



**REINFORCEMENT OF THE
WATER SUPPLY SYSTEM TO
THE MAFRA MUNICIPALITY**

Client:

Empresa Portuguesa das
Águas Livres, S.A.

**Preliminary Study and Final
Design:**

2001 / 2003

**Adaptation of the Final
Design:**

2005

**Civil Construction Works
Reservoir R3 and Pumping
Station EE2**

Client:

Compagnie Générale des Eau
(Portugal), S.A.

**Supervision of the
Construction Works:**

2006 / ...



DESCRIPTION:

Reinforcement of the Water Supply System to the Mafra Municipality envisages reinforcement of drinking water supply to serve a population of approximately 130.000 inhabitants, through the provision of an additional volume of 33.000 m³/day of treated water to the Venda do Pinheiro municipal reservoirs. The implementation of this system results from the need to meet the increasing water demands originating from the demographic expansion which has occurred in the Mafra Municipality.

The system consists of a water intake in the ring road conveyor, three reservoirs (with 2 000 m³, 2 000 m³ and 14 000 m³ capacities), two pumping station and approximately 18,7 km of ductile cast iron pipelines with a 700 mm diameter.

Reservoirs R1 and R3 shall comprise semi-buried rectangular cells, each with a capacity of, respectively, 1 000 m³ and 7 000 m³. On the other hand, reservoir R2 shall comprise two semi-buried circular cells with a capacity of 1 000 m³ each.

The system's pumping stations, EE1 (flow: 0,425 m³/s; rated capacity: 1 000 kVA) and EE2 (flow: 0,384 m³/s; rated capacity: 1 250 KVA), attached respectively to reservoirs R1 and R3, shall both be equipped with 4 pumping units, of which one shall act as a standby unit. The rated capacity of the electric engines of each pumping unit shall be 200 kW in pumping station EE1 and 250 kW in pumping station EE2.





**REHABILITATION OF THE
WATER INTAKE OF THE
VALADA PUMPING SYSTEM
IN THE TAGUS RIVER**

Client: EPAL – Empresa
Portuguesa das Águas Livres,
S.A.

Final Design:
2000 / 2001

**Technical Assistance to
Construction:**
2002/04

DESCRIPTION

The Rehabilitation of the Water Intake of the Valada Pumping System in the Tagus River has the purpose of complementing the existing gravity canal intake, in order to improve the pumping conditions during low water levels in the river (below 0.7).

The previous system used pumps installed on a floating structure to impound the water during low water levels in the river (in situations of high levels, water was lifted to the former suction pit). Although practical, this structure involved some problems associated with sediment deposition or the impact of floating debris during floods. To solve this problem, movable suction pipes were installed near the canal intake, which can be moved for sediment cleaning purposes and to prevent the impact of floating debris during floods.

The new pumping system is materialised through a rectangular caisson built nearby the bank, to which four steel suction pipes with a length of 12 m, articulated on the base and servomotor maneuvered are fixed. These suction pipes feed four electropump units installed in the caisson by means of a vacuum system; these units lift the water up to the existing gravity canal intake.

The structure is installed on the low consistency alluvial soils of the Tagus banks. This fact, together with the execution of an important part of the structure during high flows period, implied the adoption of complex solutions and building methods. During the execution, a number of designed measures had to be adjusted to the actual conditions, aspects that are also approached in the paper.





**SISTEMAS DE
SANEAMENTO DE
AGLOMERADOS URBANOS
NAS BACIAS DOS RIOS
REAL E ARNÓIA.**

Cliente: IPE – AdP / Águas do
Oeste

Projecto de Execução: 2000/02
Assistência Técnica: 2003/2004

SISTEMAS DE ÁGUAS RESIDUAIS E PLUVIAIS

Sistemas de Drenagem

SISTEMAS DE SANEAMENTO - BACIAS DOS RIOS REAL E ARNÓIA

PORTUGAL

DESCRIÇÃO:

O Projecto de Execução comportou as seguintes fases:

- Análise crítica do sistema de despoluição da lagoa de Óbidos, onde se insere o presente sistema de Saneamento;
- Estudo prévio do Sistema de Saneamento;
- Fornecimento de dados de base para a elaboração do estudo económico-financeiro (de viabilidade da empresa concessionária da exploração do sistema de Saneamento);
- Projecto de execução da infra-estrutura física do sistema, incluindo a ulterior assistência técnica em fase de obra;
- Levantamento de proprietários afectados pelas obras (2520 parcelas afectadas);
- Estudo de incidências ambientais;
- Elaboração do Regulamento de descarga de águas residuais domésticas e industriais;
- Levantamentos das indústrias existentes e quantificação de investimentos a efectuar nas redes municipais.

