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International Association
of Dredging Companies

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Front cover:
The new FIDIC Contract for Dredging and Reclamation Works addresses the risks involved with modern mega dredging projects, which can involve many vessels working day and night (see page 3).

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International Association of Dredging Companies

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TERRA ET AQUA

EDITORIAL

The attacks on New York, Washington, DC and near Pittsburgh sent a shock around the world which will be felt for a long time. Firstly, our sympathy goes out to all the families of the victims of this tragedy. Secondly, as an industry, we are especially aware of our colleagues at the Port Authority of NewYork/New Jersey who were housed in the World Trade Center and with whom we have shared many professional exchanges at meetings and social gatherings.

One of those occasions was the World Dredging Conference in Las Vegas, Nevada. At that meeting, in the IADC booth, the industrial artist Paul Kerrebijn was busy painting his impressions of ports and dredging vessels. The cover of the September 1998 issue of Terra featured one of his works depicting the skyline of New York and a ship dredging its harbour. Little could we know that only three short years later this painting would become a historical record of New York's World Trade Center, "the twin towers," and harbour as they no longer exist.

We in the dredging industry, be it in Europe, Asia or the Americas, are dedicated to building — to constructing new ports, harbours, container terminals; to restoring and maintaining waterways; to help prepare for the laying of gas and oil pipelines; to reclaiming land for housing, recreation and industrial complexes. All that we do is based on improving infrastructure to maintain and expand economic opportunities and to create them where they did not exist. The devastation we have witnessed on September 11th is contrary to all that we stand for.

Despite the worldwide repercussions, the turbulence in financial markets, and an atmosphere of uncertainty, the dredging industry will continue to push forward. For the true means of conquering the forces of destruction are to remain steadfast in our belief in progress, in technology and in the creative energy of engineering.

Robert van Gelder
President, IADC Board of Directors

Constantijn P.I.M. Dolmans

A Contract for "Just Digging a Hole"

Abstract

In 1999 FIDIC published four new standard forms of contract: EPC Turnkey Projects; Plant and Design-Build with Design by the Contractor; Construction with Design by the Employer (the former FIDIC Red Book); and the Short Form of Contract. This new work does not meet specific dredging and reclamation work needs. Consequently, FIDIC formed a Task Group to examine the possibility of a contract customised for the dredging industry. In the tradition of FIDIC, the new "FIDIC Form of Contract for Dredging and Reclamation Works" has been carefully developed by this Task Group and is now available in a test edition.

Special thanks go to Philip Jenkinson from WS Atkins (Dredging Task Group Leader) for his valuable comments, and to the other members of the FIDIC Dredging Task Group: Tony Sanders of Mouchel, Edward Corbett of Corbett & Co. on behalf of FIDIC and Pieter Boer of Royal Boskalis Westminster on behalf of IADC.

Constantijn Dolmans graduated from Leiden University in fiscal law (1995) and has a professional degree in insurance. He had worked as a cost-controller for BFI (currently SITA, a waste company) since 1992, when in 1997 he joined IADC. One of his first tasks was to comment upon FIDIC's draft for a new "Conditions of Contract for Construction" and he then became a member of FIDIC's Dredging and Reclamation Contract Task Group.

Constantijn Dolmans

Introduction

For the smooth execution of a dredging project one cannot do without a strong and clear contract.
The objectives of this contract should be (Bray et al.):

- to describe accurately the work to be done and the conditions under which it is to be done;
- to apportion risk; and
- to provide a fair and equitable method of payment for that work when it is completed satisfactorily.

FIDIC, the International Federation of Consulting Engineers, has a long history in publishing standard forms of contract for engineering construction. FIDIC was founded in 1913 as an association for national member associations in engineering and has at present a membership coming from nearly 70 countries. Their first standard forms were published in 1957. Editions in 1969 and in 1977 of the so-called Red Book included explicit provisions for dredging and reclamation works.

However, the Fourth Edition of the Red Book in 1987 did not include these dredging provisions. To meet the specific requirements of dredging projects, IADC (International Association of Dredging Companies) published a "Users Guide" to this Fourth Edition of FIDIC's Red Book in 1990. This cooperation between the IADC and FIDIC provided the basis for developing the present publication (Figure 1).

The New FIDIC Contracts

In 1999 FIDIC published four new standard forms of contract, the Conditions of Contract for:

- EPC Turnkey Projects;
- Plant and Design-Build with Design by the Contractor;
- Construction with Design by the Employer (the former FIDIC Red Book); and
- the Short Form of Contract.

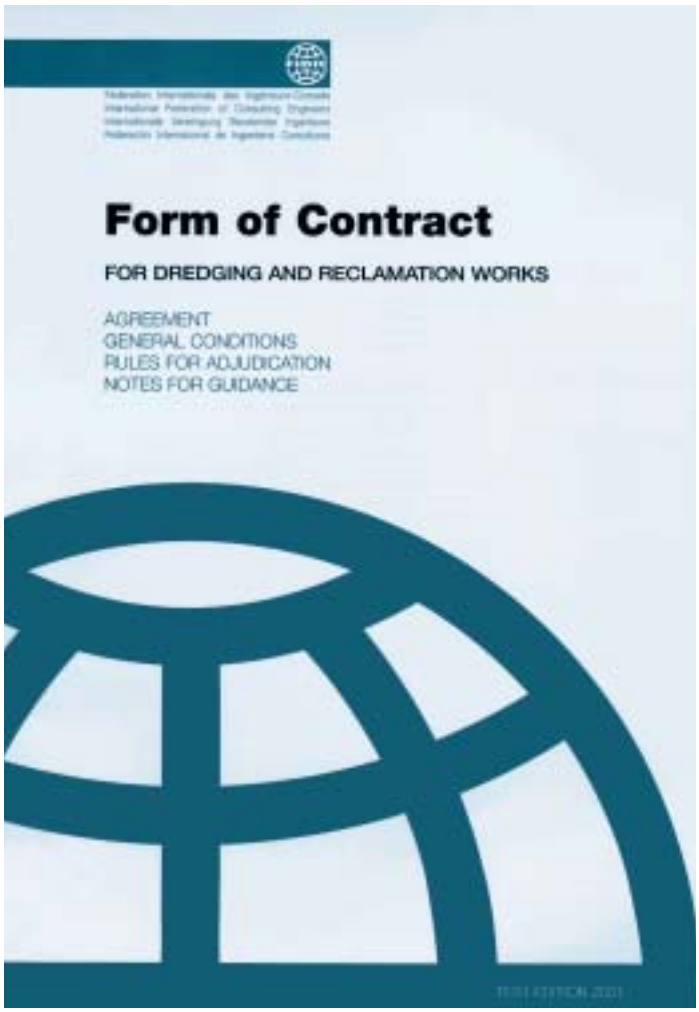

Figure 1. The cover of the new "FIDIC Form of Contract for Dredging and Reclamation Works", Test Edition 2001.

In the past, the Fourth Edition of the Red Book has often been used as a basis for contracts for dredging and reclamation works. However, IADC felt that its successor — the new "Contract for Construction with Design by the Employer" — was not suitable for application to dredging and reclamation works. The new Contract for Construction has an extensive size. One might say, "It is just a little bit too large for just digging a hole under water". Furthermore, in this new Contract for Construction, no special attention is given to the wide variety of circumstances in dredging and reclamation works.

The dredging industry is a specialised, capital-intensive sector of the construction industry. The execution of a dredging project not only necessitates technical knowledge associated with civil engineering construction projects but also maritime expertise about the operation of a dredging vessel and compliance with international maritime shipping law. The logistics of ensuring continuous sufficient work for the specialised fleet coupled with the massive capital investment and high operational costs inevitably means higher than normal risks in the event of change on a project. The very nature of dredging activities, i.e. at various depths underwater, creates difficulties in obtaining accurate information regarding sub-soil conditions. Climatic and physical operating conditions such as wave height have a higher impact than on most other construction operations, particularly with regard to safety for workers.

The FIDIC Dredging Contract; a Legal Framework

The need for a special short and simple dredging contract was clear. IADC contacted FIDIC about the possibility of a separate FIDIC dredging contract and a Task Group was formed. On the strong basis of FIDIC's Short Form of Contract, the Task Group produced the "FIDIC Form of Contract for Dredging and Reclamation Works". The test edition of this dredging contract was published in June 2001. The formal first edition is to be published a year later, taking into consideration the comments that may arise from the test edition.

The contract is published under full responsibility of FIDIC and the ultimate decisions on the form and content of the document rests with FIDIC's Executive Committee. Input to the contract has been given, not only by IADC, but also by consulting engineers, employers and organisations like the World Bank.

The aim has been to produce a fair, balanced and straightforward document which includes all essential commercial provisions. It may be used for all types of dredging and reclamation work and ancillary construction with a variety of administrative arrangements.

Under the usual arrangements for this type of contract, the Contractor constructs the Works in accordance with design provided by the Employer or by his Engineer. As in the construction industry in general, more and more works are contractor-designed. Therefore, the form may easily be altered into a contract that includes, or wholly comprises, contractor-designed Works.

The essential part of a dredging contract is formed by the description of the activity itself; the specifications, drawings and design of the work. The "FIDIC Form of Contract for Dredging and Reclamation Works" provides a legal framework to this. It governs the general obligations and responsibilities of the contracting parties. The document starts with an Agreement — a simple document that incorporates the tenderer's offer and its acceptance. All relevant data should be included in the Appendix to the Agreement. References to documents forming part of the contract such as the specification and the drawings are also made in this

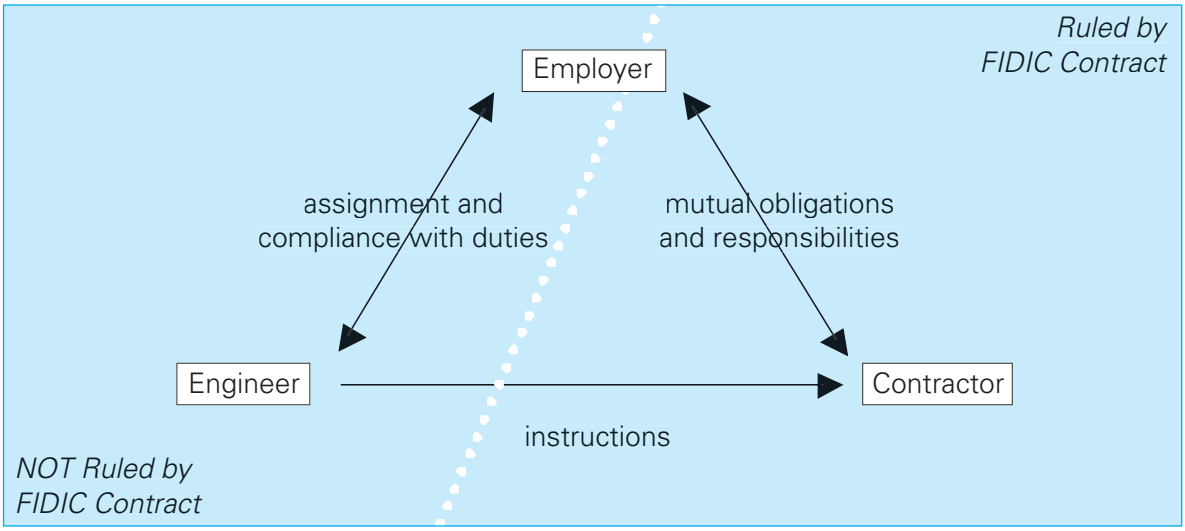

Figure 2. Relationships between parties to the Contract and the Engineer.

Appendix. The General Conditions are expected to cover all essential elements of the legal framework.

Nevertheless, every situation is unique. Modifications may be required in some jurisdictions or may be necessary to suit special circumstances. Users are able to introduce Particular Conditions if they wish to handle such special cases or circumstances.

Contract Parties and the Engineer

The "FIDIC Form of Contract for Dredging and Reclamation Works" is a two-party contract between the Employer and the Contractor. However, contrary to FIDIC's Short Form, provision is made for an Engineer, as is usual for dredging and reclamation works. Although this Engineer is not a party to the contract, he has an important role in the execution of the work (Figure 2).

The Role of the Engineer

The FIDIC Dredging Form gives the Engineer several duties and authorities, such as:

- approval of contractor's design;
- the authority to instruct variations to the Contractor;
- the issuing of Taking Over Certificates; and
- the certification of payments.

This important role — especially when executed by an experienced engineer — is to the benefit of both Employer and Contractor. The Employer is ensured of expert advice and the Contractor has an experienced partner with whom to work, resulting in a more cost-efficient execution of the dredging project. The issuing of Taking Over Certificates and certification of payments by the Engineer may often be necessary in projects that are externally financed by government bodies or international organisations such as the World Bank. However, if there is no need for an Engineer in the Contract — in smaller projects an experienced Employer may want to act for himself directly — the FIDIC Dredging Form can be easily adjusted to a contract without an Engineer.

In line with the other major FIDIC Contracts, the Engineer is no longer expected to be an impartial person or organisation. After years of discussion, FIDIC broke with the tradition of the impartial Engineer. The close relationship between the Employer, who pays the bill, and the Engineer made the independence of the Engineer questionable in practice. It does not mean that in the new FIDIC Contracts the Engineer may do whatever he wants. The Dredging Form states:

"The Engineer and any assistants shall exercise their duties and authority in a fair manner in accordance with the Contract".

