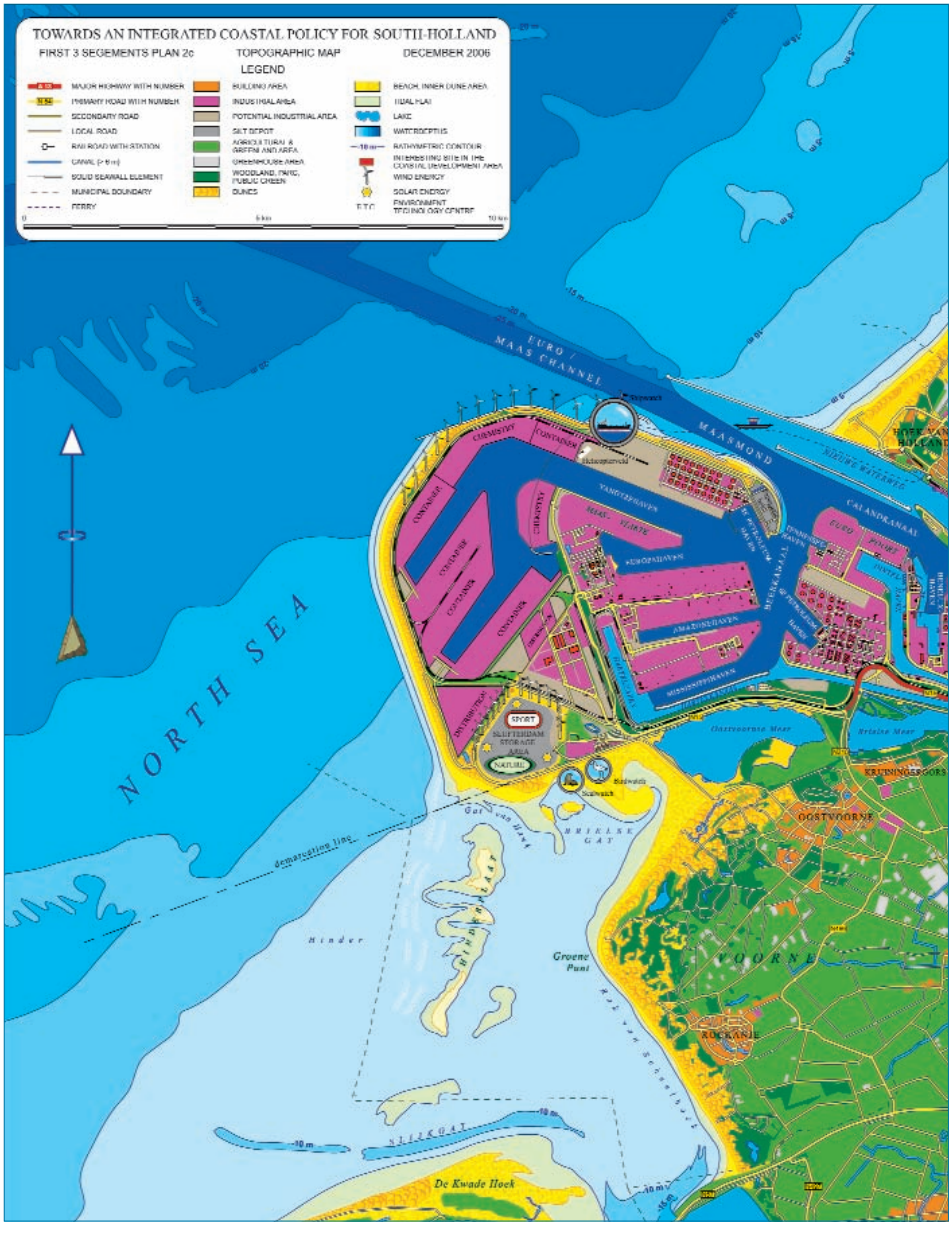


Figure 12. Plan 2, Segments 1, 2 and 3.

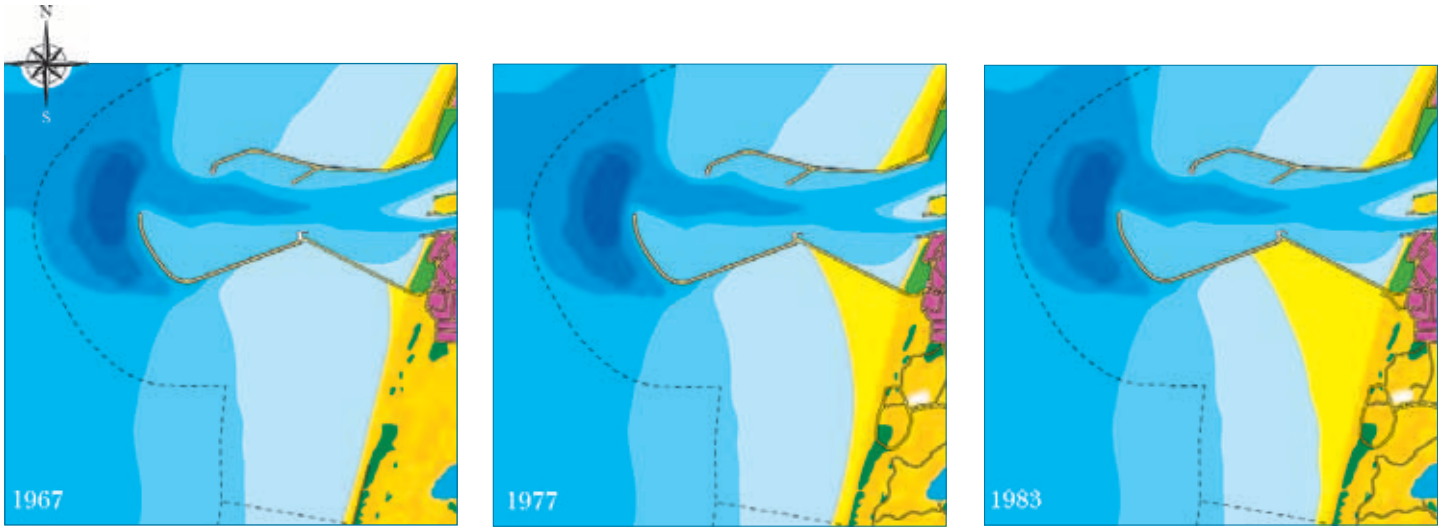


Figure 15. Seaport Marina IJmuiden / Kennemer Beach, Plan 3a. Nature already developed a new area south of the existing southern harbour mole of IJmuiden, owing to littoral sand transport in a northern direction along the coast from the Province of South Holland to the Province of North Holland. The process was quickened by human induced action – dredging external and internal waters. © *Ronald Waterman.*

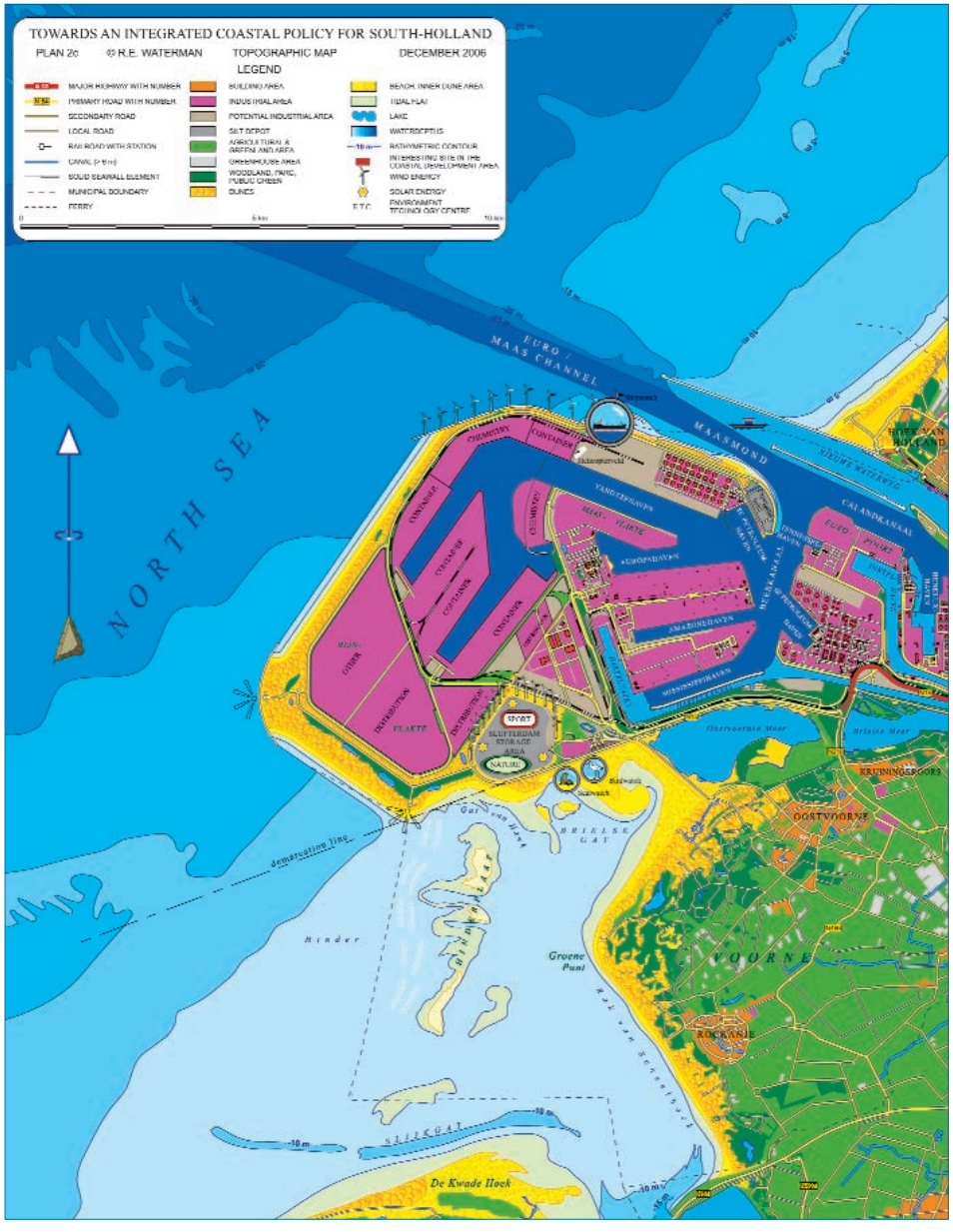


Figure 14. (Following on pages 18-19). Artist's rendering of Plan 2, the terrestrial and marine nature reserve area West Voorne, with birdlife, wildlife and fauna.

Figure 13. Plan 2, Segments 1, 2, 3 and 4. © *Ronald Waterman.*

Plan 3

Plan 3 is a multifunctional land reclamation in IJmuiden, on both sides of the entrance channel of the Port of Amsterdam, situated in the angle between the extended southern harbour mole of IJmuiden and the coast south of it (Plan 3a), and situated in the angle between the extended northern harbour mole of IJmuiden and the coast north of it (Plan 3b) (Figures 15, 16 and 17).