População da área em estudo: 69 400 habitantes.

A infra-estrutura física do sistema de saneamento estudado e projectado envolve as seguintes obras principais:

- Cerca de 100 km de condutas, dos quais 59 km em interceptores e 41 km em emissários com diâmetros entre 110 e 560 mm
- ETAR da Charneca para cerca de 45.000 habitantes caudal total médio de 9 104 m³/d e caudal de ponta de 185 l/s.
- ETAR por lamas activadas de Reguengo Grande para uma população de 1615 habitantes
- ETAR por macrófitas de Casal Camarão para uma população de 231 habitantes
- 21 estações elevatórias, das quais 12 ao longo de interceptores principais e 9 em emissários com potências dos grupos entre 5 e 110 kW.
- estações de tamização e pontos de medição de caudal;
- ETAR terciárias, obtidas por ampliação das ETAR secundárias existentes, para populações entre 100 e 1600 habitantes.



**WATER SUPPLY TO THE
CITY OF N'DALATANDO**

Client:
Direcção Nacional de Águas
(D.N.A.).
(National Water Directorate)

**Final Design and Tender
Documents:**
2004 / 2005

*Works undertaken in
association with Consulprojecto*

Total Investment Cost:
11,1 MUSD

DESCRIPTION

The project envisages water supply to the urban and peri-urban zone of N'Dalatando, with an estimated population of 600.000 inhabitants in the project horizon year (2025). The following infrastructures were studied within the Final Design stage:

- **Muraci River Water Treatment Plant**, designed to treat an average daily flow of 8 280 m³, based on a treatment system by slow sand filtration followed by a final disinfection with calcium hypochlorite; the nominal capacity is 96 l/s. Includes construction of a reinforced concrete reservoir for the treated water, with a capacity of 750 m³.
- **Regulating Reservoir R1** (1st Phase: 2 x 2500 m³ and 2nd Phase: 2x2500 m³ + (1x5000 m³)), the reservoir shall be supplied by the new Mucari conveyance system. In a short-term, the implementation of the new conveyance system with a water intake in the Lucala River will reinforce the water supply. Reservoir R1 shall be built on Mount Miradouro and shall be interconnected to an existing smaller reservoir, which is to be maintained operational. Maximum water height inside the reservoir is 5 m.
- **Water Distribution Network:** about 43,6 km of PVC pipes of diameters DN90 to DN400 mm and 1,4 km of Ductile Cast Iron pipes of diameters DN500 and DN600 mm, installed on trench, including fittings, isolation and dewatering valves, pressure reducer valves, valve boxes and fire and washing hydrants.
- **Public Fountains:** 93 units
- **Water House Connections:** about 1,600
- **Rehabilitation works of the existing Mucari Intake Structures and the existing Reservoirs of Miradouro and Kipata.**

**WATER SUPPLY TO THE
CITY OF MALANJE**

Client:
Direcção Nacional de Águas
(D.N.A.).
(National Water Directorate)

**Final Design and Tender
Documents:**
2004 / 2005

Supervision:
2006 / 08

*Works undertaken in
association with Consulprojecto*

Total Investment Cost:
25 MUSD

DESCRIPTION

The project basically includes the water distribution network and regulating reservoir R1 (1st Phase) and envisages water supply to the urban and peri-urban zone of Malanje, with an estimated population of 600.000 inhabitants in the project horizon year (2025).

The **distribution network** is approximately 129 km long, with pipeline diameters ranging between ND90 and ND600 mm, divided into six independent sectors that cover a total area of 22,2 km². House connections were foreseen for the consolidated urban zone, while the peri-urban zone is to be provided with approximately 300 communitarian fountains.