If disputes or differences between the Employer and the Contractor, including dissatisfaction with decisions of the Engineer, cannot be settled amicably, the FIDIC Dredging Form provides for resolution of the dispute by a Dispute Adjudication Board (DAB). This DAB has in fact taken over the impartial decisional role of the Engineer in case of disputes. Should the decision of the DAB not satisfy one or both parties to the Contract, the FIDIC Dredging Form provides for international arbitration under the Rules of Arbitration of the International Chamber of Commerce.

Risks and Responsibilities

Within the execution of a dredging project there may never be a situation in which all required information is available. Unexpected events, whether caused by nature or people, may occur. These uncertain factors

CONTENTS of the FIDIC FORM OF CONTRACT for DREDGING and RECLAMATION WORKS

in the execution of construction projects are risks. The purpose of any contract is to allocate these risks between the parties to the contract. Risks can best be borne by the party that is best able to handle the risks. Technical risks, for instance, like the safety of a dredging vessel, may be best controlled by the Contractor, whereas an Employer may have better knowledge of the specific conditions of the Site where the project has to be executed (Figure 3).

Of course, the best means of avoiding unexpected situations is by informing each other as adequately as possible. Therefore the FIDIC Dredging Form gives the Employer the obligation to supply the Contractor with all Site data relevant to the execution of the work prior to tendering. The Contractor is responsible for the interpretation of these data and for making thorough enquiries as far as practicable taking into account cost and time.

Sometimes one party can more easily fulfil an essential condition for the execution of the project than the other party. In dredging projects the Employer, for instance a port authority, can often obtain the permits and licences needed for the execution of the work more readily. The FIDIC Dredging Form therefore makes the Employer responsible for this activity.

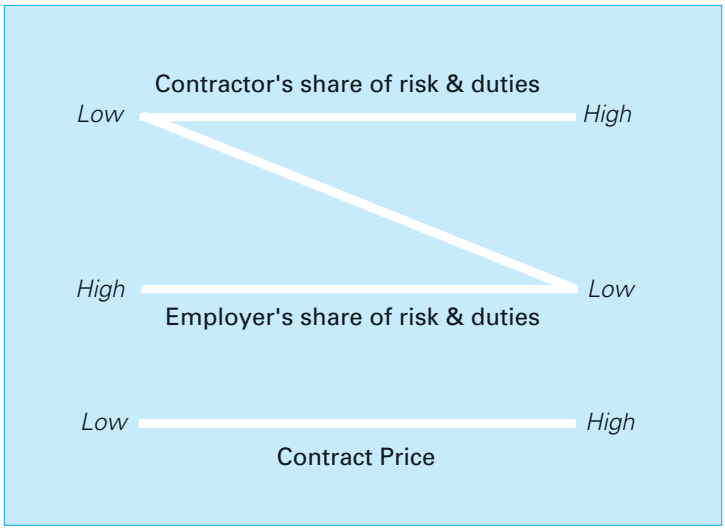

Figure 3. Contractor's and Employer's shares of the risks and duties: the more risk for the Contractor the higher the price.

Figure 4. Major dredging projects today often involve multiple vessels from several companies, working 24 hours a day, 7 days a week. The FIDIC Form of Contract addresses the need for clarity in contractual agreements amongst all parties.

Of course, circumstances differ from project to project (Figure 4). The allocation of risk must fit the specific project and the General Conditions of the FIDIC Dredging Form should be adjusted by Particular Conditions when necessary. However, the allocation of risk should remain fair and practicable. In a project where the Employer is responsible for almost everything, there is little incentive for optimal performance by the Contractor. On the other side of the balance, an Employer that transfers all the risks and duties to the Contractor will have to pay a very high price. In that case there is little flexibility for variation and the project will certainly be expensive.

Liability

The fact that one party bears the risk for an event that happens or has not fulfilled his duty — in other words that party is responsible — does not automatically mean the party is liable for the consequences and that these consequences result in a valid claim under the contract. The Dredging Form is clearer on this subject than the other FIDIC Forms of Contract. A clear view of risks and liability is of course very important in the execution of dredging projects where small things can have major consequences in time and money.

Responsibility may lead to a liability when a party suffers a loss as a consequence of inappropriate action of the responsible party. Sometimes, when a party suffers a loss as a consequence of certain events like adverse climatic conditions, this may also lead to liability of the responsible party (Figure 5). When a party is liable he should indemnify the other party for his loss according to the conditions of the contract. The way the indemnification — a valid claim — should be calculated may already have been agreed in the contract, particularly in the Appendix.

Insurance arrangements may cover the indemnifications that have to be paid by one party to the other. The general provision in the FIDIC Dredging Form is that the Contractor effects these insurances before the work starts. The FIDIC Dredging Form takes care of the specific needs in dredging projects related to insurance.

In general, the marine insurance policy of the Contractor will cover hull and machinery and often liability for the dredging vessels. For dredging works, insurance of the Works, Materials, Plant and Fees (as in a normal Construction All-Risk or Contract Works Insurance) is not possible. You cannot insure a hole under water. But when non-dredging works are involved, the FIDIC Dredging Form also requires insurance of these during the construction. Of course, damage to other property of the Employer, death or injury to the Employer, Engineer or their personnel and third-party liability should also be insured under the FIDIC Dredging Form.

Members of the FIDIC Dredging Task Group

Philip Jenkinson graduated from Oxford University in Engineering Science, qualified as a Chartered Civil Engineer, and is now a Principal Consultant with WS Atkins. He became Task Group leader for FIDIC's Short Form of Contract and most recently leader of the Dredging and Reclamation Contract Task Group.

Tony Sanders OBE is a chartered quantity surveyor and Director of Dispute Management of Mouchel Consulting, specialised in civil engineering. Prior to joining the Dredging Task Group, he worked with FIDIC on the Orange Book and the Short Form of Contract. He is a member of the FIDIC President's List of Approved Adjudicators and the FIDIC List of Experts.

Edward Corbett MA MSc FCI Arb, studied law at Oxford University and is the principal of Corbett & Co, a practice specialising in international construction law. He authored *FIDIC Fourth Edition - A Practical Legal Guide* and is now working on a Guide to the Orange Book. He is a member of the International Bar Association's committee on the FIDIC contract as well as the Task Group for the Short Form and Dredging Form of Contracts.

Pieter Boer graduated as civil engineer from Delft University (1964),started at the Public Works Department of Rotterdam. He then switched to Hydronamic bv and continued his career within the Royal Boskalis Westminster group, becoming Director of Boskalis International in 1986. Retired from Boskalis, he is currently chairman of IADC's legal committee and as such was asked to join the Dredging Task Group.

Constantijn Dolmans, author of this article, is Assistant to the Secretary General of the IADC and as such was invited to be a member of the Dredging Task Group.

Figure 5. Adverse climatic conditions, be it tropical storms or icey waters, as seen here, can have an influence on the risks involved in a dredging operation.

Defects liability

A specific responsibility that may lead to liability of the Contractor is a defect of the work. As under the other FIDIC Forms, the Contractor has to remedy at no cost to the Employer any defects due to the Contractor's Design, Materials, Plant or his (lack of) workmanship.

Normally, this obligation ends one year after taking over the project or the relevant part of the project. However, remedying defects after demobilisation of high value dredging equipment may lead to unreasonably high costs for the Contractor if remobilisation of this equipment is required. Furthermore, natural processes may also have their effect on the completed dredging work which may lead to defects that could not have been foreseen. Therefore, under the FIDIC Dredging Form, the Contractor has no obligation to remedy defects in dredging works after the completion date of these works. This does not mean that the Contractor will not be held liable for the defect after completion. When the Contractor is liable, he may still have to indemnify the Employer.

When the contract involves more than dredging works only, a clear distinction should be made in the specifications and the drawings between dredging works and non-dredging works. The FIDIC Dredging Form explicitly

Figure 6. Risks and responsibilities in the FIDIC Dredging Form.

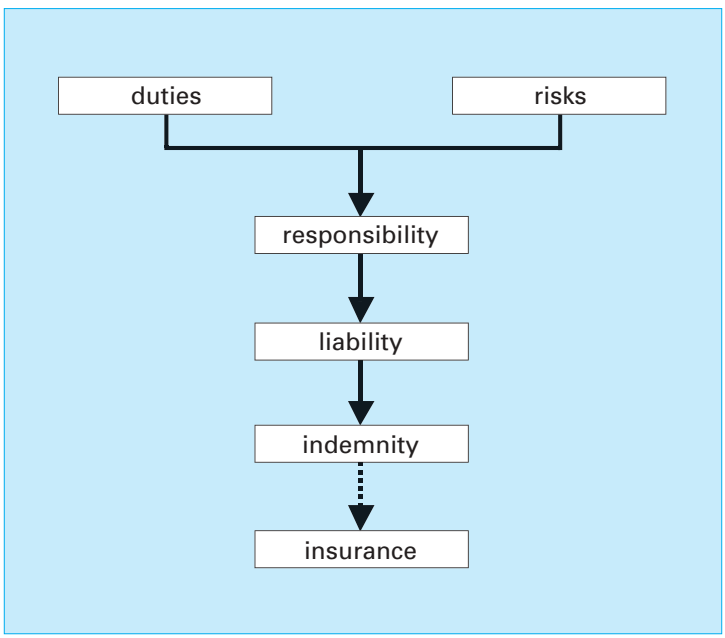

Figure 7. Dredging works are often a part of larger construction projects, such as this fixed link bridge in Argentina. The FIDIC contract asks for a clear distinction between dredging and non-dredging works.

asks for such a distinction (Figure 7). It may appear to be in favour of the Contractor that there is no time period allocated for notification of defects after completion of dredging works. However, this condition is also very much for the benefit of the Employer, as the existence of a defects notification period for dredging works would certainly increase the contract price. Nevertheless, the Employer has to be indemnified when he suffers a loss as a consequence of defects in dredging works due to one of the Contractor's responsibilities.

Conclusion

Thanks to the cooperation of FIDIC and IADC as well as other organisations and persons, there is once again a standard construction contract that meets the special requirements of dredging and reclamation projects. In large projects where dredging and reclamation are just a part of the work, one of the other FIDIC contracts may still be suitable. However, even in these cases, the straightforward provisions and clear conditions of the FIDIC Dredging Form may help to design particular conditions for these standard contracts to meet specific dredging needs.

The "FIDIC Form of Contract for Dredging and Reclamation Works" creates a fair and balanced legal framework for the optimal execution of dredging and dredging related projects. In general the provisions will suit most dredging projects. When needed due to specific circumstances, the FIDIC Dredging Form can easily be adjusted and particular conditions can be added. In addition, comments from users may in the future improve the FIDIC Dredging Form even further.

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Jan Vandenbroeck and Ben Charrada Rafik

Restoration and Development Project of South Lake of Tunis and its Shores

Abstract

This paper describes the development of the South Lake of Tunis which has recently been accomplished by the group LAC SUD 2000 (a consortium of five dredging contractors) at the request of the Tunisian Government. The project is within the framework of the national development programme of the coastal Tunisian lagoons, in an effort to improve the living conditions in this area and to protect the environment against the various forms of pollution which have affected it for more than half a century.

It is amongst the rare projects which introduce viable solutions for limiting the extent of pollution in one of the most eutrophic lagoons in the world. Considering the location of the lake within the heart of the town of Tunis City, the project will offer to Tunis centre an opening onto the sea, giving it a whole different look. The history of the Lake Tunis, its location before the development works, the after-project results and the work volume executed during the project period will also be discussed here.

The works were completed within the contractual period and a programme monitoring water quality will follow the project during a maintenance period of two years and a guarantee period of five years.

For information about the remediation of the North Lake of Tunis see *Terra,* number 49, September 1992.

Introduction

The South Lake of Tunis is a shallow lake located in the north of Tunisia at the east side of Tunis City. Before the works described here were implemented, all rainwater and wastewater of south Tunis City and Ben Arous industrial zone were discharged into this lake. The investigations carried out before the start of the project showed the presence of approximately 2 million m^3 of organic sediment contaminated by heavy metals such as Chrome, Copper, Zinc, Iron, Nickel, Aluminium and Hydrocarbons. Owing to this, the South Lake had reached a high level of pollution and eutrophication. The extreme eutrophication conditions appear in summer with dystrophic crises characterised by red water, bad smells and high mortality of fish life.
In order to solve these pollution conditions, the "Societé d'Etudes et de Promotion de Tunis Sud" (SEPTS) invited LAC SUD 2000 (a consortium of five contractors led by Dredging International) to carry out a large restoration and development programme during a period of three years.

The main objectives of this programme consisted of the creation of a flushing system of seawater by the construction of an inlet and an outlet sluice driven by natural tidal forces, the confinement in a terrestrial zone by a vertical PEHD liner of 1 million m^3 polluted sediments, the removal of a quantity of 12 million m^3 of organic sediments in order to dredge the lake to a depth of 2 m and the extraction of a quantity of 5 million m^3 of sand in order to gain reclamation land on the shores of the lake. Most importantly, however, this project aimed for a total regeneration of the lake including a modification of its shores, its morphology and its topography.