Plan 3a has been completely realised and shows a perfect combination of *Building through Nature* and *Building with Nature*. It was primarily caused by a long shore net sand transport in northern direction. This sand was blocked and caught by the extended southern harbour mole of IJmuiden. In this way the plan started to come into being and *Building through Nature* found its expression. This process

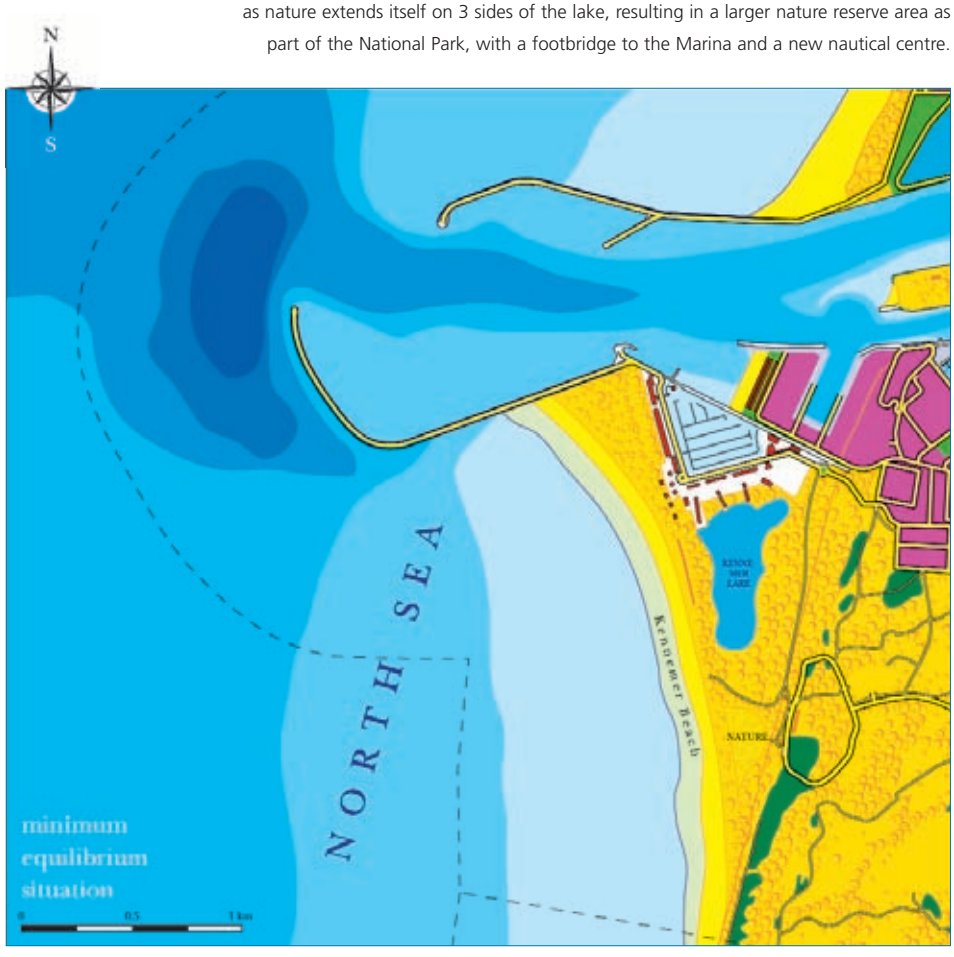
Figure 16. Birds' eye view of Plan 3a at IJmuiden / Kennemer Beach.

was quickened by the actions of people by using special dredging equipment and then in a later stage people completely took over and started to construct a marina, a double boulevard, a nautical centre, apartments, restaurants & shops, hotel capacity and an artificial lake.

In addition, following the methods of *Building with Nature,* conditions were created for the establishment of a new nature reserve area linked to an existing nature reserve area. After these conditions were created, *Building through Nature* once again took over.

At the inner side of the old southern harbour mole was projected a third harbour for IJmuiden with port related activities and a new perched beach with two rows of beach recreation dwellings. Plan 3a which started in 1983 has now been fully realised (Figures 16 and 17).

Figure 17. Seaport Marina IJmuiden / Kennemer Beach, Plan 3a. Continuing developments as nature extends itself on 3 sides of the lake, resulting in a larger nature reserve area as part of the National Park, with a footbridge to the Marina and a new nautical centre.



CONCLUSIONS: PLANS 1, 2 AND 3

It is interesting that all plans 1, 2 and 3 were created using the method of *Building with Nature*. They all have a dune-beach outer perimeter as coastal defence. They all include one or more nature reserves. They all have economic functions in harmony with the nature reserves, realised by carefully considered zoning and overall spatial planning.

And they all encompass a flexible master plan that was implemented in stages, segment after segment. Instead of using solid seawall elements as bulwarks against the sea, these dunes and beaches are realised in harmony with the sea, with a minimum of solid seawall elements and a low maintenance factor by beach nourishment.

Building with Nature leads to sustainability in harmony with the natural environment and has the advantages of an inherent flexibility, adaptability and cost effectiveness.

IV. COASTAL ZONE DEVELOPMENT WORLDWIDE

As previously mentioned, approximately 80 percent of the largest population centres in the world are situated along coasts and in deltas with limited space available for living, working, tourism & recreation, for infra-structure and coastal defence. Therefore, it is not surprising that forms of land reclamation can be found in the direct vicinity of these population centres all over the world. Remarkable examples are present on nearly all continents, in Europe as well as in Asia, in Africa and America, and even in Australia with its very thinly

populated hinterland. There is such an abundance of examples, that only a select few can receive attention here.

More and more the focus is on well-balanced combinations of spatial functions, in which values related to environment, nature and landscape play an increasingly important role, and rightly so. Furthermore, the importance of attractive new, extended and improved waterfronts comes prominently to the fore.

With regard to the creation of coastal extensions, one can observe a gradual shift from pure land reclamation by integrating land in sea, towards a two-way process in which land is integrated in water and conversely water in the existing and newly acquired land.

With regard to safety, here too the emphasis is no longer on the application of bulwarks against the sea in the form of solid seawall elements, but instead the emphasis is directed towards the creation of a flexible, dynamic, equilibrium coast consisting of dunes and beaches in harmony with the sea. Insofar as solid seawall elements are being applied, they are designed in such a way that they form an attractive substratum and habitat for marine organisms.

Environment-friendly dredging techniques are increasingly used. Integrated water resources management is introduced, including special attention to gradients from salt water to brackish and fresh water.

The importance of the development of both new terrestrial and marine nature reserve areas, in which net environmental gain is achieved, is being recognised and applied. In short, to some degree, both the concepts – *Integrated Coastal Policy* and *Building with Nature* – are gaining increasing acceptance worldwide.

In the following pages, a few examples of coastal extensions and waterfront developments in various parts of the world are presented in which these principles are beginning to be applied.

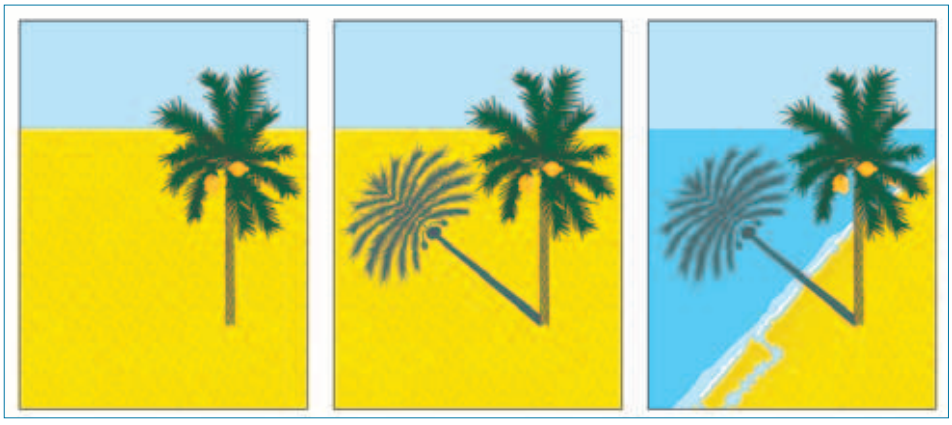


Figure 18. Overview Date Tree and its Shadow, the inspiration for the Palm Islands, Dubai.

ARTIFICIAL ISLANDS: DUBAI, UNITED ARAB EMIRATES

The design and execution of a series of spectacular artificial islands in front of the coast of Dubai, based on the vision of H.H. General Sheikh Mohammed bin Rashid al Maktoum, Crown Prince of Dubai and UAE Defence Minister has marked a major achievement in the beginning of the 21st century.

Palm Island Jumeirah

The Palm Island Jumeirah can be considered as one of the most spectacular example of land reclamation in the world. It was inspired by nature through the vision of a date palm tree projected in the sea and linked to the coast. The date palm tree is a symbol for valuable food production and for other life-giving essentials in the emirate of Dubai, where the desert meets the sea (Figure 18).

The Palm Island is connected by a causeway and bridge to the original coast. The trunk of the palm tree is 2 km long and 450 m wide and contains a stately palm lined motor parkway, a central 50 m wide canal, a pedestrian promenade, a high quality hotel and a theme park with ponds and lagoons. There are also shopping arcades with exclusive shops and boutiques, art galleries, restaurants, a gourmet supermarket, a panoramic tower with a rotating top restaurant, as well as utilities for energy and fresh water supply, ICT provisions, sewer system and waste-water purification units (Figure 19).

There are 17 palm-leaf-shaped peninsulas, each with a central access road flanked by architecturally designed villas with private beaches, swimming pools and docking facilities. The length of the beaches around the palm leaves along the 1,000 single-family villas adds to a total 60 km of coastline, whereas the width of the original coast leading to the causeway of the island is less than 80 m.

A crescent-shaped barrier reef 13 km in length, acts as a protection for the Palm Island by creating a relatively calm sea around the island. The cross-section of the crescent is specially designed in width and height with an outside armouring by rocks to ensure stability and to minimise overtopping of waves. In the 200 m wide crescent, there are two openings of 100 m each to ensure water quality by adequate water flow around the Palm Island and to ensure waterway access.

The inner side of the crescent consists of sandy beaches. On the crescent there are 10-15 theme resort hotels, a spa and health facilities. In the vicinity of the crescent, artificial coral reefs are provided, including shipwrecks, plane wrecks and replicas of archaeological objects. This series of artificial coral reefs were specifically designed by marine biologists. A special diving centre was built with provisions for diving activities, from which these reefs and marine organisms can be observed and studied.