The network shall be equipped with shutoff valves, bottom outlets, air relief valves, pressure reducing valves and fire hydrants.

The **regulating reservoir R1**, which is to be built on the highest point of the city's urban perimeter, shall be constructed in two phases: during the 1st Phase, two identical tanks with 14.000 m³ capacity shall be built (sufficient to supply the distribution network until 2015); the 2nd Phase contemplates a second similar reservoir which will increase the water supply capacity until the project horizon year (2025). In the beginning, the reservoir shall be supplied by the existing conveyance system which originates at the Guiné River spring. In a short-term, the implementation of the new conveyance system will reinforce the water supply, contemplating a water intake in the Cuije River (the Preliminary Engineering Studies were previously undertaken by the Consultant). Reservoir R1 shall be interconnected to two existing smaller reservoirs (a water tower and surface reservoir). Both these reservoirs shall be maintained operational.



**WATER SUPPLY TO THE
CITY OF KUITO**

Client:
Direcção Nacional de Águas
(D.N.A.).
(National Water Directorate)

**Final Design and Tender
Documents:**
2004 / 2005

*Works undertaken in
association with Consulprojecto*

DESCRIPTION

The project envisages water supply to the urban and peri-urban zone of Kuito, with an estimated population of 14.000 inhabitants in the project horizon year (2025). The following infrastructures were studied within the Final Design stage:

- Intake, pumping station and raw water pipeline (80 l/s)
- Cussola water treatment plant (80 l/s)
- Pumping station and Cussola drinking water supply (80 l/s; capacity: 37 kW; head: 100 m)
- Regulating reservoir R1 (1st. Phase: 4 000 m³, 2 cells (2x2 000 m³); 2nd phase: 1 cell for 4000 m³).
- Water Distribution Network: 54 km long with diameters DN90 to DN600.
- Extension of Cangalo water treatment station, in order to increase the treatment capacity to the maximum flow abstracted from the Cangalo river: 300 m³/h (83 l/s).
- Public Fountains
- Water House Connections: about 1,600



**WATER SUPPLY AND
SANITATION MASTER
PLANS FOR THE CITY OF
ONDJIVA**

Client:
Direcção Nacional de Águas
(D.N.A.).
(*National Water Directorate*)

Date:
2002 / 2005

Financed by:
Angolan Government

DESCRIPTION:

The studies envisaged the execution of a water supply and sanitation Master Plan for the city of Ondjiva, with an estimated population of 283 000 inhabitants in 2005.

PROJECT CHARACTERISTICS:

Water Supply System:

- Conveyance Pipelines: 150 km long ductile cast iron pipelines, with diameters ranging between ND 250 and ND 500;
- Distribution network: 38 km;
- Xangongo WTS: $Q_{dim} - 564$ l/s; $Q_m - 31\,795$ m³/day;
- Pumping Stations: 4, with rated capacity of 0,213, 0,567, 0,430 and 0,091 MW.

Scope of the Works:

- Preparation of the master plan for water supply and sanitation, within a 20-year time period;
- Evaluation of the sanitary and socio-economic impact of the proposed schemes, expected benefits and communitarian participation;
- Execution of preliminary engineering studies associated to priority rehabilitation / expansion works, and preparation of Terms of Reference for engineering final designs;
- Identification of alternative technologies in light of the available technical, financial and human resources (operation and maintenance).



**WATER SUPPLY AND
SANITATION MASTER
PLANS FOR THE CITY OF
N'DALATANDO.**

Client:
Direcção Nacional de Águas
(D.N.A.).
(National Water Directorate)

Date:
2002 / 2004

Financed by:
Angolan Government

WATER SUPPLY SYSTEMS

Water Pumping, Transport and Distribution

N'DALATANDO MASTER PLAN

ANGOLA

DESCRIPTION:

The studies envisaged the execution of a water supply and sanitation Master Plan for the city of N'Dalatando, with an estimated population of 205 000 inhabitants in 2005.