Pre-dredging Studies

At the beginning of the project, detailed studies were carried out by setting up mathematical models for water circulation and water quality. The water circulation has been studied by 2D and 1D models. The 1D model was coupled with an ecological model that was used to predict water quality and the effect of the circulation on the ecosystem. The ecological model, based on site measuring and laboratory tests, describes the nutrient seasonal variation in relation with

Jan Vandenbroeck

Jan Vandenbroeck received his degree in Civil Engineering from the University of Ghent (Belgium). He joined an affiliate of the DEME Group in 1989 and has worked within this group since. From 1998 to summer 2001, he was Project Manager of the group LAC SUD 2000 for Dredging International NV. He is presently Co-Project Manager of Marine Works PORT 2000 Le Havre (France).

Ben Charrada Rafik

Ben Charrada Rafik was involved with the restoration and development of both the North and South Lakes of Tunis and has extensive experience in management of water and environmental problems. He obtained his Doctorate in Hydraulic Engineering in 1997, basing his thesis on his study of hydrodynamic flows in the Tunisian coastal ecosystem.

the macro algal growth and nutrient release from bottom sediment.

Hydraulic study showed for the retained dredging plan that the water circulation in the lake will be homogenous and the lake water will be regenerated in a short time. The residence time will be from 4 to 7 days as a function of the tide and the wind.

The prediction of water quality carried out by the ecological model showed that the lake can be regenerated with the new flushing system. The nutrient contents in the lake will be comparable to those in the Tunis Gulf, the bottom concentration of macro algae will be reduced and water will be well oxygenated. This will improve the situation of the lake by eliminating red waters and all sources that had negative effects on water quality before the works.

Geographic Situation

The South Lake of Tunis belongs to a Mediterranean lagoon complex including the North Lake and the navigation canal. This complex belongs to the set of the coastal Tunisian lagoons and is located at the bottom of the Gulf of Tunis which is located on the south part of the Sicily-Tunisian canal. The South Lake constitutes the south part of this complex and it is separated from the

Figure 1. Geographic localisation of the South Lake of Tunis.

North Lake by the navigation canal. It is limited by the town of Tunis and its surrounding from the east, the southeast and the south sides (Figure 1).

History

Before the end of the 19th century, the South Lake was part of a more extended lagoon having a surface of 4000 hectares (Figure 2). It was only in 1881, when France colonised Tunisia that this lagoon was divided into two parts by the navigation canal which was dredged to allow the entry of boats up to Tunis harbour. The south part, of about 1500 hectares in surface and 0.80 m in average depth, constitutes the South Lake and is the subject of the present project (Figure 3).

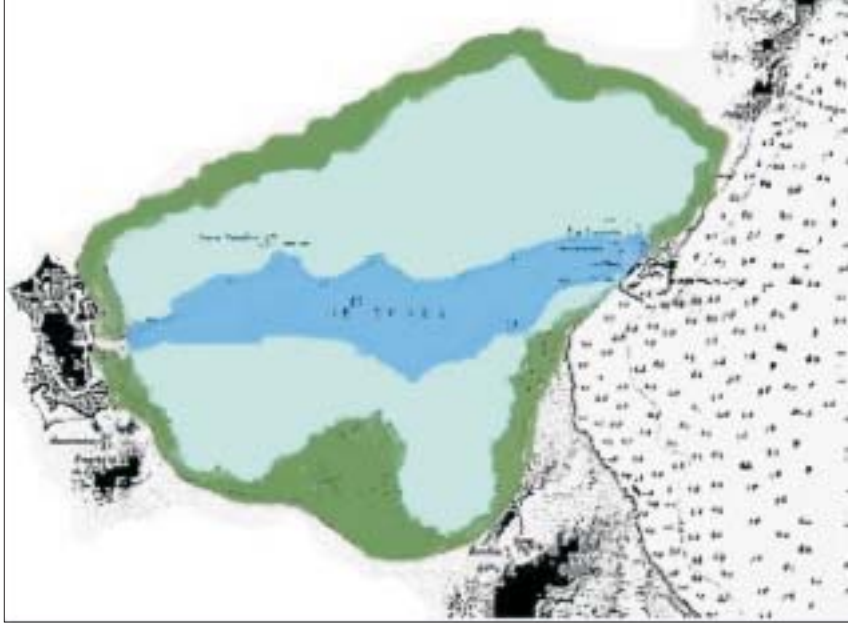


Figure 2. The Lake of Tunis in 1880 before its subdivision. In straight blue: navigation canal yielding to the Port of Tunis in the arsenal zone.

Considering their location within the heart of the capital Tunis, the two lagoons constituted the town's only receptacle of wastewater and therefore they deteriorated during the 1970s into a very eutrophic state. This situation pushed the Tunisian government, beginning in 1980, into initiating a large cleanup programme which consisted of treating the crude domestic wastewaters (previously discharged into the North Lake) in treatment plants and, between 1985 and 1988, of executing a project to develop the North Lake.

The South Lake, however, remained in its eutrophic state until the end of the 1990s. Its location at the centre of the urban and industrial section of Tunis south has exerted intensive pressure on the ecosystem, which has worsen its eutrophication state. The only exploitation activities at the South Lake were undertaken by the "Office National de Pèche" to allow fishing at the pass ways with the navigation canal. This exploitation stopped in 1997.

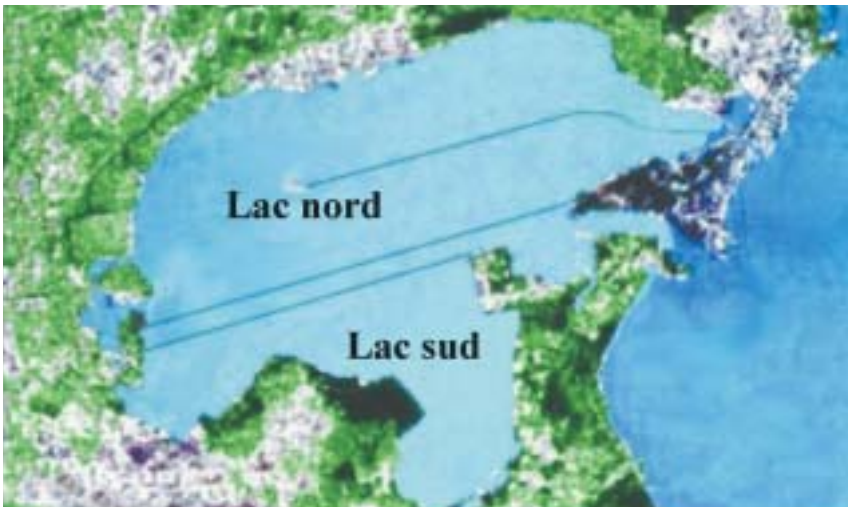


Figure 3. The Lake of Tunis in 1995 (satellite photo). The lagoon complex just before the beginning of the project to restore the North Lake.

SEPTS

With growing consciousness of the significance of the problem, the Tunisian State prepared a development and cleanup programme of the lake in order to stop the pollution which negatively affects the water quality. This programme started in 1989 with a preliminary study executed by the "Ministry of Public Works".

In 1990, the Tunisian company "Société d'Etude et de Promotion de Tunis Sud" (SEPTS) was created in order to promote and develop the South Lake and its shores. Since its creation, SEPTS has co-ordinated different actions with all the interfering parties in the zone and has undertaken several studies in an effort to fight pollution in the south zone of Tunis. In 1997, SEPTS has offered an international bid for the restoration and the development of South Lake and its shores.

In February 1998, the project was awarded to the group LAC SUD 2000 for a work period of three years with a lump sum of 60 000 000 €. The group comprised the following five companies: Dredging International N.V. (leading company); Van Oord ACZ B.V.; Tideway B.V.; Societa Italiana Dragaggi Spa; and Sider Almagia Spa.

The Control Inspection mission of these works has been entrusted to a joint venture of consulting firms STUDI (Tunisian) and SOGREAH (French).

Objectives

The main objectives of the project awarded by SEPTS to the group LAC SUD 2000 were to limit the pollution effects on the city's water quality and to ensure a clean environment which would allow the city of Tunis the opportunity to extend its leisure sites, green parks and residential spaces.

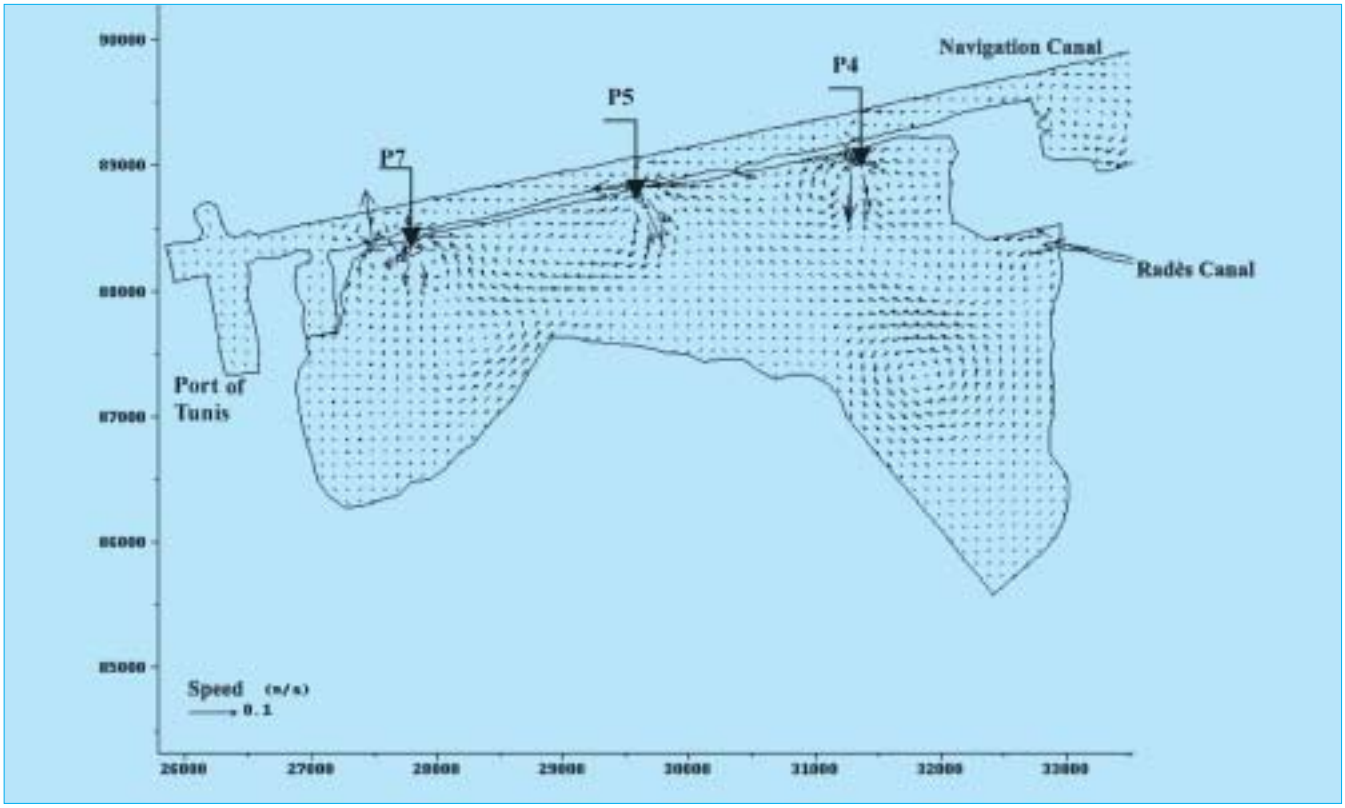


Figure 4. State of the circulation in the South Lake of Tunis just prior to the project.

The project should ensure:
- the elimination of stagnation zones and the renewal of the lake waters in an adequate time period;
- a maximal oligotrophic character, being highly mixed with sea water;
- avoiding the development of short cycle algae (type *Ulva* and *Enteromorpha*-originating from putrefaction and anoxia yielding to eutrophication);
- the elimination of bad odours and their origins; and
- a good physico-chemical quality of the waters, in conformity with certain criteria related to those of the Tunis Gulf.

State of the Lake Before the Project

The development works of the lake were preceded by assessment measures of the site by SEPTS before the project as well as by LAC SUD 2000 during the start-up period of the works. These investigations have concerned:
- the identification of the effluents;
- the hydraulic situation;
- the ecological situation; and
- the sediments quality.

The effluents

The downhill basin of the South Lake has a total area of about 4000 hectares, of which 1500 hectares are occupied by the industrial zones of Ben Arous, Megrine , Bir El Kasaa and Rades, regrouping about 650 industrial units. The rainfall and the industrial waters of these zones are fed into the lake at two different locations:
- the first diverse at the east section using Bir El Kasaa canal; and
- the second at the west by Ben Arous and Megrine channels.

The shoreline of the South Lake is run by a belt canal, which is destined for the drainage of rainfall waters and for the protection of Megrine against water rise. These channels flow into the lake rainfall water during rainy periods and industrial wastewaters during normal times. The industrial waters discharged into the lake come from jeans-washing water factories, various food industry units and others. The industrial flow rates were estimated to be about 3000 m^3/day for the canal of Bir El Kasaa and about 2500 m^3/day for Ben Arous discharge canal.