There is a Central Marina Village with two marinas, one on each side of the trunk,

GEWONE ES
FRAXINUS EXCELSIOR

GRAUWE ELS
ALNUS INCANA

RUWE BERK
BETULA PENDULA

GEWONE VLIER
SAMBUCUS NIGRA

DUINDOORN
HIPPOPHAE RHAMNOIDES

DUINROOS
ROSA PIMPINELLIFOLIA

BLAUWE ZEEDISTEL
ERYNGIUM MARITIMUM

KRUIPWILG
SALIX REPENS

PARNASSIA
PARNASSIA PALUSTRIS

TERRESTRISCHE ORGANISME

HELM
AMMOPHILA ARENARIA

BIESTARWE-GRAS
ELYMUS FARCTUS

ONTE
PER
LPINA

ZEEKRAAL
SALICORNIA EUROPAEA

ZEERAKET
CAKILE MARITIMA

WADPIER
ARENICOLA MARINA

KOKKEL
CERASTODERMA EDULE

EEDUIZENDPOOT
EREIS DIVERSICOLOR

EL MET
OKKEN
S EDULIS

SINT JAKOBSVLINDER EN RUPS OP JAKOBSKRUISKRUID
TYRIA JACOBAEAE, SENICIO JACOBAEA DUNENSIS

JULIKEVER
POLYPHYLLA FULLO

ZANDHAGEDIS
LACERTA AGILIS

FYTOPLANKTON

CM
0
5
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WULP
NUMENIUS ARQUATA

ROSSE GRUTTO
LIMOSA LAPPONICA

SCHOLEKSTER
HAEMATOPUS OSTRALEGUS

TUREluur
TRINGA TOTANUS

BONTE STRANDLOPER
CALIDRIS ALPINA

KLUUT
RECURVIROSTRA AVOSETTA

WADSLAKJE
HYDROBIA SPEC.

SLIJKGARNAAL
COROPHIUM VOLUTATOR

KOKKEL
CERASTODERMA EDULE

STRANDKRAB
CARCINUS MAENAS

NONNETJE
MACOMA BALTHICA

ZEEDUIZENDPOOT
NEREIS DIVERSICOLOR

STRANDGAPER
MYA ARENARIA

PLATTE SLIJKGAPER
SCROBICULARIA PLANA

WADPIER
ARENICOLA MARINA

Figure 19. Palm Island Jumeirah can be considered as one of the most spectacular examples of land reclamation in the world.

symbolising the clusters of dates in the palm tree. In addition, two islands on each side of the base of the trunk were created in the shape of the logo of the developing company and its mirror image. One of the 14 ha private islands is equipped with berths and facilities for a large-scale yacht. The Sheik's own yacht measures 160 m in length; quay length is 200 m.

The construction of the palm leaves was executed using the method of *Building with Nature*. The total surface area of Palm Island Jumeirah is 650 ha.
The amount of sand needed to create this project was 110 million m^3 and was obtained from the seabed by trailing suction hopper dredgers. To realise the berm breakwater along the outer side of the crescent, 9 million tonnes of rocky material were used. This rocky material was obtained from 16 quarries in the hinterland. Construction started October 2001 and was completed in 2003.

Preceding this ambitious project was the design and construction of a small delta-shaped island connected by a bridge with the mainland. On this island the very luxurious seven-star 321 m high Burj al-Arab Hotel was built. The shape of this landmark hotel was inspired by a billowing sail of an Arab dhow (Figure 19).

Palm Island Jebel Ali

After the first Palm Island Jumeirah, a second, 50 percent larger Palm Island Jebel Ali was designed. This island is situated at a distance of 22 km from the first island, and like the first island is connected to the coast. Similar to the Palm Jumeirah, the shape of this second island is also based on a palm tree with a trunk, 17 palm leaves and a 15.5 km long outer crescent also acting as a protective breakwater (Figure 20). A Sea Village will feature on the trunk, which measures 2.4 km in length and 450 m in width, with hotels, apartments, shops, restaurants, marinas and a sea aquarium.

The Palm Island Jebel Ali has an inner crescent with attached shapes in the form of Arab characters, which together compose the verse of an Arabic poem, which translates as

"Take wisdom from wise people –
Not everyone who rides a horse is a jockey.
Great men rise to great challenges.
It takes a man of vision to write on water".

On top of these Arab characters, 1,060 Water Homes are built on concrete stilts with wooden structures on top. Each of these Water Homes has attractive waterfronts. The depth of the water below the homes is approximately 8 to 10 m, and each home covers a built up area of 360 m^2. Each Water Home has boardwalk access to a common parking area and private moorings for personal yachts. In addition, the outer crescent can accommodate a series of functions for recreation and living. Another modification in comparison to the first palm island, are the "fingers" on both ends of the Palm Island Jebel Ali outer crescent

Figure 20. The second Palm Island, Jebel Ali, is 50 percent larger than Palm Island Jumeirah (which is 650 ha).

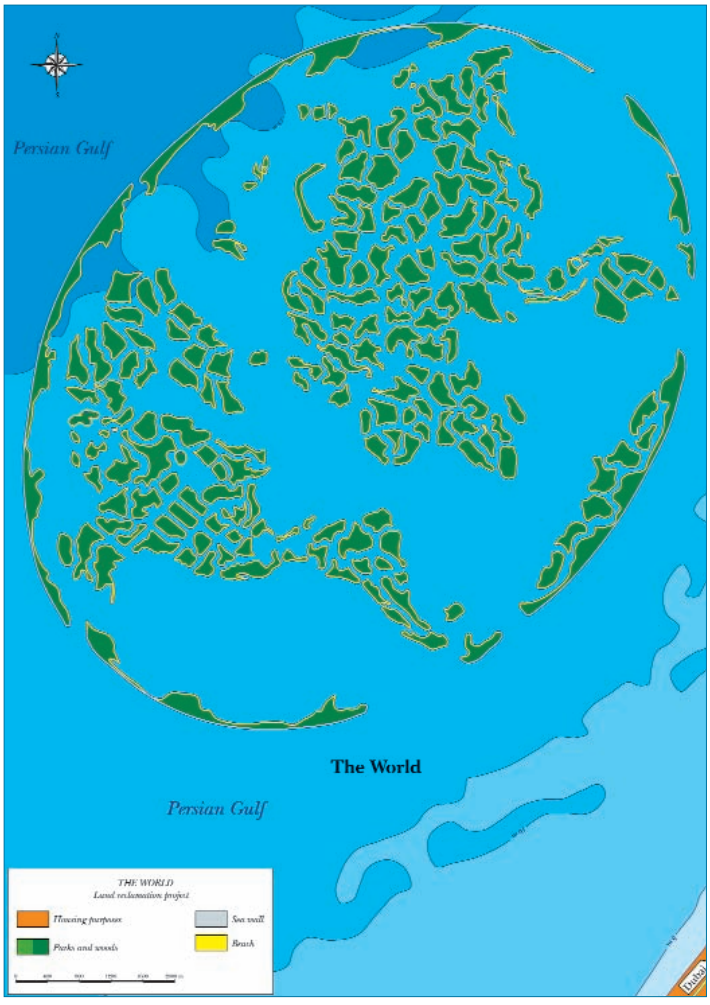


Figure 21. Another extensive artificial island project, "The World".

where luxury apartment blocks will be located. In total, there will be approximately 2,000 Signature Villas, Garden Homes and Town Homes together with luxury apartment buildings in addition to the aforementioned Water Homes.

The island will be 7.5 km in width and 7 km in length. The Palm Island Jebel Ali will be connected to the mainland via three bridges, one linking the trunk and one at either side leading to the end of the crescents.

After years of designing and planning, the construction of each Palm Island takes approximately two years to raise the island from the sea and another three years to complete the infrastructure and the buildings.

The project started in 2002, completion is expected in 2007. For the realisation 140 million m^3 sand is needed and many millions m^3 of rocky material for the construction of the berm breakwater at the outer side of the crescent. This berm breakwater acts also as a substrate and has niches which are both attractive for marine organisms and birdlife.

The World

Another artificial island project "The World" is designed in the shape of an ellipse of 6 by 9 km and is situated at a depth of 15 to 20 m – MSL (Figure 21).

"The World" is located at a distance of approximately 5 km from the coast. Access to each island will be by marine transport, since there will be no road access.

"The World" has a protective outer breakwater of 25 km – the longest breakwater ever built – with on the inner side approximately 300 islands. Together these give a visual representation of the six continents of the world. The surface area of these islands within the Island Archipelago varies from circa 2.5 to 8.5 ha. The distance between the individual islands varies from 50 to 100 m. The islands are divided into four categories, for private homes, for estates, for so-called dream resorts, and for communal use. In itself it is an attractive thought that it is possible to sail around "The World" in three hours. For the creation of "The World" 325 million m^3 sand and 32 million tonnes of rocky material are required. The project commenced in 2004 and completion is expected by the end of 2007.

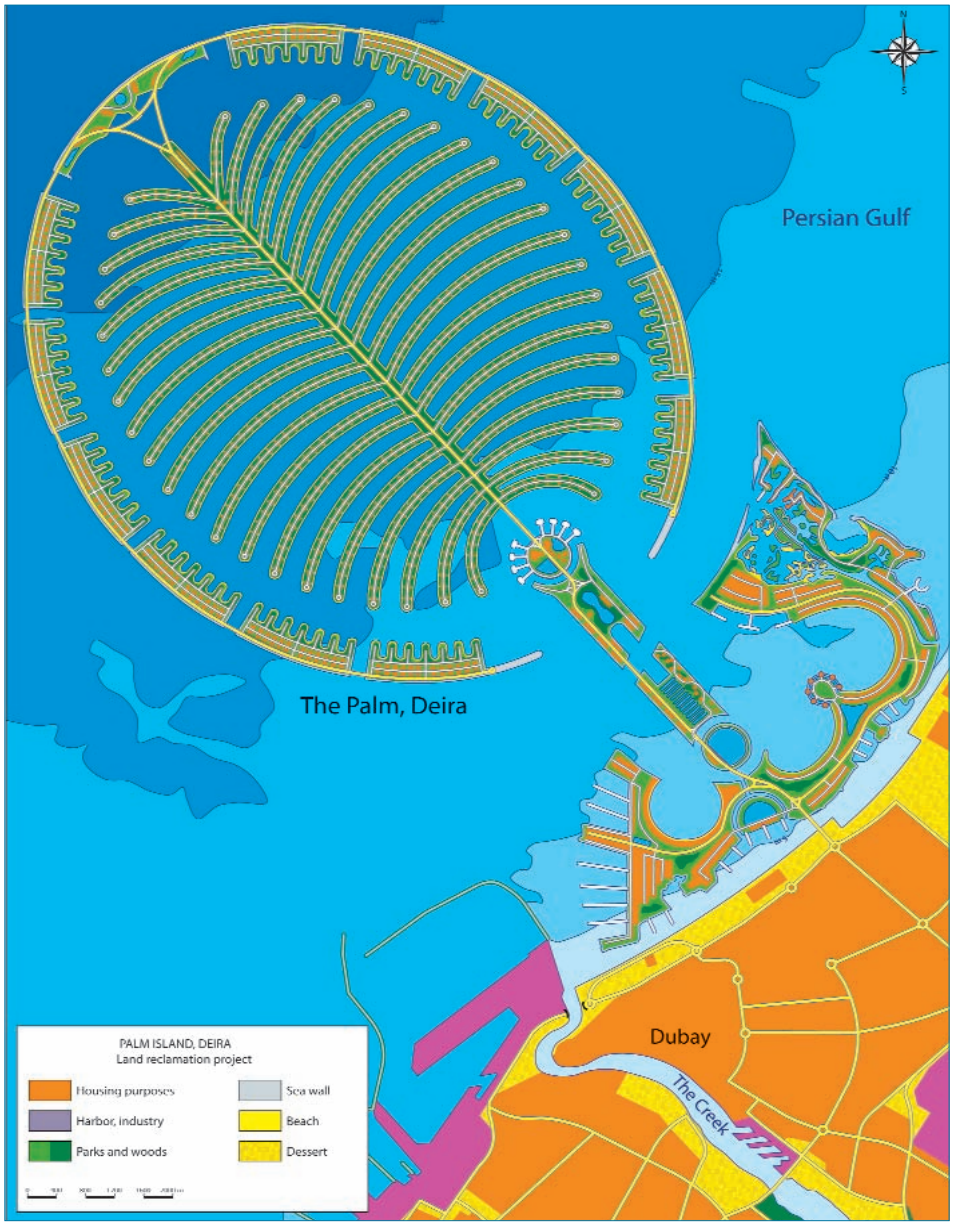


Figure 22. Palm Island Deira, the third Palm Island, exceeds the other preceding islands in size, surface area, coastal length and required amounts of sand and rocky material.