PROJECT CHARACTERISTICS:

Water Supply System:

- Conveyance Pipelines: 53,7 km long ductile cast iron pipelines, with diameters ranging between ND 400 and ND 500;
- Distribution network: 104 km;
- Murari WTS: $Q_{dim} - 96$ l/s; $Q_m - 5\,525$ m³/day;
- Lucala WTS: $Q_{dim} - 240$ l/s; $Q_m - 10\,370$ m³/day;
- Pumping Stations: 2, with rated capacity of 0,054 and 0,227 MW.

Sanitation System:

- Wastewater drainage network: 24,2 km
- N'Dalatando WWTS: population served - 30160 eq.pop.; $Q_m - 3620$ m³/day

Scope of the Works:

- Preparation of the master plan for water supply and sanitation, within a 20-year time period;
- Evaluation of the sanitary and socio-economic impact of the proposed schemes, expected benefits and communitarian participation;
- Execution of preliminary engineering studies associated to priority rehabilitation / expansion works, and preparation of Terms of Reference for engineering final designs;
- Identification of alternative technologies in light of the available technical, financial and human resources (operation and maintenance).



**WATER SUPPLY AND
SANITATION MASTER
PLANS FOR THE CITY OF
MALANJE**

Client:
Direcção Nacional de Águas
(D.N.A.).
(National Water Directorate)

Date:
2002 / 2004

Financed by:
Angolan Government

WATER SUPPLY SYSTEMS

Water Pumping, Transport and Distribution

MALANJE MASTER PLAN

ANGOLA

DESCRIPTION:

The studies envisaged the execution of a water supply and sanitation Master Plan for the city of Malanje, with an estimated population of 584 000 inhabitants in 2005.

PROJECT CHARACTERISTICS:

Water Supply System:

- Conveyance Pipelines: 14,8 km long ductile cast iron pipelines, with diameters ranging between ND 500 and ND 600;
- Distribution network: 122 km;
- Cuije WTS: $Q_{dim} - 820$ l/s; $Q_m - 32\,295$ m³/day;
- Pumping Stations: 2, with rated capacity of 0,440 and 2,0 MW.

Sanitation System:

- Wastewater drainage network: 57,4 km
- Malanje WWTS: population served – 41 830 eq.pop.; $Q_m - 5\,020$ m³/day

Scope of the Works:

- Preparation of the master plan for water supply and sanitation, within a 20-year time period;
- Evaluation of the sanitary and socio-economic impact of the proposed schemes, expected benefits and communitarian participation;
- Execution of preliminary engineering studies associated to priority rehabilitation / expansion works, and preparation of Terms of Reference for engineering final designs;
- Identification of alternative technologies in light of the available technical, financial and human resources (operation and maintenance).



**WATER SUPPLY AND
SANITATION MASTER
PLANS FOR THE CITY OF
KUITO**

Client:
Direcção Nacional de Águas
(D.N.A.).
(National Water Directorate)

Date:
2002 / 2004

Financed by:
Angolan Government

WATER SUPPLY SYSTEMS

Water Pumping, Transport and Distribution

KUITO MASTER PLAN

ANGOLA

DESCRIPTION:

The studies envisaged the execution of a water supply and sanitation Master Plan for the city of Kuito, with an estimated population of 140 000 inhabitants in 2005.

PROJECT CHARACTERISTICS:

Water Supply System:

- Conveyance Pipelines: 8,1 km long ductile cast iron pipelines, with diameters ranging between ND 200 and ND 400;
- Distribution network: 60 km;
- Cussola WTS: $Q_{dim} - 120$ l/s; $Q_m - 7050$ m³/day;
- Pumping Stations: 2, with rated capacity of 0,048 and 0,180 MW.

Sanitation System:

- Wastewater drainage network: 26 km
- Huambo WWTS: population served – 33 100 eq.pop.; $Q_m - 3 970$ m³/day

Scope of the Works:

- Preparation of the master plan for water supply and sanitation, within a 20-year time period;
- Evaluation of the sanitary and socio-economic impact of the proposed schemes, expected benefits and communitarian participation;
- Execution of preliminary engineering studies associated to priority rehabilitation / expansion works, and preparation of Terms of Reference for engineering final designs;
- Identification of alternative technologies in light of the available technical, financial and human resources (operation and maintenance).