The investigations undertaken have shown that these waters are polluted with heavy metals such as Chrome, Copper, Zinc, Iron, Nickel, Aluminium and Hydrocarbons. A treatment station under construction will be used to treat such waters. During the lake development works, these waters were deviated via a belt canal towards the Tunis harbour.

Hydraulic situation

Before the project, the lake did not maintain internal circulations and its waters were pseudo-stagnant. It communicated with the sea via the Rades Canal and with the navigation channel by three passes that were called Fisheries P4, P5 and P7. The exchanges with the Gulf of Tunis were very small, however, the exchanges with the navigation channel were relatively more important. The waters were pseudo-stagnant and circulations were only constrained at the area near the passes. Figure 4 represents the circulation state before

the works using a 2D hydrodynamic model executed within the framework of the development project.

Ecological situation of the lake

The effluents in the lake have yielded to very high pollution, which accelerated starting in the 1970s and was getting progressively worse during the 1990s owing to the rapid evolution of urbanism and industrialisation. This situation was a result of a very high eutrophication which was characterised, especially during the summer, by dystrophic crises with the appearance of red water phenomenon and the odours detectable within the whole zone of the south Tunis City.

This phenomenon was the result of the decomposition of large quantities of macro-algae of the type *Ulva rigida* (Figure 5), which was a dominant nitrophile species developing in the lake (concentration could reach 10 kg/m^2). These summer dystrophic crises were characterised by a low rate of dissolved oxygen, a very low pH, high salinity and high contents of phosphorus and nitrogen followed by a massive mortality of fishes (Figure 6).

The investigations undertaken about the physico-chemical quality of the water over a one-year period before the start of the project have revealed values proving a high eutrophication. The organic-nitrogen varied between 1500 and 3237 mgN/l, representing about 80% of the total nitrogen, the remaining account being present in the form of ammoniacal nitrogen.

The total phosphorus was also high and had reached values around 1000 mgP/l. These eutrophication conditions had yielded to a very severe natural selection of the ecosystem populations. At the zoological level, the benthic species were subject to a progressive decline starting from the zones close to the canal of Rades and the fisheries (the side of the navigation canal) of the number of species until the major confinement zones located at the level of the east and west areas.

Quality of the sediments

The South Lake sediments were also subject to different investigations in 1997 and 1998. The samples, collected at 26 sampling stations distributed over the whole lake, had revealed contamination by heavy metals such as Chrome, Copper, Zinc, Iron, Nickel, Aluminium and by Hydrocarbons at the two discharge eastern and western coves. The heavy metal pollution concerns mainly the sediments at the superior level (0.25 m) in the eastern cove, whereas within, the western cove, the pollution was found over a surface layer of 50 cm.
Figure 7 shows the spatial distribution of this pollution. Table I presents the contaminated sediments quantities

Studies

The development project entrusted to the LAC SUD 2000 group has included, besides the works, preparation of studies during the first phase of the project. These studies concern topics related to the hydrodynamic, water quality and contaminated sediments. The hydrodynamic and water quality were studied by Aveco BV with the collaboration of HR Wallingford and the NIOO Institute.

Hydrodynamics

The solution adopted consisted of introducing a flushing system which could allow a continuous

Figure 5. Ulva rigida: the dominant macroalgae species in the South Lake before the works.

Figure 6. Fish deaths at the South Lake shores during the summer dystrophic crisis.

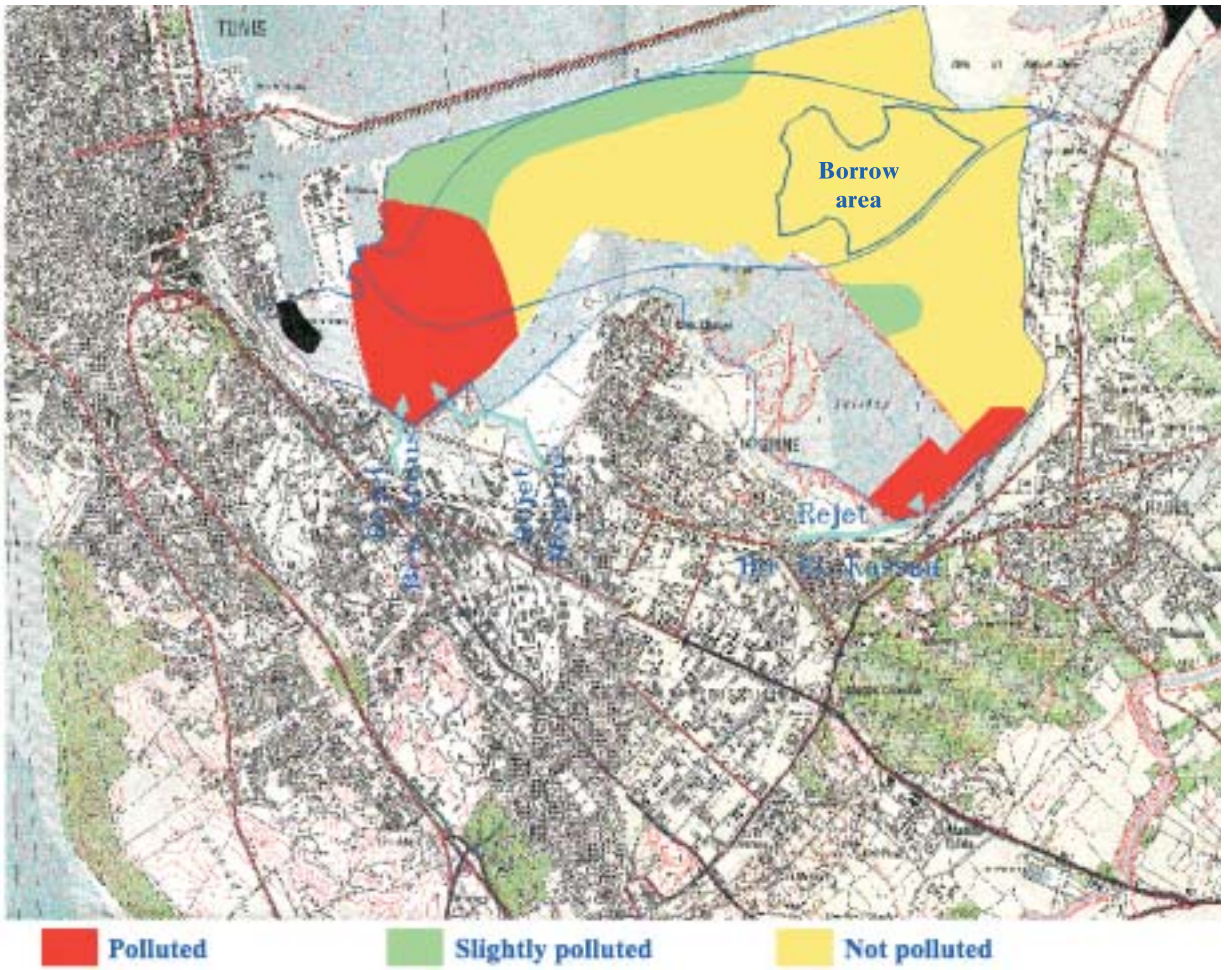


Figure 7. Distribution of the pollution within the sediments and localisation of the effluent points in the lake just before the project.

Table I. Estimated quantities of the contaminated sediments in the South Lake.

Zone	Polluted surfaces (m^2)	Thickness of polluted sediments (m)	Quantity (m^3)
Zone 1a (Effluent of Bir El Kassaâ)	180 000	0.25	45 000
Zone 1b (Effluent of Bir El Kassaâ)	300 000	0.25	75 000
Zone 5a (Effluent of Ben Arous)	850 000	0.50	425 000
Lake zone, west side (Effluent of Ben Arous)	1 000 000	0.50	500 000
Zone 4 (west side of the lake)	150 000	0.50	75 000
Total	2 460 000		1 120 000

regeneration of the lake waters without allowing them to be stagnant within the sites. This solution was ensured by the two following actions:

- The construction of two sluices, driven by the tidal forces. The first, located in Rades, represents the inlet sluice and it allows the entrance of seawater into the lake during high tides. The second one (the outlet sluice) is placed in Tunis and permits the lake waters to exit towards the navigation canal during low tides.
- The use of a geometric shape particular to the lake allowing a homogeneous circulation without local stagnation. This was ensured by the reduction of the lake surface from 1500 to 710 hectares, therefore avoiding the east and west coves which constituted the two major stagnation zones.

The studies were undertaken by using 2D and 1D hydrodynamic modelling. The results showed that the lake waters can be auto-regenerated in 4 to 7 days with

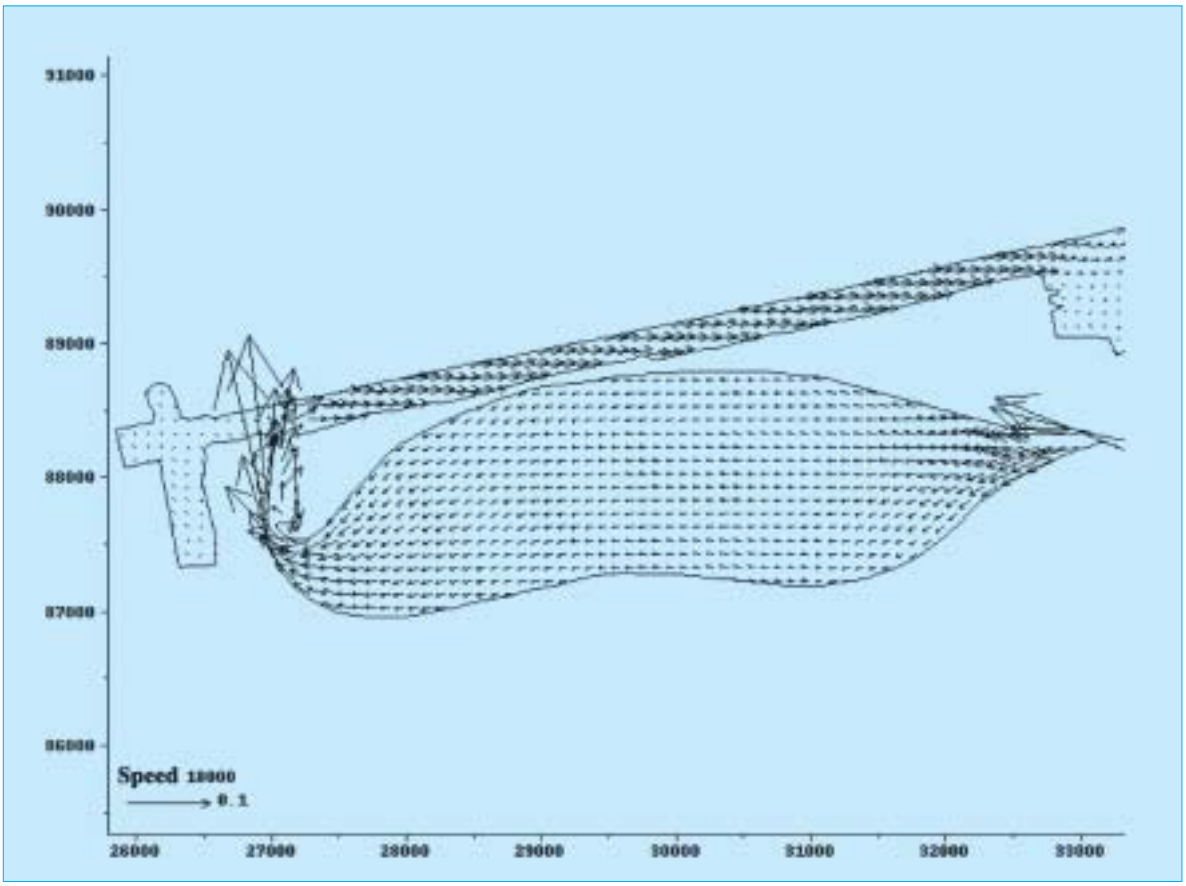


Figure 8. Expected circulation within the lake after the development project.

a daily rate varying as a function of the tides from 2.5 to 3.5 millions m^3/day. Figure 8 presents the expected circulation in the lake after the execution of the project.

Ecology and water quality

The water quality was simulated using a hydro-ecological model (ECO) that represents a combination of hydraulic and ecological processes. It describes the variation of few state parameters such as macro algae, phytoplankton, phanerogams, phosphorus, nitrogen, the pH and dissolved oxygen as a function of the hydro-dynamic, the benthic sediments release and other hydrologic parameters such as temperature, sunlight, salinity and so on. These parameters are calculated in three compartments of the lake with a time step of 1 hour. The variation processes are presented in Figure 9.

The predictions given by this model showed that the designed circulation system could regenerate the lake towards a high oligotrophy with seawater of Tunis Gulf.

The nutrient level will be comparable to that of the Gulf and the water will be well oxygenated during the entire year, which will help avoid anoxic periods that created all the pollution phenomena that affected the ecosystem prior to the restoration project (Figure 10).

A specific study about the future of bird life around the lake was carried out with the collaboration of the Dutch Reporting Commission of Environmental Impact. The solution given by this study was to create a reserve for these birds in a permanent wetlands area on the western side of the lake with a surface of 43 hectares (see Figure 12).