Palm Island Deira

A third Palm Island exceeds the other preceding islands in size, surface area, coastal length and required amounts of sand and rocky material. The design has not been finalized yet, but will likely have 41 palm fronds with central veins in the form of roads, with villas on both sides and private beaches. Again, a protective outer crescent with a length of 21 km in the form of a berm breakwater has been included. The overall length from trunk base to the central tip of the outer crescent is 16.5 km, whereas the overall width is 9 km. The total surface area is around 80 km^2.

In the direct vicinity of the trunk base from left to right the so-called Deira Corniche is under construction (Figure 22).

The construction of Palm Island Deira, together with the Deira Corniche, results in increasing the local coastal length to almost 400 km. The sea depth of the construction area varies from 6 to 22 m – MSL.
The quantities needed for the construction are a staggering 1,300 million m^3 of sand and 42 million tonnes of rock.
The construction of Palm Deira is therefore the largest reclamation project in volume of replaced material ever undertaken.

Palm Island Deira will include facilities for leisure, recreation and tourism, more than 7000 villas, a large number of luxurious hotels, several large marinas, restaurants, shopping malls, art galleries, sports facilities, cinemas, and so on. The crescent is divided into 12 segments to ensure efficient water circulation and to ensure shipping accessibility as well. Each segment contains a number of finger shaped peninsulas in order to lengthen the waterfronts and their beaches. Each frond has at its tip a park for communal use.

A road infrastructure has been provided for, complete with fly-overs, bridges and tunnels, sewer systems, wastewater purification, a storm water drainage system, irrigation, drinking water supply, natural gas supply, telecommunication, electricity supply, cooling water provision, marinas, port facilities, fire fighting systems, safety precaution measures, separate waste collection, recycling & processing, navigation channels, landscape and waterscape architecture and integrated water management. Special attention is paid to parks and greenery.

The vast dredging and construction works have commenced in 2005 and the duration will be around 8 years.

Dubai Waterfront Project

This fifth, ambitious project is located both in the Arabian Gulf and in the mainland of Dubai. It involves integration of land into the sea and of water into the new and the old land. As far as the latter is concerned, a 75 km long canal, the so-called Arabian Canal, will be dug as well as a series of water courses connected to this canal. This will be combined with a number of impressive developments on the existing land and on the new land in the sea, making use of all the newly created waterfronts (Figure 23).

The project comprises a substantial crescent shaped development around the western side of Palm Island Jebel Ali.

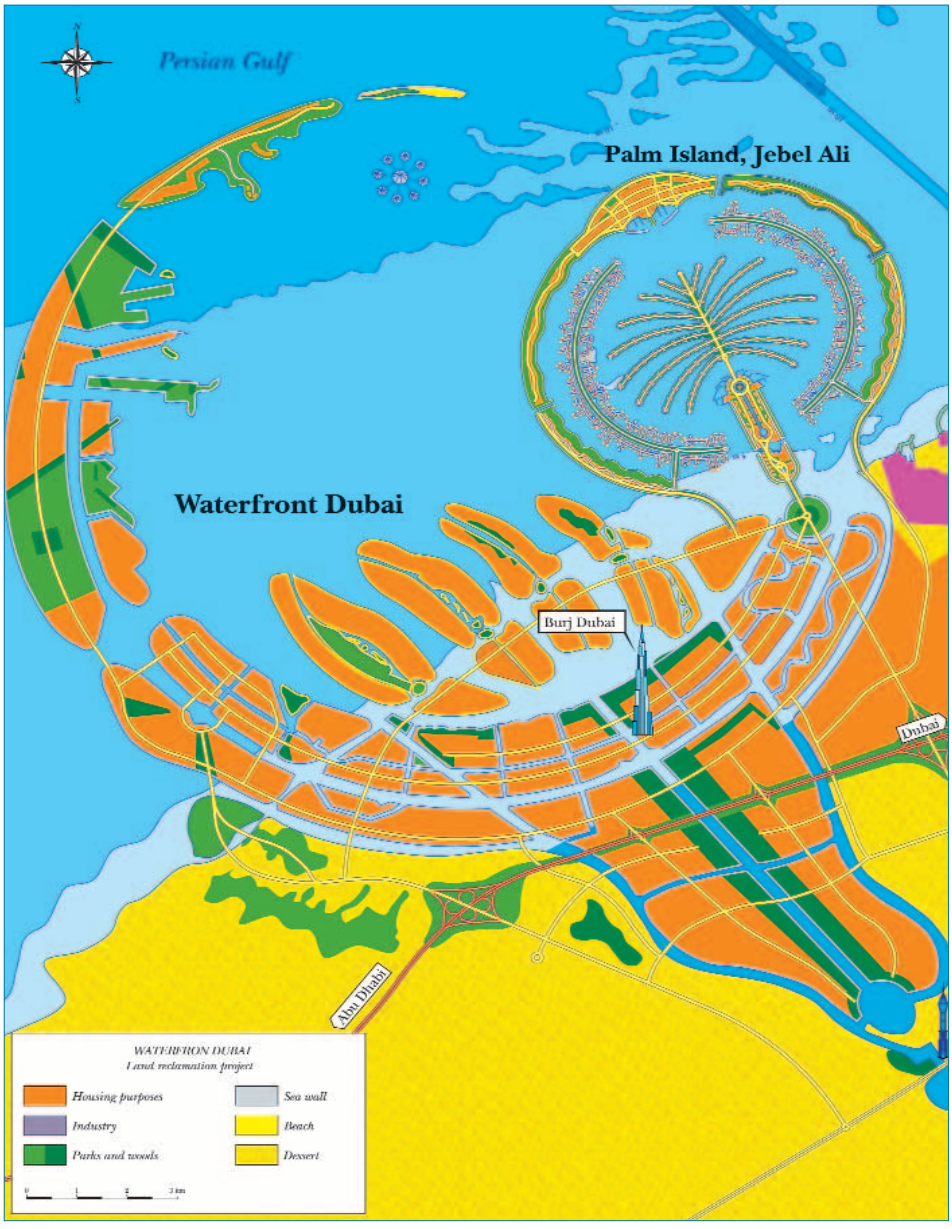


Figure 23. Dubai Waterfront Project, with Burj Dubai, the tallest building in the world in the centre.

The nucleus structure of this development has the shape of a waxing moon (first quarter). This crescent has twelve districts, partly situated in the old land and partly situated in the new land.

They are: Al Ras, Outer Corniche, Inner Corniche, The Riviera, The Promenade, Al Mina, The Peninsula, The Palm Boulevard, Madinat al-Arab, Downtown, Boulevard and The Exchange. In the Madinat al-Arab District the world's tallest skyscraper, the Burj Dubai with a planned height of between 700 and 800 m, is under construction. In the vicinity there are Jumeirah Lake Towers, Jumeirah Islands, The Gardens Shopping Mall, and the existing Jebel Ali Harbour.

The project comprises 8,100 ha of waterfront related area for mixed uses. This includes living and working space for 400,000-750,000 people divided over 250 communities. Realisation of this project will imply lengthening the original coastline by around 800 km. In addition, 5 km^2 of coral reef will also be constructed.

Reflections

The dimensions of the five projects are such that – as the Dubai promotion team points out – they can be observed from the moon. This was also the objective. In this way, Dubai puts itself on the world map literally and figuratively (Figure 24).

The strategic position of the United Arab Emirates, bordering the Arabian/Persian Gulf and the Straits of Hormuz, their enduring merchant spirit, the vicinity of fossil fuels, together enable the UAE, including Dubai, to develop themselves into a very prosperous federation. With modern ports and airports, Dubai has become an important logistics, distribution and trade centre between Europe and Asia.

The fascinating aspect of these developments is that they include both a seaward expansion as well as a land inward development, with special attention to existing and newly created waterfronts. Furthermore, they are not limited to only two dimensions as the concept comprises also a third dimension, upward into the air and downward into the sea. There are manifold examples of this concept. These include the construction of the tallest skyscraper in the world, the realisation of a complete underwater hotel and diving centre, and also the creation of a Snow & Ice Sports Centre in the middle of the desert.

Bear in mind that the original inspiration was taken from nature, that is, an island resembling the shadow of a date palm.

Furthermore, during the execution of the various land reclamations more and more attention was paid to the principles related to *Building with Nature*. This refers to both the methods of dredging and creating the new land as well as to establishing conditions for marine and terrestrial nature development. This also has involved carrying out mitigating and compensation measures there where existing nature has been affected.