**WATER SUPPLY AND
SANITATION MASTER
PLANS FOR THE CITY OF
HUAMBO**

Client:
Direcção Nacional de Águas
(D.N.A.).
(National Water Directorate)

Date:
2002 / 2004

Financed by:
Angolan Government

WATER SUPPLY SYSTEMS

Water Pumping, Transport and Distribution

HUAMBO MASTER PLAN

ANGOLA

DESCRIPTION:

The studies envisaged the execution of a water supply and sanitation Master Plan for the city of Huambo, with an estimated population of 874 000 inhabitants in 2005.

PROJECT CHARACTERISTICS:

Water Supply System:

- Conveyance Pipelines: 30,6 km long ductile cast iron pipelines, with diameters ranging between ND 500 and ND 900;
- Distribution network: 151 km;
- Cunhangâmua WTS: $Q_{dim} - 1500$ l/s; $Q_m - 81650$ m³/day;
- Pumping Stations: 2, with rated capacity of 0,270 and 1,740 MW.

Sanitation System:

- Wastewater drainage network: 140 km
- Huambo WWTS: population served - 204680 eq.pop.; $Q_m - 24560$ m³/day

Scope of the Works:

- Preparation of the master plan for water supply and sanitation, within a 20-year time period;
- Evaluation of the sanitary and socio-economic impact of the proposed schemes, expected benefits and communitarian participation;
- Execution of preliminary engineering studies associated to priority rehabilitation / expansion works, and preparation of Terms of Reference for engineering final designs;
- Identification of alternative technologies in light of the available technical, financial and human resources (operation and maintenance).



WATER SUPPLY SYSTEMS

Water Intake, Transport and Distribution

CHELIFF / KERRADA CONVEYANCE SYSTEM – LOT 3.1: WATER SUPPLY TO THE MOSTAGANEM – ARZEW – ORAN CORRIDOR

ALGERIA

CHELIFF / KERRADA CONVEYANCE SYSTEM – WATER TREATMENT PLANT AND WATER SUPPLY SYSTEM TO THE MOSTAGANEM – ARZEW – ORAN CORRIDOR.

Lot 3.1: Water Supply to the Mostaganem – Arzew – Oran Corridor

Client:

Joint-Venture TEIXEIRA DUARTE / ETRHB-HADDAD
(Owner: ANBT)

Final Design and Technical Assistance:
2005/09

DESCRIPTION:

COBA's intervention in the process consists in the preparation of the final design and provision of technical assistance to a group of contractors, covering all activities related to the completion of the Mostaganem - Arzew – Oran Conveyance Works.

General Characteristics:

- a) Conveyance canal between the Sidi Lahdjel water treatment plant and the Oran reservoir, involving approximately 88,5 km of pipelines with diameters ranging between 1 800 mm and 2200 mm. The Macta crossing is accomplished through a 2 x DN1400 m section.
- b) Pumping station and rising main between the Oran I and Oran II reservoirs, with a length of 4 100 m and DN1400 mm.
- c) Mostaganem Reservoir, a buried reservoir with a capacity of 120 000 m³ (two cells with dimensions of 102,4 x 102,4 m² and 7,0 m clearance.)
- d) 2 Oran Reservoirs, comprising buried reservoirs with a capacity of 150 000 m³ and a pumping station. These reservoirs are divided into two identical cells with dimensions of 136,6 x 102,4 m² and 7,0 m clearance.





CONNECTION OF THE HAMMA SEAWATER DESALINATION PLANT (200.000 M3) TO THE ALGIERS DRINKING WATER SUPPLY NETWORK

Client:
Algérienne des Eaux (ADE).

Detailed Design and Tender Documents
2003/05

Special regulating structures:

- ⇒ Gate chamber at the origin of the system to distribute and control the flows and pressures in the three water transfer lines to the TGK system.
- ⇒ Gate chambers along the system to control ruptures.

Remote control

- ⇒ Control Center at Kouba 97
- ⇒ Terminals at the site of works
- ⇒ Optic fiber cables along the water mains

DESCRIPTION:

The connection of the *Hamma seawater desalination plant (200.000 m3)* to the *Algiers drinking water supply network* is within a global desalination project undertaken by the Algerian Government with a view to diversifying and reinforcing the drinking water supply sources, in order to meet the increasing water demand and attenuate the effects of lasting dry periods in the country over the last years. COBA carried the studies for the said connection that included three stages: Stage 1 – Study of alternative solutions; Stage 2 – Preliminary Design; Stage 3 – Design and Tender Documents.