Contaminated sediments

The presence of a quantity of 1.12 million m^3 of sediment contaminated with heavy metals required special treatment different from that adopted for other types of sediments (categories II and III). Despite the fact that this topic was not included within the bid initially entrusted to the LAC SUD 2000, it was studied during the work period conforming to Tunisian legislation (law 96 – 41 of June 1996 relating to the treatment of polluted solid waste). A number of alternatives were studied concerning the confinement mode on land over the lake shores and in the aquatic area placement pit.

The final option was chosen with the collaboration of the Tunisian government represented by the "Agence Nationale de Protection de l'Environnement".

This option, which was applied, includes the following confinement modes:

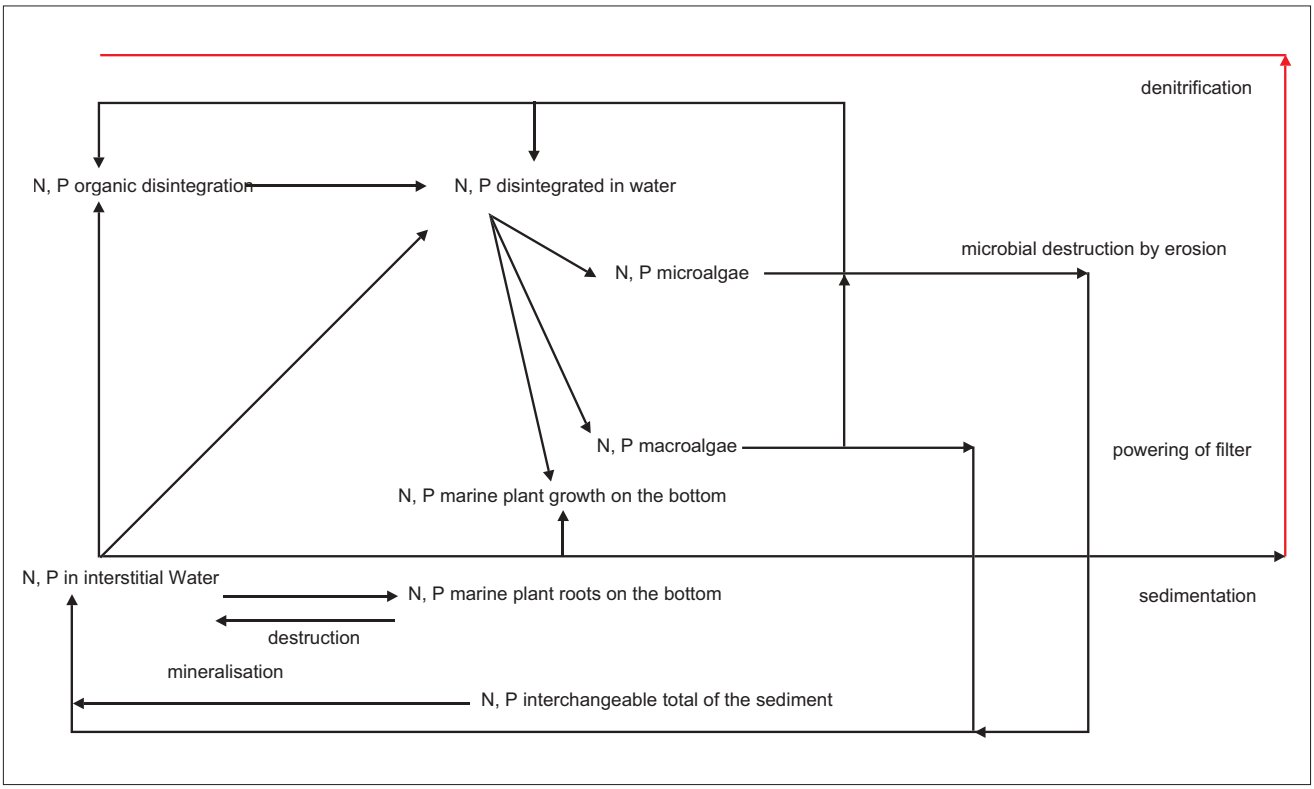
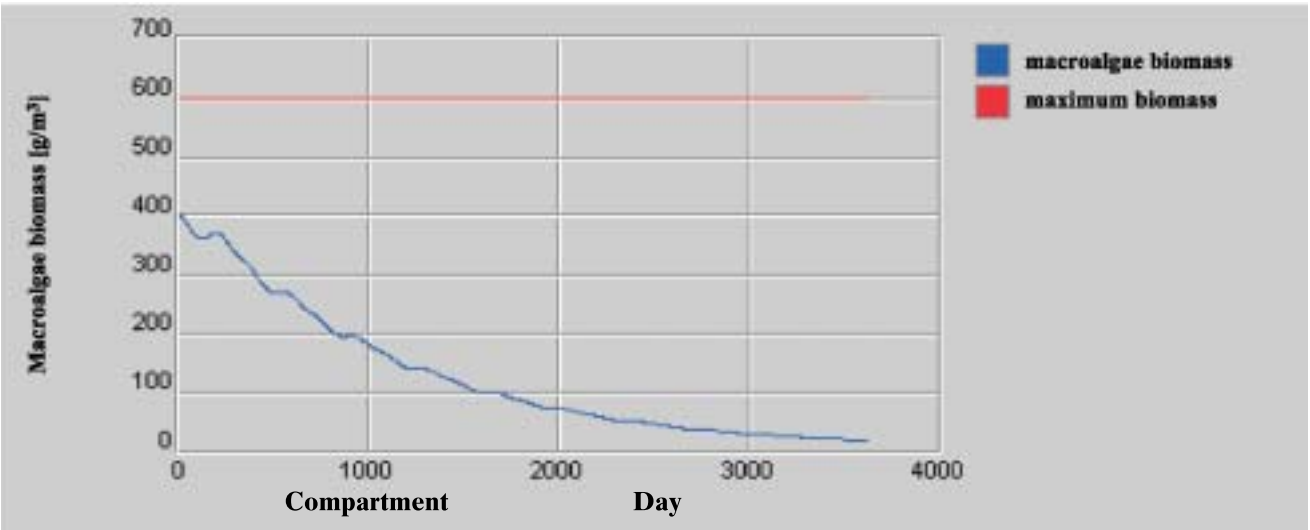


Figure 9. Adopted ecological processes within the hydro-ecological model.

Figure 10. Expected evaluation of the macroalgae after the development.



- The contaminated sediments of the east cove, representing the effluent zone of Bir El Kassaa, were left on site (on land) and covered with an inert material layer.
- The sediments of the west part of the lake were removed and taken to the terrestrial zone 5a, located on the western shores, over the locally contaminated sediments and were then covered by a non-polluted material layer. This zone was isolated from the lake by cavalier of sand that is made impermeable by using a vertical PEHD liner over a total depth of 8 m (Figure 11).

The risk study, using underground modelling, showed that the pollutants would be stopped in this terrestrial confinement zone and that Cadmium, being the most

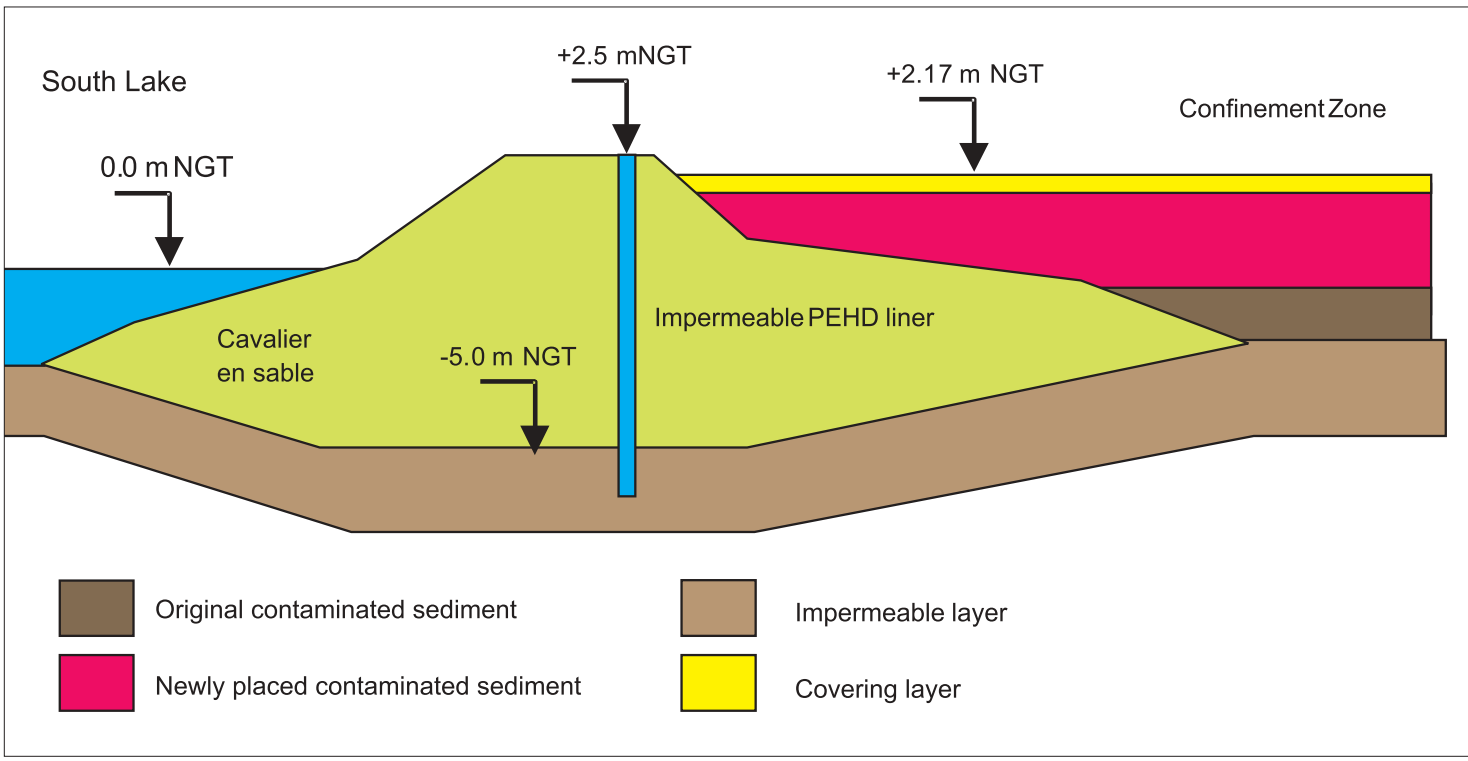


Figure 11. Confinement system installed over the west shores of the lake.

mobile pollutant, would be displaced by a few centimetres within a time period of 50 years.

The Executed Works

Taking into account the objectives of the project as well as the results of the studies undertaken within the framework of this project, the following activities have been executed:

- the dredging of a quantity of 5 million m^3 of sand category I from the lake, in an effort to create land reclamation site appropriate for housing;
- the dredging of a quantity of approximately 12 million m^3 of organic sediment categories II and III, in order to deepen the lake at a homogeneous level of –2 m NGT;
- the development of about 873 hectares of reclaimed land over the lake shores, including 350 hectares by sand category I and the rest by sediments categories II and III;
- the development of 13 200 m of cavaliers protected by rip raps extracted from Tunisian stone quarries;
- the installation of 2 100 m of PEHD liner (8 m deep) along the cavalier in order to confine the contaminated sediments in the terrestrial zone 5a;
- the development of a seawater feeding canal of 2 100 m in average length and 50 m in average width. This canal includes a section going into the sea of 765 m in length made by two dikes of large rocks of which the northern one is protected by the accropodes from the waves;
- the development of two bridges located over the canal of Rades, in an effort to maintain a hydraulic section sufficient to ensure a seawater inlet to the lake;
- the construction of an inlet sluice to Rades and an outlet one to Tunis marine. Each sluice is made of 8 compartments, separated by vertical concrete walls spaced by 9 m, including a pair of one-way metallic gates; and
- the development of two targets, in Tunis marine, of 1800 mm diameter and equipped by one-way valves in order to improve the circulation in Tunis harbour:

The South Lake, that previously had an area of 1500 hectares, now extends over an area of 710 hectares and includes a new shoreline of over 13 200 m in length and an overage depth of 2 m. Figure 12 shows the new configuration of the South Lake as well as the land reclamation on its shores.