Hydraulic engineering construction of the series of islands, Palm Island Jumeirah, Palm Island Jebel Ali, The World, Palm Island Deira and Dubai Waterfront, influences the

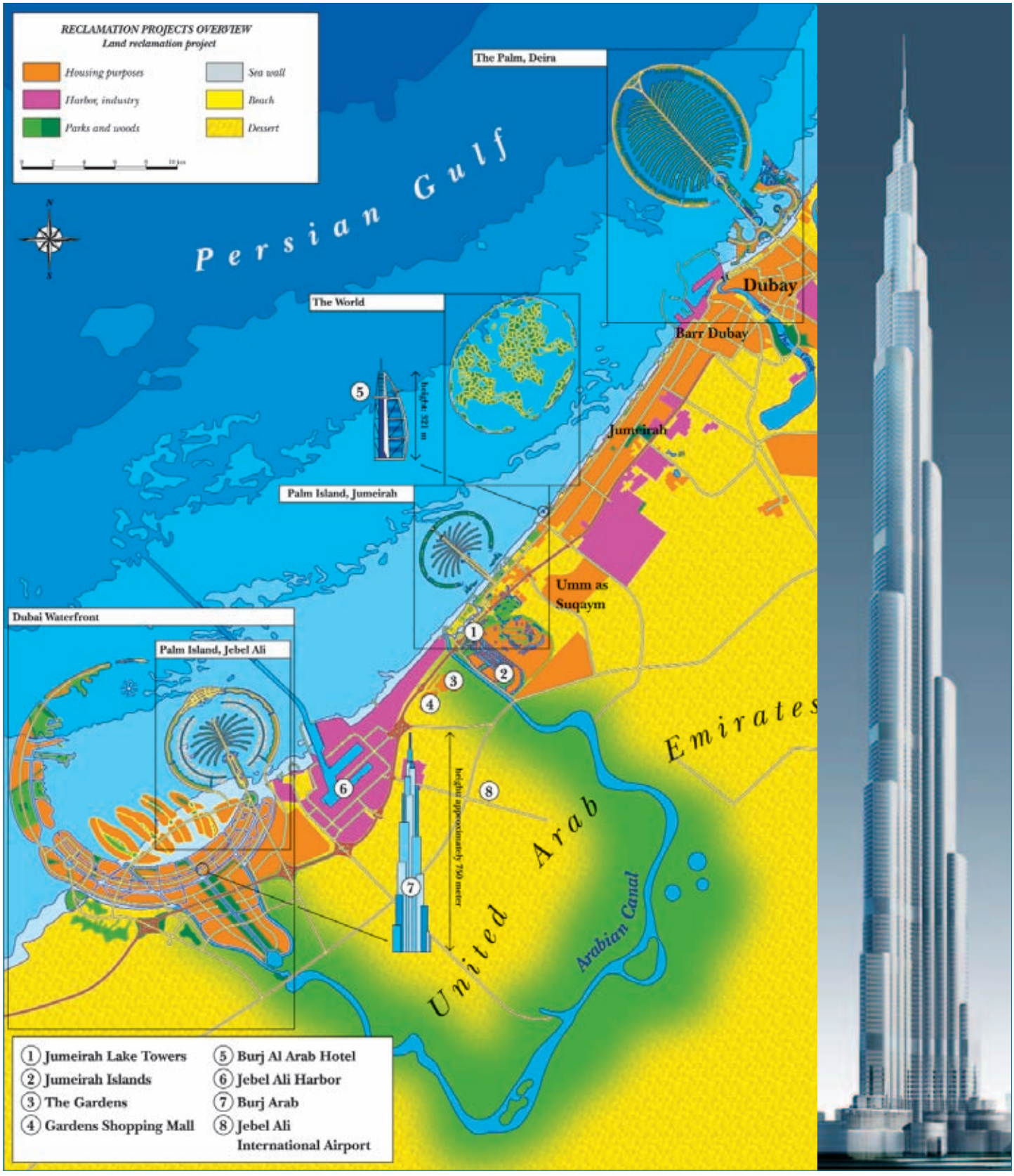


Figure 24. Overview of all the Dubai Land Reclamation Projects. The coast in its totality, including the Arabian Canal.
Right, the world's tallest skyscraper, the Burj Dubai with a planned height of +/- 800 m, is under construction.
The base of the building is in the form of a common desert flower blossom.

wave and flow pattern in the Arabian/Persian Gulf. The beaches in the sphere of influence shall adapt themselves causing local erosion and accretion. These influences will be considered before the execution of these projects through model studies. The results are being used for the Total Development Plan of the coastal zone, including all the afore-mentioned islands. This has led to adaptation of the detailed designs of these islands.

As mentioned before, attention has been paid to the marine environment, including the realisation of artificial reefs and the creation in general of favourable conditions for marine organisms and birdlife. Marine biologists and other specialists were and are involved in this process. Experience gained in earlier projects has been used. Although execution of the aforementioned projects has led to initial disturbance of the environment, provisions are made for net environmental gain in due time. Of the utmost importance are not only the implementation of environment-friendly dredging methods and the thoughtful designed construction of breakwaters, but also the ensuing careful urban development, landscaping, water-scaping and the final operation and maintenance of the newly created territories.

Similar spectacular coastal zone developments can also be found in other parts of the Arabian Peninsula along the coasts of the other Emirates, Saudi Arabia, Qatar, Bahrain and Oman.

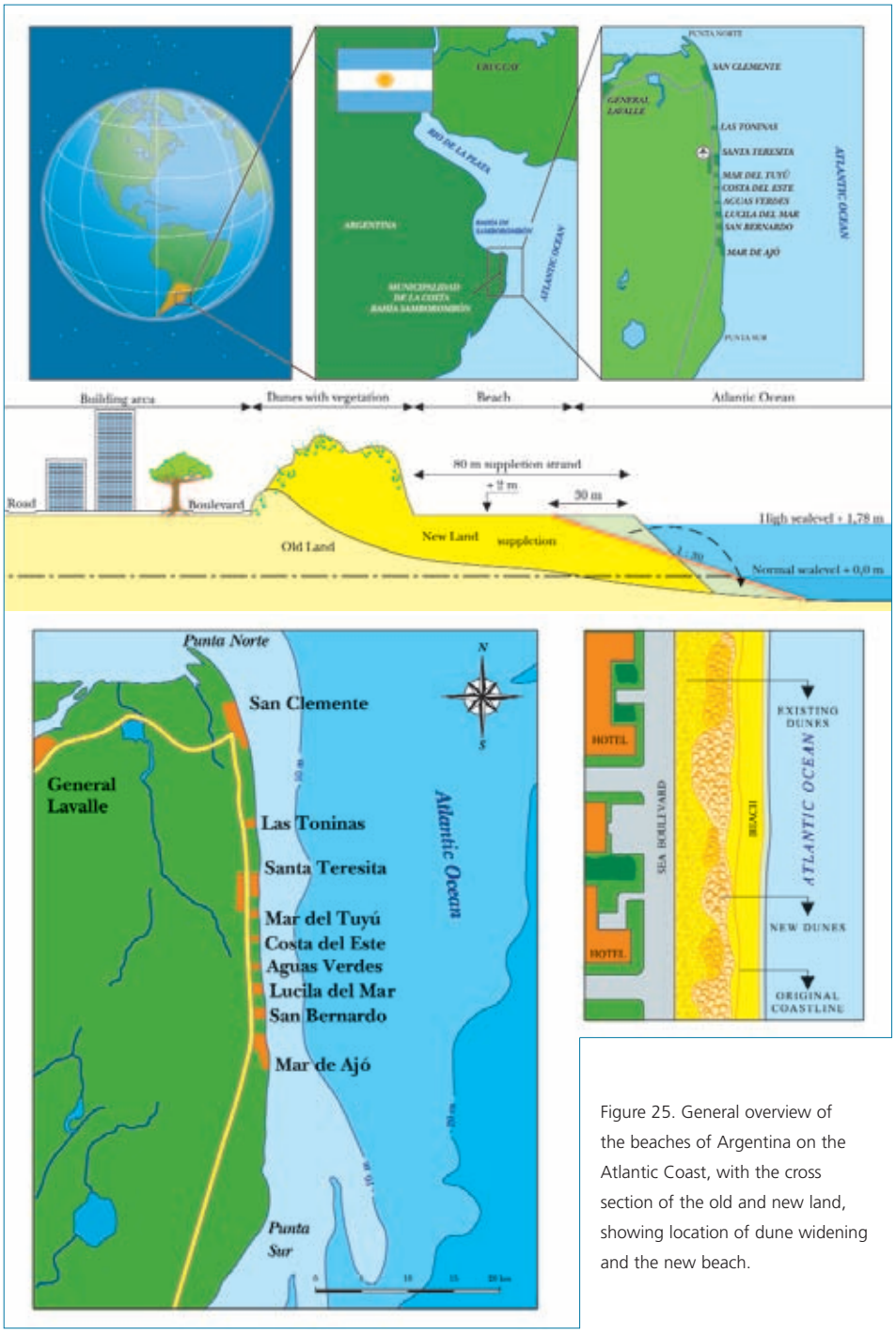


Figure 25. General overview of the beaches of Argentina on the Atlantic Coast, with the cross section of the old and new land, showing location of dune widening and the new beach.

MUNICIPALIDAD DE LA COSTA, ARGENTINA

República Argentina covers 2,780,000 km^2 and is thereby the eighth largest country in the world. It has a coastline of almost 5,000 km along the Rio de la Plata and the Atlantic Ocean. Its capital Buenos Aires has approximately 12 million inhabitants and is situated at the Rio de la Plata, whereas the total number of inhabitants of the country is over 40 million (2007).

The most spectacular land reclamation plan Aeroisla concerns an artificial island in the Rio de la Plata with an airport complete with other functions. In the future, a bridge and tunnel connection between Buenos Aires and Colonia del Sacramento (Uruguay) is considered. At this time however, these very ambitious plans are far from being realised.

Expansion step-by-step of the most important harbours is taking place, coupled with dredging wherever necessary for the approach channels and harbour basins. Applying the principle of "making work with work" coupling dredging with land reclamation plays a role in this process. Attention should be given to the coastal stretch south of the Bahia de Somborombón from Punta Rasa to Punta Médanos. In this coastal stretch of 65 km facing the full expanse of the Atlantic Ocean are the Municipalidad de la Costa consisting

Figure 26. Map of the plan of Curaçao Sea Aquarium land reclamation project, with insert of rock boulder profiles.

of San Clemente del Tuyú, Las Toninas, Santa Teresita, Mar del Tuyú, Costa del Este, Aguas Verdes, La Lucila del Mar, San Bernardo and Mar de Ajó.

This coastal stretch has a very important function for tourism & recreation, especially for the population of the greater metropolitan area of Buenos Aires. There are many hotels, restaurants and their facilities along a seaside boulevard, which was originally protected by a primary range of dunes, with a beach in front. However, over a stretch of 25 km, comprising all the Municipalidad de la Costa, with the exception of San Clemente del Tuyú, a terrible mistake was made by levelling in parts the primary range of dunes and building hotels and seaside pavilions in the original primary range of dunes, resulting in severe coastal erosion. The results were indeed dramatic, as hotels collapsed and the seaside boulevard was attacked.

Incorrect advice led to the construction of solid seawall elements, which only aggravated the problem. Reflected waves caused scouring. The concrete walls were undermined, broke and caused havoc.

Having carefully studied the problem, the ideal solution is to recreate a primary range of dunes with a new beach in front by supplying sand from the seabed using trailer suction hopper dredgers. In this way, a resilient coast is created, whereby the primary range of dunes must be restored and maintained without building any artificial structure on it and in it (Figure 25).

CURAÇAO – THE CARIBBEAN

Curaçao, Aruba, Bonaire, St. Eustatius, St. Maarten and Saba belong to the Lesser Antilles and are situated in the Caribbean. Curaçao, like Aruba and Bonaire, is located off the coast of Venezuela at a distance of approximately 70 km. Curacao has a surface area of 444 km^2 and has a population of 150,000. The length of the island is 61 km and its width varies from 5 to 14 km.