The system encompassed the following major works:

Water mains:

- ⇒ Hamma - Garidi, with an extension of 4450 m and Ø 900
- ⇒ Hamma - Kouba 97, with an extension of 4450 m and Ø 900
- ⇒ Hamma - Telemly, with an extension of 4600 m and Ø DN 800

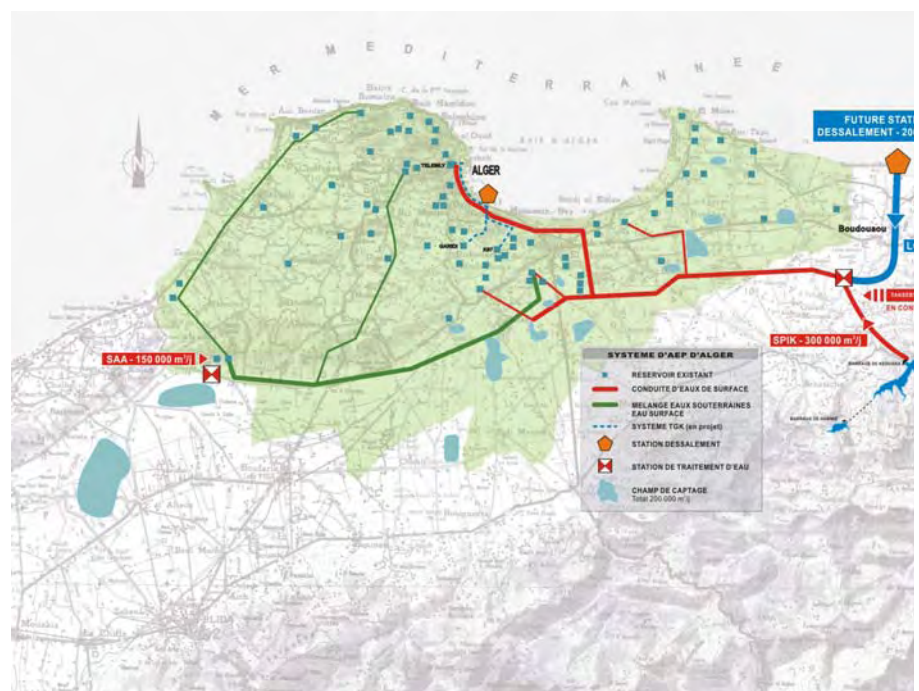
Reservoirs:

- ⇒ New cell for 20 000 m³ at Kouba 97

Pumping Stations:

- ⇒ Electropump unit for Stand: Q1= 1175 m3/h, H1= 195 m, P1= 970 kW,
- ⇒ Electropump unit for Birkhadem: Q1= 1295 m3/h, H1= 48 m, P1= 235 kW

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WATER SUPPLY SYSTEMS

Water Pumping, Transport and Distribution

WATER SUPPLY TO THE NORTHERN REGION OF GREATER OPORTO

PORTUGAL

INTERMUNICIPAL WATER SUPPLY SYSTEM TO THE NORTHERN REGION OF GREATER OPORTO

Client:

IPE - Águas de Portugal /
Águas do Cávado, S.A.

Preliminary Study:

1995/96

Final Design, Tender Documents and Procurement Processes:

1996

Technical Assistance (follow-up of the works):

1997/2000

Studies undertaken in association

Investment Cost:

110.000.000,00 Euro



DESCRIPTION

Design of the new water supply system to totally or partially feed the municipalities of Barcelos, Esposende, Póvoa do Varzim, Maia, Vila do Conde, Vila Nova de Famalicão, Santo Tirso and Guimarães, serving directly about one million inhabitants.

The new network begins at the Cávado River, at Areias de Vilar, immediately downstream to the Penide hydroelectric undertaking. At the chosen location, the river has sufficient water to satisfy the expected consumption in the long term (about 2.6 m³/s in the project horizon).

The services provided by COBA comprised the following activities:

Studies

Preliminary Study of the Caniçadas subsystem, except for the Water Treatment Station.