The Monitoring Programme

The development works of the South Lake have been executed within the predicted due date of 3 years. The bid predicted a guarantee of the water quality, including the following parameters and criteria:

Dissolved oxygen	Tolerated minimum level: 30% of saturation
Total N and P	Tolerated maximum concentration for annual average: twice

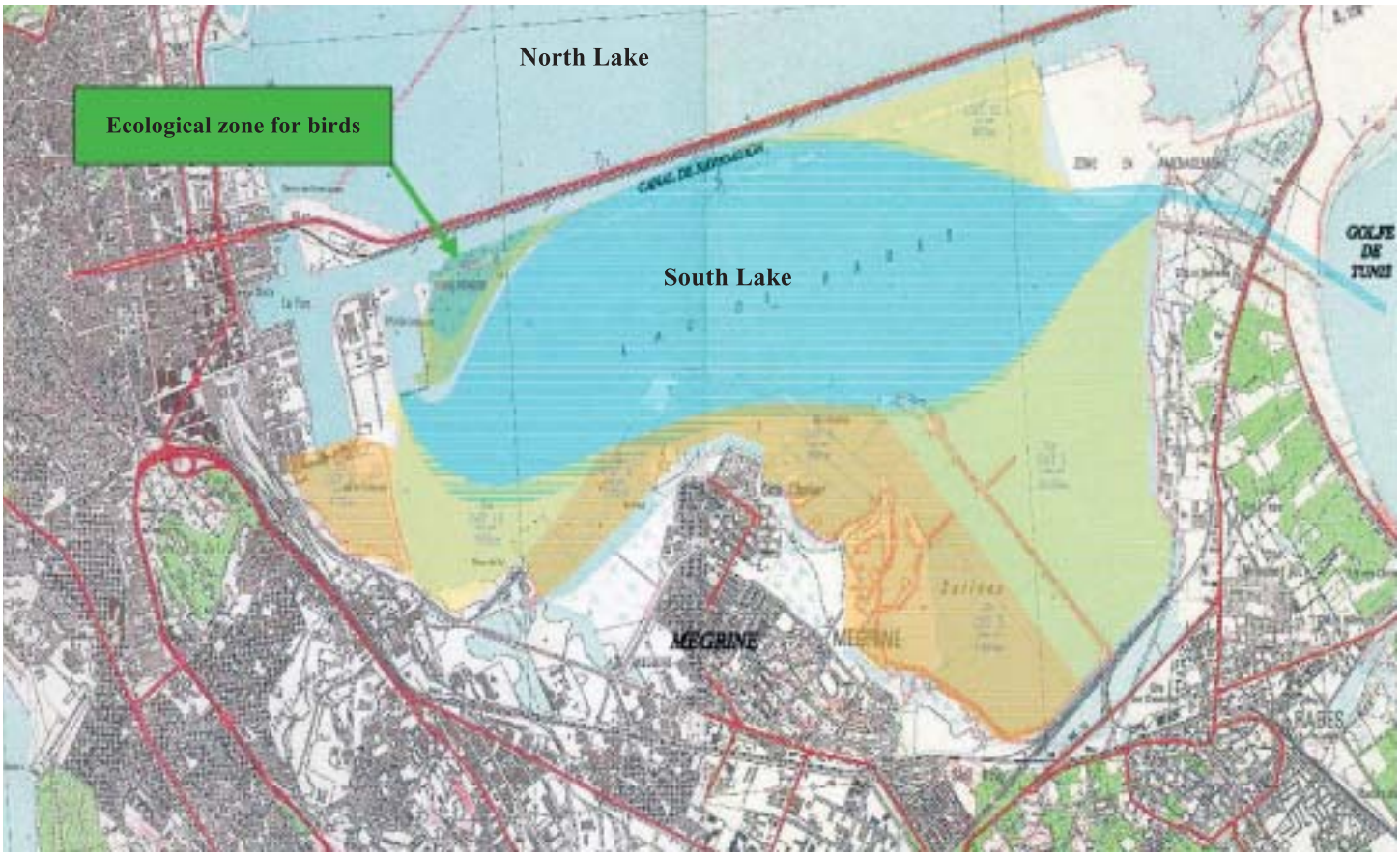


Figure 12. The new configuration of the South Lake after the restoration works.

	that of the gulf water for the east site and three times for the west side of the lake
Chlorophyll a	Tolerated maximum concentration for annual average: 10 mg/l
PH	Must be between 7 and 9 at any time
Transparency	Must be higher that 2 m in calm weather
Algae	Absence of accumulation of floating algae on the water surface
Macro algae biomass	Tolerated maximum bottom concentration: 0.6 kg/m^2 in dry weight.

The work period will be followed by a maintenance period of 2 years and a guarantee period of 5 years during which a monitoring programme maintaining the above parameters will be executed. A chemical laboratory was installed on-site to this purpose.

Conclusion: Technology Transfer

The aim of this project for a total regeneration of the lake including a modification of its shores, its morphology and its topography seems to have succeeded.

Moreover, the development project of the South Lake has allowed the transfer of new technologies to Tunisia. This transfer includes hydro-ecological modelling, management of lagoon water quality and management of dredged polluted sediments.

The group LAC SUD 2000, with the collaboration of the Dutch firm Aveco BV, has organised a training week on hydro-ecological modelling in order to allow the SEPTS engineers to explore and use software for the hydro-ecological provision and the management of the lake water quality. This software was supplied and installed within the terms of the project for SEPTS in two versions: one version, being based on exploitation and calibrated for the sake of the project, and a second study version which could be calibrated upon future changes within the lake. A new technique relating to the confinement of contaminated sea sediments was also adopted and constituted the first of its kind in Tunisia.

Jorrit K. de Groot and Pieter van Groen

The Gorai Re-Excavation Project

Abstract

In the last decades the Gorai River, a branch of the Ganges in Bangladesh, has been drying up, causing difficulties for the people that live along its banks. The decrease in water in the river during the dry season caused an increased salinity intrusion into the river, leading to harmful environmental conditions of a large mangrove forest situated at the rivers mouth. To get the river flowing again, a number of solutions were considered. Owing to the extreme morphological activity, the river response to an intervention is very hard to predict. Therefore investing in permanent structures was considered too high a risk. A better solution was found to be dredging a deeper channel at the bifurcation where the Gorai splits off from the Ganges.

After implementation of three dredging seasons, 1998, 1999 and 2000, this solution has increased the water flow in the river, restoring the fish population and allowing year-round shipping.

The authors would like to thank Fred Hoogervorst for the use of his photographs.

Introduction

The Gorai is one of the most important river branches in Bangladesh. The river is a branch of the Ganges and is the most important sources of sweet water for the southwestern part of Bangladesh. It is also important for shipping, fishing and for the ecological environment of the mangrove forests, the Sundarbans, situated along the coast.

Not insignificant is also the household use of the river water for the people living along the river's banks.

During the last decades the flow of the river gradually began to slow down. In contrast to the decrease in the (low-water) discharge of the river, the annual sedimentation of sand in the river increased. The combination of too little water and too much sand led to the lengthening of the period in which the river was completely dry.

After receiving his master degree in civil engineering at the Technical University of Delft in 1999, Jorrit de Groot started working at Hydronamic, the "in house" engineering company of Boskalis. Specialised in coastal and river engineering, he became a project engineer at the Gorai River Re-Excavation project soon afterwards. There he designed and evaluated the works and supervised the on-site survey department. During his stay in Bangladesh he also worked on a feasibility study of dredging the old Brahmaputra, a tributary of the Jamuna.

Jorrit K. de Groot

For the last 25 years Pieter van Groen has been involved in numerous river related projects in Asia. From 1991 onwards he participated in several large river projects in Bangladesh. He was design engineer for low cost river training works (FAP22) and project manager of the River Survey Project (FAP24) for Delft Hydraulics. Since 1998 he has worked as site engineer on the Gorai River (pilot dredging) for Boskalis.

Pieter van Groen

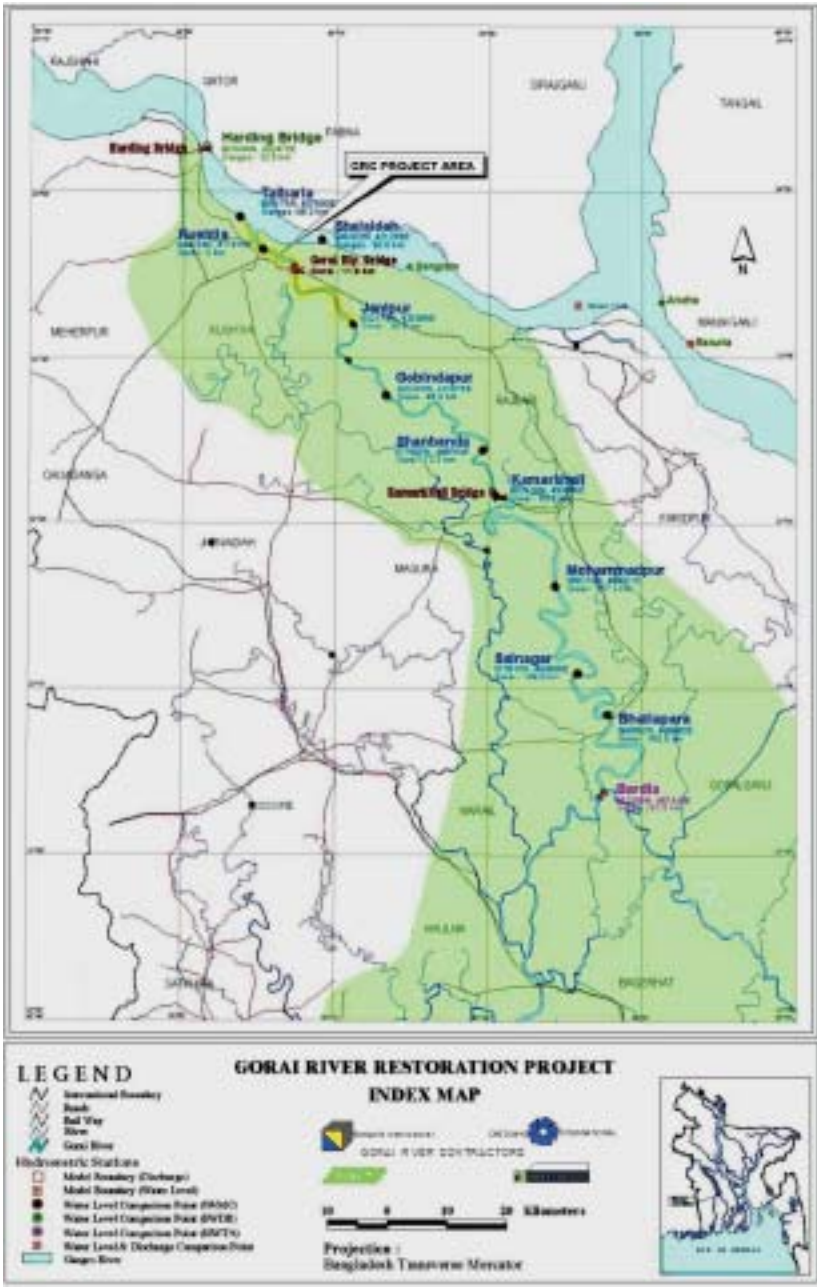


Figure 1. Map of the Gorai River. Project area marked in yellow.

This drought was catastrophic for all the functions of the river. In the last few years the Gorai was dry from January through April. Shipping was in this period no longer possible, and the related trade in goods was disrupted. The health of the inhabitants of the area around the river was threatened because there was no clean water available for household tasks. Because the river was dry, the salty sea water was able to push further upstream into the riverbed. As a result of the higher salinity, the river water could no longer be used for irrigation for agriculture. In addition, the increase in salinity resulted in a decrease in the biodiversity of the mangrove forest.

Treaty between India and Bangladesh

In order to solve these problems, the Bengali Government signed a treaty with India in which the distribution of the water from the Ganges between the two countries is regulated. The treaty establishes a certain minimum discharge and as a result of that a certain minimum water level for the Ganges. The treaty became effective in 1997 and established the circumstances for the restoration of the discharge of the Gorai. However, because the top part of the course of the Gorai was blocked with sediment, there was still no water flowing through from the main stream, the Ganges. In other words, the cork was still in the bottle.

To solve this problem a dredging project was begun in 1998 with the projected duration of two years. The dredging, performed by a joint venture of Boskalis, Dredging International, HAM and VOACZ, was meant to dig a low-water channel in order to restore the low-water discharge of the river. Because the Bengali Government attached great importance to these dredging works, the project was given the stamp of high priority (Figure 2).

Purpose of the Dredging

Owing to insufficient and limited knowledge of the behaviour of river systems such as the Gorai-Ganges system, it was impossible to adequately predict the response of the river to the action of dredging.

A secondary aim of the project was therefore to gain insight into the role that dredging could play in the restoration of the Gorai river in the long run. By intensively measuring the behaviour of the river during and after the dredging a better idea of the response of the river to dredging was achieved, and the ability to predict the response in the long run was improved.

Because alluvial rivers — such as the Ganges and the Gorai — consist of beds composed of fine sand, they are heavily subject to morphological changes. It is thus difficult to plan a detailed design of the work far in advance. For this reason a so-called "design and construct" contract was chosen, in which both the design of the work as well as its implementation are left to the contractor. The design, the evaluation of the dredging works and the interpretation of the surveyed data were done by Hydronamic bv, the internal engineering group of Boskalis.

The Works

At the end of the wet period in October 1998 the dredging work began at the bifurcation where the Gorai branches out of the Ganges (Figure 3). At that point a

Figure 2. At the request of the Bengali Government dredging of the Gorai took place; interested citizens line the river banks to watch the works.

large amount of sedimentary sand was blocking the stream of water into the Gorai. A new low-water channel was dredged at this fork in the river with help from two cutter suction dredgers, the *Gemini* and the *Wombat.*

The dredging of the channel took place in a down-stream direction, until the low-water discharge of the river was restored. The final length of the dredged low-water channel reached a distance of about 20 km from the fork of the Gorai branch and the Ganges.