The total coastal length is around 200 km. The island has an interesting geological history that finds its expression in the landscape and in the morphology of the coast. The capital Willemstad is beautifully positioned along the Saint Anna Bay, with its famous "Pontjesbrug" (Pontoon Bridge), and the larger "Schottegat" (Bay). The old, partially restored city with Fort Amsterdam, Water Fort and Rif Fort, has been declared a World Heritage Site. The various nature parks, the historic plantations with their mansions, the manifold tourist attractions along the varied coast, the previously mentioned beautiful bay with its numerous shipping activities, other port-related activities and the still active oil refinery complex, are all worth mentioning.

The focus here is on a special coastal zone development project in which land into sea and water into the old and into the new land are integrated. The principle of *Building with Nature* and *Integrated Coastal Policy* were both applied in this project.

Figure 27. Aerial photo of the area of the Curaçao Sea Aquarium land reclamation project including the Dolphin Academy, hotels and houses.

The project concerns a transformation of a coastal segment on the southwestern side of Curaçao, east of Willemstad with a length of approximately 1 km.
This coastal stretch used to be a severely neglected area with a garbage dump and an adjacent polluted partially swampy area. The cleaning-up and transformation plan was designed by Adrian "Dutch" Schrier and executed for a large part under his own supervision. Advice was given by professor J.F. Agema.

The project is known under the name of Curaçao Sea Aquarium. It comprises parks, artificial beaches, specially designed coast parallel breakwaters, lagoons, a marina, an ocean resort, hotel and condominiums, disco, bar, restaurants, fitness centre, dive shop, a public sea aquarium, a maritime museum and educational centre, gift shop, footpaths and roads and parking facilities. The lagoons encompass a dolphin therapy lagoon, an animal encounter lagoon, a dolphin swim lagoon and a sea lion lagoon (Figures 26 and 27).

Special attention has been paid to well thought-out greenery provisions with regard to the various sections of the project. These greenery provisions fulfil three purposes: to provide an attractive environment for the visitors; to create a modest but attractive habitat for flora and fauna, including birds; and to fixate sand and silt through the root systems of the plants, shrubs and trees.

The project started in 1990. Sixty to eighty thousand cubic metres of limestone boulders were quarried in the hinterland of Curaçao. The construction occurred from the landside using earth and rock moving equipment and trucks.

The construction originally caused a serious disturbance of the environment in the offshore area. However, after several years the coast parallel breakwaters and their niches acted as an attractive substratum for marine organisms, while the coral reefs in front of the artificial reefs were thriving.

The required amount of sand for the artificial beaches was gained from a depth of 45 m – MSL on the northern side of Curaçao by using a trailer suction hopper dredger. This sand was applied in the designated area beyond the newly created coast parallel breakwaters. A series of round trips, each time carrying 6,000 m^3 of sand, were executed until a total of 80,000 m^3 for the new beach was reached. The new beach and the coast parallel breakwaters are separated by a lagoon with inlets and outlets.

The majority of the special saltwater lagoons, including the large lagoon in front of the new beach, were excavated in the old land in order to remove the original sand, silt and peat. This system of lagoons with their inlets and outlets was designed in such a way that ocean currents, waves and wind energy guarantee a constant supply of clean ocean water. An underwater nature reserve park was established, bordering the Curaçao Sea Aquarium with extensions at the lefthand and righthand

Figure 28. The land reclamation created an attractive habitat for birdlife and wildlife including frigate birds, pelicans, flamingos, and turtles.

Figure 29. At the Curacao Sea Aquarium, doing therapy with a handicapped child at the Dolphin Academy.

sides, up to a total length of 20 km and of a certain width in the direction of deeper waters. This protected nature reserve park allows eco-tourism with certain restrictions (Figure 28).

Various trees, shrubs and plants were selected for the greenery provisions with regard to the separate sections of the project. On and in the direct vicinity of the artificial beach, coconut palms were planted because of their ability to thrive in a more or less saline environment. Date palms were also planted at a somewhat larger distance from the beach with their root systems above and partially in the brackish and salt water. To stimulate their growth, expansion granules (Terrasorb / Terracotton) were applied around the base of each palm tree. These granules can absorb water up to a hundred times their own volume and will last up to 10 years. In this way, around 850 coconut palms were planted.

Some of the other plants which were used are the cocoloba unifera and the mangrove type conocarpus erectus, as well as aloe vera and a variety of grasses and other plants and flowers. Drip irrigation and special sprinkler systems are also introduced, partially computer controlled and partially manually operated. Special attention has been paid to the foundations of the various buildings and constructions. A sewer system is installed linked to an existing wastewater purification unit. There are provisions for the drinking water supply as well as for the energy supply.

The Dolphin Therapy for handicapped children and their immediate family is applied with great success. At the moment six inshore bottlenose dolphins (tursiops truncatis) with their current offspring are used for this therapy (Figure 29).

What makes this project so extraordinary is that it is a perfect example of good entrepreneurship based on a clear vision coupled to an understanding and knowledge of sea currents, waves, tidal action, climate and of border zones water-land. Where necessary, this was complemented by additional scientific advice in the field of civil engineering and biological engineering. All together, this has resulted in a remarkable project, which has around 300 personnel, including physicians, therapists and animal specialists.

V. THE SIGNIFICANCE OF WATERFRONTS

In general the discussion here has been limited to a sampling of land reclamations and water-land transformations in the vicinity of densely populated coastal and delta areas. The majority of examples are indeed found in the vicinity of 80 percent of the largest population centres in the world in coastal and delta areas. It follows that 20 percent of population centres are not along coasts or deltas.

Mexico City is the most prominent example. However, Mexico City was once a city in the middle of a lake, connected by dams to the lake shores where satellite towns were located. The original lake fell dry for a large part because of water extraction, causing Mexico City gradually to sink into a basin. Originally, Mexico City had a clear relationship with water. It is fascinating to note that nowadays action is taken to restore, this historic relationship, be it to a limited extent. As far as possible, dilapidated industrial sites are converted into lakes and waterways with parks, recreational and other facilities, complete with cultural-historical elements (Figure 30).

Many other of those 20 percent largest inland-situated cities have a strong historical and present relationship with water, even though they are not located near a coast or in a delta. Take Chicago for instance, with its location along Lake Michigan, or Saint Louis at the confluence of the Missouri and the Mississippi. But also in the case of land-locked cities like Moscow and Berlin, there is a strong relationship with water. Moscow as capital of the Russian Federation is positioned along the locally wide Moskva River.

The other example is Berlin as capital of Germany, with five rivers flowing through it, being Spree, Havel, Panke, Dahme and Wuhle, as well as several canals. Berlin is also situated along 13 lakes, including the Wannsee and the Grosser Müggelsee. Berlin has 60 km^2 open water surface (6.5 percent of the total urban area) with 500 km shore length. These waterfronts are nowadays developed as part of a well

Figure 30. Historical map of Mexico City shows its original location, in a lake which for 80 percent has disappeared. Today the mayor of Mexico City is planning to create waterfronts with four beaches in this land-locked capital city situated on a high plateau. The first beach was opened a few months ago.

Figure 31. The capital of Australia, Canberra, was designed and is built on an artificially created body of water, Lake Burley Griffin.

Figure 32. Venice manifests itself as two interlocking hands, separated by the S-shaped Canal Grande.

thought-out urban planning policy, while waterway connections for transportation of both people and freight receive special attention. The same applies to the establishment of blue-green arteries acting as an ecological network, serving both nature as well as urban beautification.

The significance of waterfronts does not only limit itself to the historically grown large urban areas in coastal or delta positions. Even cities that were not organically developed along existing waterways, coasts or in deltas, but which were artificially created on land without natural waterfronts, artifically-made water surfaces were deliberately created. An example is Canberra, the capital of Australia. When Australia became a federation, Sydney and Melbourne vied to become the capital of Australia. A decision was made to create a new capital city approximately halfway between these two cities. Thus Canberra came into existence, designed from the start along the shores of a central large artificial lake, Lake Burley Griffin (Figure 31).

Another parallel example is Brasilia, the likewise artificially created capital of Brazil. Brasilia is situated in the inland at a distance of 1,000 km from the original capital Rio de Janeiro on a plateau 1,200 m above sea level. Like Canberra, this capital is located around an artificial lake, Lago do Paranoá. Yet another example is the desert town of Las Vegas in the USA, a well-known booming tourist destination.

To enhance the attraction of the town, it has been furnished with many artificial water surfaces and fountains.

From all possible angles, the relationship water-town remains fascinating. Take another two examples, Venice and St. Petersburg. Looking down from the atmosphere, Venice manifests itself as two hands locked and separated from each other by the S-shaped Canal Grande. One hand is connected to the mainland by a long dam. Both hands are situated in the Venice Lagoon. In this Lagoon a number of small islands are located in the vicinity and are also part of Venice (Figure 32).

The Lagoon is separated from the Adriatic Sea by several barrier islands, including Lido. In the opening between these islands, hinged water barriers are constructed in order to protect Venice against flooding. Both hands of this unique city contain a network of secondary canals. The historic city is by its shape, its location and its history a World Heritage Monument in its entirety, while its individual components like bridges and buildings, are monuments in their own right.

St. Petersburg, Russia can in many ways be considered as the vision set in marble, stone and granite of Tsar Peter the Great and his successors, especially Catharine the Great. This city of Tsars, master builders, poets and other inhabitants has risen from the swampy area in the delta of the Neva River.

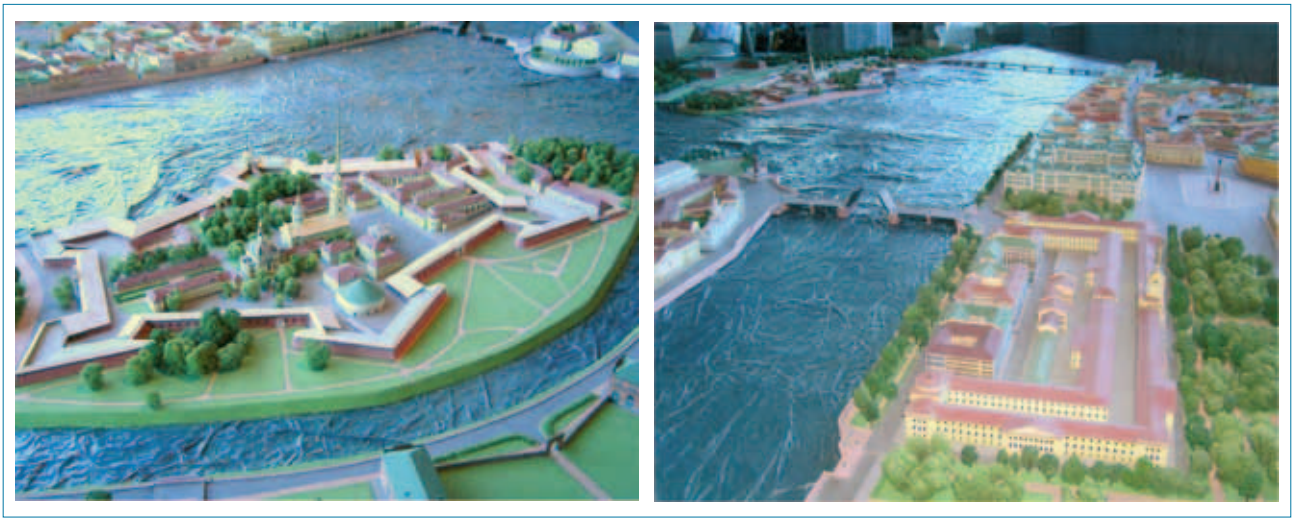


Figure 33. Two models of St. Petersburg, Russia, with its historic waterfronts along the Neva.