The dredged sand was placed within the high-water banks, so that the high-water bed was narrowed and the flow channel was deepened.

In Bangladesh the dry period is followed by the very wet monsoon season, during which the flowing water stream carries a great deal of sand along with it. This destroyed part of the dredging work so that another dredging intervention was necessary to prevent the river from drying up.

The second dredging season started in September 1999, just after the monsoon was finished. This time only one cutter was used. With less effort than the first time, the low-water discharge of the Gorai was restored for a second time. This provided evidence that by dredging the river, the conditions of the river stream could be restored and that a general improvement in

Figure 3. Bifurcation area of the Ganges and Gorai.

Figure 4. Aerial view of the cutter suction dredger at work.

Figure 5. The Gorai provides water for washing for the populations along its banks. In the background, the dredgers continue their work.

the condition of the river was possible. The results of the project were so promising that it was decided to extend the project another year.

After the third dredging season — going from October to mid-December 2000 — the low-water discharge restored itself again, while the dredging effort itself lessened. The condition of the river again demonstrated further general improvement.

Continuing Improvement

Since the start of the dredging project, the volume of sand to be dredged in order to improve the river discharge during the dry season has steadily declined. In the first season, going from mid-October to mid-March two suction dredgers removed 9.2 million cubic metres of sand. In the second season going from mid-September to the end of January, one suction dredger removed 5.8 million cubic metres of sand. In the third dredging season, mid-October to mid-December, only 3.4 million cubic metres were dredged (Figure 4).

Despite the decreasing volumes of sand dredged, the results in terms of low-water discharge through the Gorai have remained the same. Soundings taken from the riverbed indicate that the river is slowly restoring itself in response to the dredging. The overall sedimentation which the river was experiencing in the years prior to the start of dredging has now been turned around into an increase in net erosion of the riverbed.

This has resulted in a steady deepening of the flow channel over the years, leading to an improvement in the flow of the river and a reduction in the volume of sand needing to be dredged.

The Future

Despite the present situation of increased river erosion, and thus a reduction in the annual volumes to be dredged, the future in terms of dredging is uncertain. The from year-to-year varying characteristics of the monsoon, the ever-changing configuration and heading of the Ganges main channel upstream, the bifurcation and the shape of the bifurcation area have great influences on the sedimentation pattern of the Gorai. These factors subsequently influence the volumes to be dredged. Because these factors are difficult to predict, so are the volumes to be dredged.

It is clear that for the near future it is necessary to continue to dredge in order to safeguard the low-water discharge of the river. From soundings of the riverbed it seems that during the monsoon the river is re-profiling itself. This means that the deep, narrow dredged channel is transformed by the monsoon into a broader, shallower channel, which is (still) unable to guarantee that water will be discharged through the Gorai during extreme low-water levels in the Ganges.

Another morphological process, which occurs during the monsoon, is that shallow spots develop at bend crossings in the river, which again create obstacles during extreme low-water situations. After the monsoon it is then necessary to dredge the flow channel back to a geometry that is capable of low-water discharge.

Conclusion

The conclusion after three seasons of dredging the Gorai is that intervention by dredging should be included in any long-term solutions for the restoration of the river, and can be seen as an alternative for building any conventional hard (i.e., stone) constructions in the river. The dredging operation can be seen as a flexible long-term solution for river problems, which — in contrast to conventional options — can anticipate the extreme changes in the morphology of the river system.

As a direct result of the intervention by dredging, water is flowing once again through the Gorai even in the dry season. Villagers can use the water of the Gorai to wash clothes, to catch fish for a nutritious evening meal, and children can play in the river and on its banks (Figure 5). The river can be used the whole year through for shipping so that goods can easily be transported from one village to another. The fish have returned to the river and the intrusion of salinity has been strongly reduced.

The restoration of low-water discharge has established the prerequisites for an enduring development of the Sundarbans. The certainty of sweet surface water during the entire year also creates the basic conditions for further development of irrigation for agriculture. The availability of surface water during the whole year can, with the installation of water purification facilities, be used in the future as a source of drinking water. Because the groundwater in Bangladesh is contaminated with arsenic, while the surface water is not, the use of surface water can remove a serious threat to public health.

In general the conclusion may be drawn that the restoration of low-water discharge of the river, as a result of these dredging works, have created new chances for further development in southwestern Bangladesh.

Charles W. Hummer, Jr.

Books/ Periodicals Reviewed

Guidelines for the Assessment and Planning of Estuarine Barrages
UK Department of Environment, HR Wallingford and Environmental Agency. Thomas Telford Publishing, London, UK. 2001. Hardbound, 529 pp., 170x245 mm, illustrated, indexes. £ 75.00.

Edited by Neville Burt and Andrew Rees

The UK Department of Environment, HR Wallingford and Environmental Agency compiled this book as a joint endeavour. The Department of Environment, which paid for half the costs, commissioned the research which forms the basis of the book. The Environmental Agency funded the other half. The project was overseen by a steering committee and HR Wallingford was the contracted research entity.

The objective of the research was to review available experience on the design, operation and environmental impact of estuarine barrages in order to provide the best practice design and operational engineering solutions to overcome or mitigate problems and enhance the aquatic and riparian environment.

For the purposes of the research and this book, a barrage is defined as a structure built in an estuary, at a point where it is not less than 15 m wide, with the specific intention of preventing or modifying tidal propagation.

The book is very well organised and begins with an excellent and rather comprehensive preface that effectively summarizes the following chapters. There are twelve narrative chapters, a chapter of references, eight appendices, and an index. The expansive preface serves as a quick read of the subject matter in summary and thence gives the reader the ability to go directly to the chapter wherein more detailed treatment is contained. This is a technique not generally seen and it is a very effective means to introduce the casual readers to the subject and direct the more serious readers to their specific areas of concern.

The guidelines presented recommend that future barrage schemes should closely embrace the principles of sustainable development, thereby insuring that economic investment and environmental improvements are congruent. With this as a positive underlying principle, the book is divided into the following chapters:

Chapter 1 contains an introduction to the issues, an amplified list of the issues, a description of appropriate levels and methods of study, a description of monitoring, methods pertaining to the issues, and case studies.

Chapter 2 presents the chronology for decision-making. It covers pre-feasibility and feasibility studies, detailed design, monitoring, long-term ownership and responsibility issues and legislative framework.

Chapter 3 is entitled, "Fisheries and conservation", and has sections on migrating fish, marine fish, invertebrates, birds, habitats and recreation.

Chapter 4 considers water quality both upstream and downstream of the structure. The effects of salinity, effluent loading, oxygen balance, eutrophication and other effects on water quality are discussed. The chapter also considers recreational water quality and remedial measures that prevent poor water quality.

Chapter 5, "Hydraulics", describes the principal features of the tidal hydraulic processes in an estuary and then considers the effect a barrage is likely to have on them. The features discussed include: tides, gravitational circulation and saline intrusion.

Chapter 6 presents morphology or shape of an estuary and the effects of fluvial and tidal flow as well as the effects of tidal and fluvial-borne sediments.

Chapter 7 is a discussion of flood defence regime in the watercourse. It lists the principal issues regarding flood defence, and its relationship to the functions of river authorities, no matter where they may be located.

Chapter 8 discusses the impacts of barrages on estuarine water levels, the interaction with aquifers and the consequent effects on groundwater. Specifically the impacts of derogation of water resources, impacts on property and stability of bankside structures are enumerated. Potential hazards associated with rise in groundwater are listed.

Chapter 9 considers navigation and the impacts barrages have on this function. Because a barrage of any type is designed to obstruct tidal propagation, it naturally follows that it will have some impact on navigation. Design parameters, upriver and downriver effects are discussed at length.

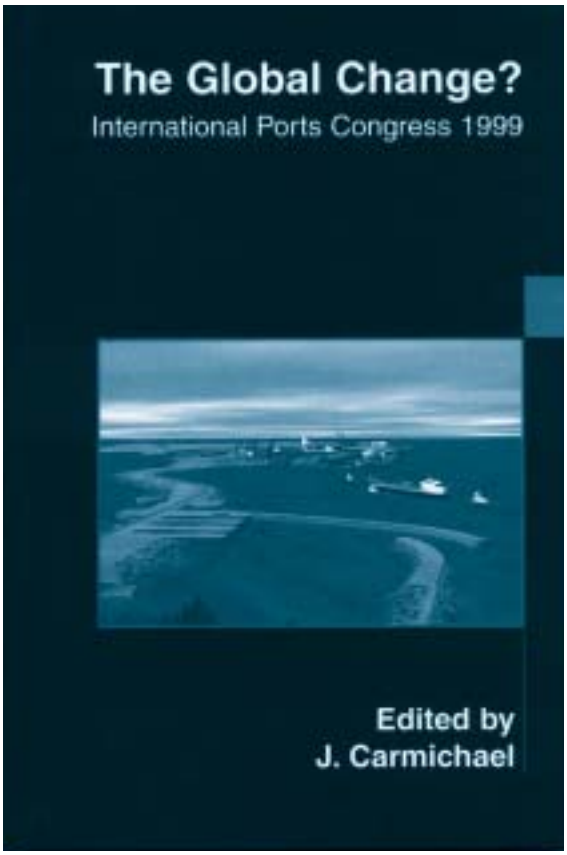
Chapter 10, "Waves", is a discourse on those instances when waves present a problem for barrages and the protective measures that are in order.

Chapter 11, "Structure", is divided into sections; issues concerned with the structure; design; commissioning; maintenance; and monitoring.

Chapter 12, the final narrative chapter, summarizes research priorities drawn from those areas that were identified in the study as requiring further research. The greatest single research need is for the monitoring of existing barrages, not just in physical terms but also in the wider short- and long-term socio-economic implications. In addition, the chapter itemizes sustainable development issues, technical issues and modelling.

Chapter 13 is a comprehensive listing of references. The eight appendices cover planning and environmental legislation, a number of case studies, and codes, standards and reference manuals, gates, valves and ancillary equipment and modelling.

Estuaries have a high conservation environmental and amenity value and are also a limited natural resource, so while the research and the book itself present case studies related to experiences in the UK, the design, operation, monitoring, modelling and environmental issues have a universal application. In that regard, this book is a valuable contribution to the international technical literature and will provide meaningful information for a wide international audience.



The Global Change? — International Ports Congress 1999
Proceedings of the international congress organised by the Institution of Civil Engineers, held in Southampton, UK, on 14-15 June 1999. Thomas Telford Publishing, London, UK. 2000. Hardbound, 16 x 24 cm, 208 pp, illustrated. £ 45.00.

Edited by J. Carmichael

This seemingly small publication is misleading insofar as the relevance and importance of its subject matter. The content and presentation certainly merits far more consideration than its modest size would indicate.

The seventeen papers and the keynote summary represent the proceedings of a conference organised by the ICE in conjunction with IAPH and PIANC. They cover a wide range of subjects within the context of the theme of the congress, "The Global Change?". Particular attention is given to recent developments in design and construction methods and how these must be economically integrated with operational requirements and environmental considerations. Also modern procurement and funding are examined and consideration is given to ports in relation to integrated transport systems.

Beginning with the keynote paper that presents an overview from the perspective of the UK's Associated British Ports Holdings, the papers cover

design, environmental, operational, and funding issues related to ports and port technology and a listing of them gives an impression of the comprehensive nature of the proceedings:

- Ports — facing global changes and challenges
- Naval architecture and the ship to shore interface
- The environmental bottom line
- Port development: dealing with environmental issues — a consultant's perspective
- Bulk handling in ports
- Fast ferries
- Port revitalisation and diversification
- Coastal shipping
- Construction techniques in quay walls
- Ship handling and pilots
- Controlling port safety in a changing work environment
- Risk management projects in a sea of new forms
- Project procurement and administration
- Funding issues
- Port developments on exposed coastlines
- Techniques of port design and port simulation
- Ro-ros
- Container handling — global change?

There seems to be something for virtually any reader connected with the marine construction field. Readers who are attracted to certain specific papers of interest will find themselves reading almost every paper — a tribute to both the authors and the organisers of the congress.

Perhaps especially noteworthy are the following papers:

"Port development: dealing with environmental issues — a consultant's perspective" by Sian John and Steve Challinor, is a very useful summary of the issues relating to all sectors in port design and construction. Of particular worth are the tables that summarise various aspects and processes that should be considered. In some sense, it is a review of some fairly obvious issues, but the presentation makes it a valuable tool for the reader.

Likewise, the paper, "Construction techniques in quay walls", by Piet Meeuwissen, presents the case of the Port of Rotterdam project, Delta 2000-8. Covering the design and construction aspects of both the waterside and landside elements of the project, the author discusses the concrete curing control measures resulting from the tender document requirements.

Finally, as an example of the nature of the papers contained within the publication, the paper by Martin C G Smith, "Risk Managing Projects in a Sea of New Forms", should pique the interest of readers from almost any background. The paper discusses the relevance of forms of contract to quality, cost and defects in port infrastructure construction and equipment supply. The author concludes, in part: "There is promising potential for improvements to Quality, cost and defect minimisation in projects contracted under the new forms, providing the Employer or his consultants actively and appropriately manage the new context. A 'Hands off' management philosophy which existed in some minds was a false dawn".

Following the papers are 22 pages of discussions on selected papers. These discussions definitely provide added value to the book and almost any reader with any background and profession connected to port and marine construction will want to have a look.

Construction Risk in River and Estuary Engineering: A Guidance Manual
Thomas Telford Publishing, London, UK. 2000.
Softbound, A-4 size, 265 pp, illustrated, with appendices and index. £50.00.

Edited by Mark Morris and Jonathan Simm

This manual aims to assist in identifying and taking account of risks in works design and construction. It offers guidance on risk assessment and management techniques along with the identification of typical risk issues likely to be encountered in river and estuary environments. The manual was produced as an outgrowth of a HR Wallingford (UK) research project and was also published as HR Wallingford Strategic Report No. SR562.

The manual consists of six sections or chapters. The table of contents is detailed enough to be quite effective in locating and referring to pertinent aspects of the subject. It contains extensive illustrations consisting of tables and figures, as well as text and illustrated boxes. Moreover, there is a comprehensive listing of references, a glossary and eight appendices. The organisation of the manual makes it quite effective in achieving its objectives.

The contents are summarised as follows:

1. Introduction
2. An overview of risk appraisal and management techniques
3. A predictable river?
4. Health and safety
5. Insurance
6. Procurement
7. References

continued on page 32

Seminars/ Conferences/ Events

Port China & Marintec China

Intex Shanghai, China
December 4-7 2001

China's premier maritime conference and exhibition, Marintec China, will now include Port China. Currently China has over 2000 ports and 128 ports which are open to foreign vessels. Many ports are already being upgraded and increased trade is expected to come form China's entry into the WTO. The port authorities of Shanghai and Rotterdam have signed a letter of intent to cooperate on technology interchange.
Port China will address the demand for better and more expedient ort facilities and services and will benefit from running concurrently with Marintec China. High level seminars and the Senior Maritime Forum will allow policy makers and industry leaders a chance to exchange views.

For further information please contact:
Ms Ginnie Koay in Hong Kong,
email: ginniekoay@mfasia.com.hk

Madam Wang Lingzhi in Shanghai,
email: ssname@uninet.com.cn

Mr Richard Johnson,
email: rjohnson@seatrade-global.com

Mr Michael Kazakoff, Miller Freeman
email: mkazakoff@compuserve.com

Oceanology International 2001

Singapore International Conference & Exhibition Centre
December 4-6 2001

OI Pacific Rim 2001 provides a unique place to network with industry, academia, the R&D community and governments in Southeast Asia. Disciplines such as marine environmental sciences, survey and engineering, navigation and remote sensing, marine pollution monitoring and control, hydrography, dredging and coastal engineering, renewable energy and more are represented at the exhibition.

The exhibition is supported by an important conference with the theme "Science and Technology for Surveying, Evaluating and Protecting Marine Resources and the Environment". The National University of Singapore's Tropical Marine Science Institute will help coordinate the conference and keynote speakers. The topics include:
- coastal oceanography
- marine information systems
- ballast water management
- coastal marine resource management.

For further information about the conference contact:
Angela Pederzolli
tel. +44 20 8949 98339
fax +44 20 8949 8186
email: angela.pederzolli@spearhead.co.uk
www.oceanologyinternational.com

Marine Indonesia

Jakarta International Convention Centre
January 14-16 2002

The 10th International Marine, Shipping, Port Equipment and Cargo Handling Exhibition will be held concurrently with the complementary shows Oil & Gas Technology Indonesia 2002 and Gas Indonesia 2002. It is the established trade show for international suppliers of marine equipment and technology tarketting the Indonesian market. With Indonesia's economy in a growth spurt, it is an ideal moment for suppliers in the marine industry to renew old contacts and make new ones.

For further information contact:
Overseas Exhibition Services Ltd.
11 Manchester Square, London W1U 3PL, UK
tel. +44 20 7862 2090/2000
fax +44 20 7862 2098/2001
email: indonesia@montnet.com
www.montnet.com

Bahrain Naval & Maritime 2002

Bahrain International Exhibition Centre
January 14-17 2002

Bahrain International Naval & Maritime Exhibition and Conference is the Middle East's first dedicated naval and maritime event featuring naval and merchant shipping and equipment; maritime engineering; environmental protection and control technology.

The conference running parallel with the exhibition will concentrate on issues related to integrated coastal zone management with particular reference to the Arab world. The venue will be spread between the International Exhibition Centre and the Port of Mina Sulman, offering an optimal combination of covered and outdoor exhibit space, deep-water dockside moorings and conference facilities.

For further information please contact:
DW Associates
19 Bulstrode Street, London W1U 2JN, UK
tel. +44 20 7487 2551,
fax +44 20 7487 5195
email: exhibitions@dial.pipex.com, or

Arabian Exhibition Management
PO Box 2020011, Manama, Bahrain
tel. +973 55 0033,
fax +973 55 32 88
email: naval@aeminfo.com.bh

Oceanology International 2002

ExCel, London, UK
March 5-8 2002

This is one of the largest and busiest international events in the global marine science and ocean technology fields. It has some 600 exhibitors and will attract thousands of trade visitors including policy makers, industrialists, government representatives, researchers, managers and manufacturers involved in all aspects of marine science.
It is sponsored and supported by the Society for Underwater Technology, European Oceanographic Industry Association, World Meteorological Organization, Intergovernmental Oceanographic Commission, The Hydrographic Society and Hydro International.

For further information please contact:
PGI Spearhead Ltd.
Coombe Hill House, Beverley Way,
Raynes Park, London SW20 0AR, UK
tel. +44 208 949 9222,
fax +44 208 949 8186
www.spearhead.co.uk

Sea Japan

Tokyo Big Sight Exhibition Centre
April 10-12 2002

This is the major biennial meeting place for Japan's shipbuilding, marine equipment and ship-owning industries. Exhibitors include as well software, communications, ship classification, government and regulatory bodies, and management. A New Technology Seminar programme will allow exhibitors to present details of their latest products.

For further information in Europe contact:
The Seatrade Organisation
Seatrade House, 42-48 North Station Road,
Colchester CO1 1 RB, UK
tel. +44 1206 545121,
fax +44 1206 545190
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fax +852 2827 7831

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email: sales@cmpjapan.com
www.seajapan.ne.jp

ITMMA Maritime and Port Symposium

Antwerp, Belgium
April 18-20 2002

The Institute of Transport and Maritime Management Antwerp, an autonomous university institution within the University of Antwerp, in collaboration with McKinsey & Company has organised a symposium, entitled "The Maritime and Port Industry in Transition: Solutions beyond economies of scale and scope".

It is an effort to understand the challenges facing the maritime industry in this new century and is intended for top-level executives, policymakers and academics. A number of high-level international speakers from academia and McKinsey will address strategic issues, after which break-out workshops on inter-modality, logistics; port competition and co-operation and port networking are planned .

For further information contact:
ITMMAPS, Middelheimlaan 1,
B-2020 Antwerp, Belgium
tel. +32 3 218 0678,
fax +32 3 218 0743
email: itmma@ua.ac.be
www.itmmaps.com

COPRI Dredging '02

Rosen Plaza Hotel,
Orlando, Florida USA
May 5-8 2002

Dredging '02 organised by Coastal, Oceans, Ports, and Rivers Institute (COPRI) of the American Society of Civil Engineers, will focus on "Key Technologies for Global Prosperity". The economic impacts of dredging will be emphasised, in subjects such as:

- increasing costs of dredged material disposal;
- the necessity for deepening projects to maintain port viability; and
- benefit and cost considerations of dredging as a large-scale environmental remediation tool.

A wide range of other general topics, such as, beneficial uses of dredged materials, treatment of contaminated sediments, specialty dredging equipment, case studies of special dredging projects and so on are also of interest. In addition, the conference will feature an Exposition of the newest technologies and services for dredging professionals.

For further information about the technical programme contact:
Stephen Garbaciak, Jr., P.E.
Technical Programme Chair
BBL, Inc., 200 S. Wacker Dr, Suite 3100
Chicago, IL 60606-5802
tel. +1 312 674 4937
email: sdg@bbl-inc.com

For general information contact:
COPRI/ASCE Headquarters
Conference Department
1801 Alexander Bell Drive
Reston, VA 20191-4400
tel. +1 800 548 2723,
fax +1 703 295 6144
email: conf@asce.org

Shiport China 2002

Dalian Xinghai
Convention & Exhibition Centre, China
June 26-29 2002

Dalian, the hub of the maritime industry in Northern China, is hosting this 3rd International Ship Building, Port and Marine Technology and Transportation Equipment Exhibition. It is the premier exhibition for the industry in China offering information on shipbuilding equipment, port facilities, marine technology, transportation equipment, as well as related services and equipment. Concurrently the International Marine-Tec Conference will be held at which experts address key technology trends.

For further information contact:
Business & Industrial Trade Fairs Ltd.
Unit 1223, HITEC, 1 Trademart Drive,
Kowloon Bay, Hong Kong
tel. +852 2865 2633
fax +852 2866 2076/ +852 2865 7729/
+852 2866 1770
email: shiport@bitf.com.hk

30th PIANC Navigation Congress

Sydney, Australia
September 22-26 2002

The Organising Committee, under the auspices of PIANC and the Institution of Engineers, Australia, and with support from government, industry and academia, is presenting a conference which will focus on the following topics:

- How to guarantee sustainable navigation;
- Environmental issues, such as habitats, management of world heritage areas and stakeholder consensus;
- Policy issues, such as the role of public and private sectors in port development;
- Inland waterways transport including assessment of needs and technical and economic problems;
- Port issues, such as revitalisation and port planning and operations; and
- Issues related to ships and fairways.

A trade exhibition will be held in conjunction with the Congress. The exhibition will cover a wide range of products and services related to the maritime industry. Companies wishing to participate should contact the PIANC Congress Managers.

For further information please visit the Australian Organising Committee homepage:
www.tourhosts.com.au/pianc

or contact:
PIANC, General Secretariat
Graaf de Ferrairis - 11th Flr.
20, Boulevard du Roi Albert II,
1000 Brussels, Belgium
tel. +32 2 553 7160, +32 2 553 7155
email: info@pianc-aipcn.org
www.pianc-aipcn.org

Call for Papers

WEDA XXII & TAMU 34

Omni Interlocken Resort,
Denver (Broomfield), Colorado
June 12-2002

The Twenty-second Western Dredging Association Annual Meeting and Conference and the Thirty-fourth Texas A&M Dredging Seminar will be held in June 2002 at the Omni Interlocken Resort. The theme of the conference is "Dredging for Prosperity" and will provide a unique forum for all interested parties.

Topics for the three-day technical programme and exhibition will include, but are not limited to:
- dredging for development;
- beneficial uses of dredged material;
- wetland creation and restoration;
- dredging systems and techniques;
- multibeam surveying;
- dredging and navigation;
- cost estimating;
- navigation dredging;
- geo-technical aspects;
- dredging for beach nourishment;
- automation in dredging;
- contaminated sediments;
- project case studies; and
- inland dredging.

Deadlines for papers are:

One-page abstracts:	December 15 2001
Notification of authors:	January 1 2002
Final manuscripts:	April 1 2002

For further information or submitting one page abstracts please contact one of the following members of the WEDA Technical Papers Committee:

Dr Ram K. Mohan
Blasland, Bouck & Lee, Inc.
tel. +1 410 295 1205, fax +1 410 295 1209
email: rkm@bbl-inc.com

Dr Robert E. Randall
Dept. of Civil Engineering, Texas A&M University
tel. +1 979 845 4568, fax +1 979 862 8162
email: r-randall@tamu.edu

Mr Stephen Garbaciak, Jr.
Blasland, Bouck & Lee, Inc.
tel. +1 312 674 4937, fax +1 312 674 4938
email: sdg@bbl-inc.com

Books/ Periodicals Reviewed

continued from page 28

The Appendices are listed as follows:
- Actions to be undertaken at each step in the risk identification, assessment and management process
- Other risk assessment and modelling methods
- Example of a risk management workshop
- Perrancoombe Stream flood-area study. Test-case
- River and estuary engineering prompt lists
- Additional health and safety information
- Additional environmental impact information
- Data sources and techniques for predicting tidal water level and wave conditions at a specified location

It is apparent that the authors/editors have produced a comprehensive manual, well suited for both educational purposes as well as a working reference document for the practitioner. Specifically, the authors have directed this publication to project funders, clients and their representatives; contractors; designers; and insurers. They have attempted to provide guidance for the specialist and the non-specialist. Whilst most of the issues refer specifically to practices in England and Wales, the thrust of best practice guidance is applicable across the UK and internationally.

The table that outlines the use of the manual by chapters is very useful and is an effective introduction to the subject matter and its presentation within the manual. The publication serves as an excellent primer even for those casually involved in construction and the application of risk theory in construction practice. At the same time it serves as an effective tool for the target audience of more directly involved readers.

All these publications can be obtained from:
Thomas Telford Publishing, Ltd.
1 Heron Quay
London, E14 4JD, UK

ASCE Press
1801 Alexander Bell Drive
Reston, Virginia 20191-4400, USA

Maruzen Co. Ltd. Book Department
3 – 10 Nihonbashi 2-chome
Chuo-ku, Tokyo 103, Japan

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648 Whitehorse Road
Mitcham 3132, Victoria, Australia

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