Figure 34. Waterfront development in Hong Kong was an important addition to the harbour as well as to the living space in the overcrowded city.

This Neva Delta consists of many islands with a height of 1 to 2 metres above sea level. Partly because of strategic maritime considerations, Tsar Peter the Great decided in 1703 to establish a city in the mouth of the Neva bordering the Gulf of Finland. He decided to create a city of allure as window onto the Western World and as capital of Russia. His Peter and Paul Fortification bordering the Neva was inspired by the Dutch way of building fortifications. From the Admiralty Building the city develops in a radial fashion along a number of straight boulevards intersected by more or less concentric canals with stone embankments. These canals are connected on both ends to the Neva River. The layout is inspired by the city of Amsterdam along the IJ with its concentric canals (Figure 33).

PORTS AND CITIES

The relation between port and city requires special attention. Often city and port do not develop harmoniously in relation to each other. Autonomous development of the city on the one hand and of the port on the other hand, often leads to a back-to-back position. Gradually one realises that an integrated development of port and city is absolutely required, including special attention to waterfronts. After all, there is a dire need for town renovation, for transformation of out-dated industrial estates and out-dated port basins.

New port developments with port related activities as well as urban renewal are simultaneously urgently required in conjunction with each other, to serve a strengthened economy & employment and an improved environment and social climate. To obtain this goal, it is necessary to establish a special authority with public-private partnerships. Thus, ambitious plans can be developed in stages in order to achieve the harmonious development of port and city in tandem. In this process a large number of issues and stakeholders are involved. These issues are:

- New port basins with port related activities to be constructed;
- Urban renewal by demolition followed by attractive housing developments including houses, apartments and their facilities. Reconstruction of out-dated port basins and port estates;
- Facilities for education, sport and playgrounds;
- New and renovated industrial estates for, among others, production industry, transport, distribution and logistics sector;
- Service sector including financial sector, hotel, restaurant and catering sector, ICT and creative sector. All these coupled to a conscientious mixture of living and working;
- Community centres and shopping malls;
- Differentiated housing for all categories;
- Museums and culture-historical elements;
- Landmarks;
- Public utilities, including drinking water, energy, sewer systems, wastewater purification, separate collection, recycling, processing and storage of waste materials;
- Infrastructure including all transport modes;

- Attention to safety, security, law & order, social cohesion;
- Pursuit of environmental quality with regard to the environmental compartments air, water and soil;
- Green-blue arteries, parks, reserves and public gardens;
- Recreational and tourist facilities;
- Organisation of important events as stimulus for developments and to promote the city and its harbour;

In all these combined urban and port developments waterfronts play an e ssential role. These waterfronts provide unique possibilities for living, working, infrastructure and recreation. Prominent examples in Europe of the in harmony development of city-port combinations are:

- London with Docklands;
- Glasgow with Clyde Waterfront & Clyde Gateway;
- Rotterdam with Kop van Zuid and Stadshavens;
- Barcelona with Port Vell, Port Olimpic and Forum 2004;
- Dublin with Dublin Docklands;
- Genoa with Porto Antico;
- Lisbon with Parque das Nações;
- Copenhagen with Sydhavn, Havnstad, Nordhavn, Ørestad;
- Antwerp with 't Eilandje;
- Hamburg with Hafen City;
- Amsterdam with IJ-shores;

Also in the USA, city-port waterfront development has taken place in New York/ New Jersey, Baltimore and Miami to name a few. In the Far East as well Hong Kong is a good example of this principle of harmonious development (Figure 34).

Apart from the relation city-port and in parts overlapping, there is the relation city-river and the relation city-lake. In all these relations, waterfronts are of great importance. Considering the great rivers like Nile (6,695 km), Amazon (6,515 km), Chang Jiang (6,380 km) and Missouri / Mississippi (6,019 km), or intermediate rivers like Saint Lawrence, Parana, Orinoco, Indus, Ganges / Brahmaputra, Mekong, Congo, Euphrates, Volga, Danube, Rhine and Elbe, or relatively short rivers like Thames, Hudson, Seine, Rhone and Loire, and their connected cities with their urban developments, one immediately realises the importance of their waterfronts. That also applies to the cities bordering the Great Lakes and many other lakes elsewhere in the world.

CANALS

Canals fulfil an important role in urban developments as well. Originally canals were often constructed as important waterways for trade, a role they still fulfil as such. In conjunction they are increasingly in use for tourism and recreation, transport of persons and various types of freight, raw materials and waste products, while at the same time they fulfil an important role in urban redevelopment. Not only do canals connect cities but also rivers, lakes and seas, of which there are numerous examples, like Panama Canal, Suez Canal and the Rhine-Main-Danube Canal.

A historic and contemporary example of the former is the Grand Canal in China, which connects the cities of Hangzhou, Suzhou, Shanghai, Yangzhou, Tijanjin and Beijing. With its total length of 1,789 km this is the longest canal in the world.

CONCLUSIONS: AFTERWORD

Looking back over a period of over 25 years and at the same time looking forward, a few observations can be made.
Good plans have their roots in the past and are pointing to the future. Using the achievements of the past, we are able to meet the challenges of the future.

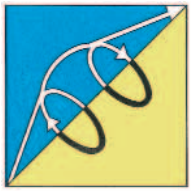
Taking into consideration *Towards an Integrated Coastal Policy* via *Building with Nature* our concern has been, not only with plans – based on relatively simple and clear principles – but also with processes. Each case involves an integrated design, followed by its execution fully based on the environment, using the most advanced, well thought-out techniques, whilst applying the lessons that the environment – including nature – teach us.

It is noteworthy that the overall investments and maintenance costs of the method based on these principles are significantly lower than those of methods that neither use an integrated approach nor use the environment as a basis. Furthermore, the proposed method improves the environment and simultaneously strengthens the economy as well.

Building with Nature, in addition to Conservation of Nature, will become even more significant in the future. It will not only be absolutely necessary for solving existing and future problems but it will also create added value and help regain lost values. The environment – including nature – constitutes the foundation and support for present and future existence.

Over the course of years, the necessity of an *Integrated Coastal Policy* via *Building with Nature* has become more apparent, not only in Europe but also elsewhere in the world. Remarkable, but not surprising, is that in this period of time broad support for these principles at a global level has been gained. The developed concept has proven to be applicable in a large number of countries in coastal and delta areas.

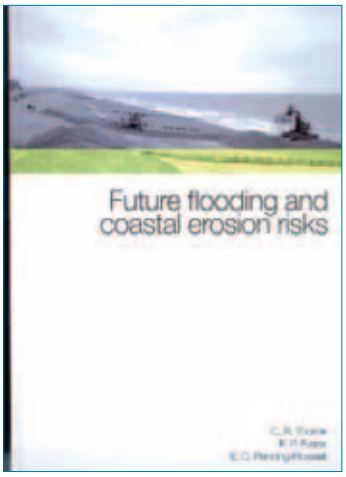
Even in areas far removed from coasts and deltas, these concepts are applicable for natural as well as artificial waterfront developments, and methods similar to *Integrated Coastal Policy via Building with Nature* are being implemented.



Towards an *Integrated Coastal Policy* via *Building with Nature*, using forces and materials present in Nature.

Achieving a Dynamic Equilibrium Coast. Flexible integration of land in water and of water in land.

BOOKS/PERIODICALS REVIEWED



Future Flooding and Coastal Erosion Risks
EDITED BY COLIN R THORNE, EDWARD P EVANS AND EDMUND C PENNING-ROWSELL

Published by Thomas Telford Ltd, 1 Heron Quay, London E14 4JD, United Kingdom. 514 pages. Hardcover. Price: £ 95.00

In 2002, the UK Government's Chief Scientific Advisor, Sir David King, commissioned the Foresight Project on Flood and Coastal Defence. This project sought to address a number of issues surrounding how the flood risk might change and how government and the private sector might best respond to future challenges.

The original study was executed by around sixty leading experts over a period of twenty months. Three of these experts, Colin R Thorne, Edward P Evans and Edmund C Penning-Rowsell, are the editors of this book. They have presented here a detailed version of the background work that led to the publication of the originally commissioned Future Flooding Report. This report concluded that:

- Flood risk would continue to rise to unacceptable levels;
- Those risks had to be tackled on a broad front; and
- Hard choices would have to be made regarding where to direct investments.

More importantly for the engineering world in general, the work carried out established a new paradigm for future work, and with the issues of flooding and flood prevention continuing to be in the headlines worldwide, the widespread interest in this subject continues. It is, thus, appreciated and appropriate that the publishers have taken the trouble to make this valuable record available to a broader audience by issuing this book.

The book is divided into eight parts, as follows:

Part 1 Introduction
Part 2 Drivers of flood risk
Part 3 Assessment of drivers and risk
Part 4 Coastal erosion drivers and risk
Part 5 Responses to future flood and coastal erosion risks
Part 6 Assessment of flood risk responses
Part 7 Sustainability and governance
Part 8 Synthesis

The first part gives a general overview of the research project undertaken and its political and scientific context. This is followed by a fairly detailed description of the methodology adopted for the project, both its conceptual framework and a number of key aspects, such as scenarios for climate change and socio-economic evolution. Part I concludes with a review of the enviromental impacts of flood risk management, changes in flooding and the significance of changes in flood management.

The second, and largest, part is devoted to the drivers of flood risk. These encompasses climate change, catchment land-use and changes, river processes, human behaviour, socio-economic drivers (including cities and science), coastal processes, urban change and other flood risks such as groundwater flooding. The part finishes with a discourse on the comparable importance of all these drivers in terms of their impact scoring, ranking and uncertainty. In Part 3 these drivers are evaluated on a national basis for England and Wales, Scotland and Northern Ireland.

Part 4 is devoted to coastal erosion, as apart from general coastal processes (covered in Part 2), and coastal erosion risk. In Part 5 the responses to future flood and coastal erosion risk are examined in detail. This part covers such subjects as managing the rural landscape, responding to future intra-urban floods, flood event management, reducing flood losses, river engineering responses, and coastal flooding and erosion management. The part concludes with another chapter on scoring, ranking and the examination of uncertainty and sustainability. Part 6 deals with an assessment of the flood risk response in England and Wales.

The final two parts cover the sustainability of responses and their governance, and a synthesis giving strategic responses. The book is well set out with illustrations, tables and text boxes and the whole has, as one might expect from an eminent trio of editors, been clearly structured and seamlessly integrated. This is clearly an invaluable reference for anyone interested in the subject of flooding, responses to flood risk and their future management.

The book is available from Thomas Telford Publisheres at www.t-telford.co.uk.

NICK BRAY

SEMINARS/CONFERENCES/EVENTS

Coasts and Ports 2007
GRAND HYATT MELBOURNE,
MELBOURNE, AUSTRALIA
JULY 17-20 2007

Convened by Engineers Australia, NCCOE and PIANC (Australia) and supported by The Association of Australian Ports and Marine Authorities Incorporated, Coasts and Ports 2007 represents an amalgamation of the 18th Australasian Coastal and Ocean Engineering and 11th Australasian Ports and Harbour conferences, and is now the pre-eminent series for coastal and port professionals in the Australasian region. The scope of Coasts and Ports 2007, with its three-day technical programme, will range from technological advances and emerging environmental issues to a review of policy and planning experience with an immediate relevance to working, living, playing and preserving the coast and port infrastructure. Keynote speaker is Todd S. Bridges, Ph.D., Senior Scientist for Environmental Sciences, Director, Center for Contaminated Sediments, U.S. Army Engineer Research and Development Center, Waterways Experiment Station, USA. Dr. Bridges' keynote speech will focus on the application of risk principles, concepts and methods in the management of navigation infrastructure.

For further information contact:
Ingrid Perronnet, Chairperson
Coasts and Ports 2007
http://coastsandports2007.com.au/

Offshore Europe
ABERDEEN EXHIBITION & CONFERENCE CENTRE,
ABERDEEN, SCOTLAND, UK
SEPTEMBER 4-7 2007

Offshore Europe is the largest oil & gas conference and exhibition outside North America. A truly global audience of engineers, technical specialists and industry leaders gather to source and discuss new exploration & production technology, to debate new ideas and to discover the solutions that will deliver sustainable oil & gas in the future.The quality of the technical conference, organised by the Society of Petroleum Engineers and a committee made up of industry business leaders ensures that a worldwide audience of oil & gas professionals arrives in Aberdeen to learn about the latest technology and its implementation in oilfields across the globe. The conference remains free of charge to attend. The exhibition features over 1500 companies displaying a range technology relevant to today's E&P industry.

For further information contact:
The Offshore Europe Partnership
E-mail: oe2007@spearhead.co.uk
Tel: +44 (0) 20 8439 8890
Fax: +44 (0) 20 8439 8897

4th International Conference on Port Development and Coastal Environment (PDCE)
VARNA, BULGARIA
SEPTEMBER 25-28 2007

PDCE 2007 is being organised by the Black Sea Association (BSCA) and supported by the Central Dredging Association (CEDA). The day before the conference, the CEDA Environmental Steering Committee, which since 2005 has a corresponding member from the BSCA, will sponsor a one-day training seminar on environmental aspects of dredging. The seminar will be open to all conference participants. The ESC will also present its 2007 year Best Paper Award at this conference. The conference will be attended by scientists and practitioners from all over Europe, with the majority coming from the host country Bulgaria, Romania and Turkey. The event will provide an opportunity for both formal exchange of knowledge on port and coastal zone development projects and challenges in these countries and for informal networking.

For further information contact:
PDCE 2007 Conference Secretariat
Black Sea Coastal Association
Capt. R. Serafimov 1, 9021 Varna, Bulgaria
Tel/Fax: +359 52 391443, E-mail: office@bsca.bg
CEDA website: http://www.dredging.org/event
BSCA website: www.bsc.bg

23rd Annual International Conference on Contaminated Soils, Sediments and Water
UNIVERSITY OF MASSACHUSETTS, AMHERST,
MASS., USA
OCTOBER 15-18 2007.

The Annual Conference on Soils, Sediments and Water become the preeminent national conference in this important environmental area. The conference attracts 700-800 attendees annually from Asia, Africa, Europe as well as South and North America, in which a wide variety of representation from state and federal agencies; military; a number of industries including railroad, petroleum, transportation, utilities; the environmental engineering and consulting community; and academia are present. "Expediting and Economizing Cleanups", this conference's theme, will be supported by a

diverse technical programme in concert with a variety of educational opportunities. Live equipment demonstrations will augment the exhibition bringing real-world application to the technical theory. Focused workshops will provide attendees with the type of practical application information which will impact their job performance immediately. General topics include: bioremediation, chemical analysis, cleanup standard setting, environmental fate and modeling, hazard exposure and risk assessment, heavy metals, hydrocarbon identification, innovative technologies, jet fuel contamination, regulatory programs and policies, sediments, site assessment/field sampling, soil chemistry, standard remedial technologies/corrective actions, and case studies on any of the above. The annual Adventus Americas Award for the Best Student Presentations will be offered. A US$1000 cash award will be given to each of three students who, in the opinion of the judges, have made the best poster or platform presentations at this year's conference.

For more information contact: www.UMassSoils.com or
Denise Leonard, Conference Coordinator
Tel: +1 413 545 1239
E-mail: dleonard@schoolph.umass.edu.com
or info@UMassSoils.com

Europort Maritime
AHOY' ROTTERDAM, THE NETHERLANDS
NOVEMBER 6-9 2007

Europort Maritime is one of the foremost international trade fairs for maritime technology in ocean shipping, inland shipping, shipbuilding, dredging, fishing and related sectors. In addition to the exhibition which attracts high-quality participants and visitors, the CEDA Dredging Days are held simultaneously during the Europort Maritime 2007 Exhibition.

For information on participation in the Exhibition contact:
Elly van der Loo at Ahoy' Rotterdam:
Tel: +31 10 293 32 50, E-mail: e.vanderloo@ahoy.nl

Mr. J. Teunisse, Senior Account Manager
Tel: +31 10 293 32 07, E-mail: j.teunisse@ahoy.nl
www.europortmaritime.nl

CEDA Dredging Days 2007
AHOY' ROTTERDAM, THE NETHERLANDS
NOVEMBER 7-9 2007

The theme of the conference is "The Day After We Stop Dredging – Dredging for Infrastructure and Public Welfare". Before almost every dredging project begins the question arises, "What will the effects of dredging be?" Taking the offensive this time, CEDA is reversing the question and asking, "What are the consequences if we do not dredge?" In five main sessions, international keynote speakers will tell about typical issues in their area of work that have led or could have led to the cessation or reduction of dredging. They will answer questions such as, Will our coasts be put at risk? What are the financial and environmental costs of the alternatives? What will happen to our domestic and social commerce? Should we leave the contaminated sediment where it is?

The Keynote Address will be given by Ronald E. Waterman, MP, Province of South-Holland; Senior Adviser to the Ministry of Transport, Public Works & Water Management. Other Keynote speakers are Freddy Aerts, Head of Division, Ministry of the Flemish Community, Maritime Access, Belgium; Dr. Gary Patrick Mocke, Head, Coastal Management Section (CMS), Dubai Municipality, Dubai, UAE; Dr Ian Selby, Operations and Resources Director, Hanson Aggregates Marine Ltd, UK; Dr. Ole Larsen, General Manager, DHI Wasser & Umwelt GmbH, Germany; and G. van Raalte, Royal Boskalis Westminster the Netherlands.

An IADC Award for the best paper by a younger author will be presented. To complement the conference, a small dredging exhibition will be located in the area adjacent to the technical session room. The CEDA Dredging Days 2007 are held in association with Europort Maritime 2007 Exhibition. A Poster Competition will be held for students and young professionals, submission deadline: October 15.

For more information contact the CEDA Secretariat:
Tel: +31 15 2682575, E-mail: ceda@dredging.org or
the Dredging Days website: www.dredgingdays.org.

PIANC COPEDEC VII
DUBAI UNITED ARAB EMIRATES
FEBRUARY 24-28 2008

After its successful start in 1983, it was decided to organise the International Conference on Coastal and Port Engineering in Developing Countries (COPEDEC) once every four years in a different developing country. At the September 2003 meeting in Sri Lanka a merger agreement between COPEDEC and PIANC (the International Navigation Association) was signed and the tradition will be continued under the auspices of the two organisations. For this reason, the newest conference will be held in five years instead of four. The theme of COPEDEC VII will be "Best Practices in the Coastal Environment". Topics will include:

- Port, harbour and marina infrastructure engineering;
- Port, harbour and marina planning and management;

- Coastal stabilisation and waterfront development;
- Coastal sediment and hydrodynamics;
- Coastal zone management and environment;
- Coastal risk management;
- Short sea shipping and coastal navigation.

For further information contact:
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c/o Lanka Hydraulic Institute Ltd.
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Tel: +94 11 265 1306/ 265 0471,
Fax: +94 11 265 0470
E-mail: Copedec@lhi.lk
www.pianc-aipcn.org

CALL FOR PAPERS

Brazil Chapter Annual Meeting
Western Dredging Association
INTERCONTINENTAL RIO HOTEL
RIO DE JANERIO, BRAZIL
DECEMBER 9-12 2007

WEDA's First Brazilian Chapter meeting will be held in December at the Intercontinental Hotel in Rio de Janeiro, Brazil. The impetus for a South American meeting grew out of the great success of the opening of the Panama Chapter. This congress and exhibition will focus on Dredging throughout South America, its impact on the ever-expanding Global Economy and the area of Marine Environment. The theme selected will provide a unique forum for all throughout the Western Hemisphere: Dredging Contractors, Port & Harbor Authorities, Government Agencies, Environmentalists, Consultants, Civil & Marine Engineers, Surveyors, Ship Yards, Vendors, and Academicians to exchange information and knowledge with their professional counterparts who work in the exciting and challenging fields related to dredging. Important discussions on the history of dredging in South America, as well as the impact that dredging or the inability to dredge has on the world economy and its environment will highlight the programme. This announcement is a First Call for papers for this three-day technical programme and exhibition. Topics of interest include, but are not limited to:

- Current Dredging in Brazil
- Environmental Concerns
- History of Dredging in Brazil
- Rivers and Inland Dredging
- Beneficial Uses of Dredged Material
- Geotechnical Aspects
- Wetland Creation & Restoration
- Dredging for Beach Nourishment
- Dredging Systems & Techniques
- Automation in Dredging
- New Dredging Equipment
- Numerical Modelling
- Surveying and Equipment
- Contaminated Sediments
- Cost Estimating
- Dredging & Navigation
- Economic Benefits of Dredging
- Project Case Studies

The Technical Papers Committee will review all one-page abstracts received and notify authors of acceptance. Final Manuscript is not required. Proceeding will be published from power point presentations. Submission of abstracts imply a firm commitment from the authors to make a presentation at the conference.
All interested authors, including CEDA and EADA authors, should mail their one page abstract to one of the following members of the WEDA/Brazil Chapter Technical Papers Committee. Submission deadlines are the following:

Submission of one-page abstracts: September 15, 2007
Notification of presenters: October 10, 2007

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