Preliminary Study of the Access Road to the Areias de Vilar Water Treatment Station.

Designs

– Water intake, treatment and pumping to the water conveyance system

- Basic Design of the Water Intake at the Cávado River and Raw Water Reservoirs (cost of the works – 900,000,000 PTE.)
- Final Design of the RR1 Reservoir and EE1 Pumping Station (820,000,000 PTE).

– Water conveyance system

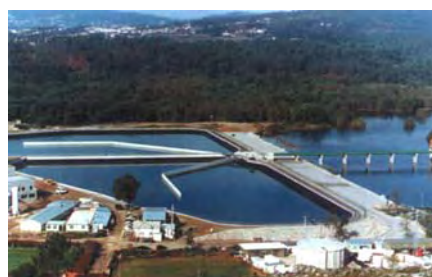
- Final Design of the Water Main of the RR1 – RR2 (600,000,000 PTE).
- Final Design of the Reservoir RR2 (320,000,000 PTE).

– Vila Nova de Famalicão Sub-system

- Final Design of the Water Supply to the Cerite, Santa Tecla and Joane Reservoirs (1,120,000,000 PTE).
- Final Design of the RR3 Reservoir and the EE3 Pumping Station (350,000,000 PTE).
- Final Design of the Joane Reservoir (R2) (80,000,000 PTE).
- Final Design of the links to the Cerite and Santa Tecla Reservoirs (30,000,000 PTE).

Technical Assistance

- Technical Assistance to – Water Treatment Station, Water Intake, Raw Water Reservoirs, EE1 Pumping Station, RR1 Reservoir and Access Road (26,300,000 PTE for COBA).





**STUDIES TO MEET THE
WATER REQUIREMENTS OF
THE METROPOLITAN
REGION OF FORTALEZA**

Client:

Secretaria dos Recursos
Hídricos, Ceará
(Water Resources Department, Ceará)

**Definition of Alternatives and
Final Design:
2000/03**

Financing:

World Bank
(within the PROGERIRH
Programme)

*Studies carried out in Association,
COBA being the leader of the
Consortium*

**Investment Cost:
300.000.000,00 Euro**



The studies aim at evaluating the water requirements and sources in the region of the metropolitan basins of Fortaleza, defining alternatives to meet those requirements, selecting the most feasible alternative and preparing the respective Final Designs.

The anticipated water requirements in the project's influence area are estimated at about 600 million m³/year, both for human consumption and for feeding several irrigation projects. The population to supply in the project horizon (2030) is calculated in 5.000.000 inhabitants.

The Castanhão-Fortaleza Water Conveyance System encompasses conveyance structures about 200 km long and pumping stations for the transport of a maximum flow of 22 m³/s, from its source at the Castanhão Dam to existing dams in the Metropolitan Region of Fortaleza. Diversion structures are anticipated along the conveyance system for human supply and irrigation.

The Castanhão pumping station, located upstream the Water Conveyance System comprises 8 vertical-axis and changeable speed electro-pump groups, with a total capacity of 16 MW. The two pressure pipelines are 2,50 m diameter and about 3,0 km long.

The conveyance system is mainly formed of a canal with a bottom width of 5,0 m and 3,0 m high, comprising several special works (siphons and bridges) for crossing waterlines.

The scope of works of this project includes also the performance of the "Environmental Impact Assessment and Social Impact Studies".





**WATER SUPPLY AND
SANITATION SYSTEM
OF THE MUNICIPALITIES
WITHIN THE ALTO ZÊZERE E CÔA REGION**

Client: IPE – Águas de
Portugal, S.A.

Overall Design Studies:
1998/00

WATER SUPPLY SYSTEMS

Water Pumping, Transport and Distribution

WATER SUPPLY SYSTEM TO THE ALTO ZÊZERE E CÔA REGION

PORTUGAL

Scope of the Studies

Definition of the main characteristics and configuration of the Water Supply System to the Municipalities of Almeida, Figueira de Castelo Rodrigo, Guarda, Meda, Pinhel and Sabugal, covering an area of about 3 400 km² and a population of 104 000 inhabitants, in the project horizon year 2030. The studies comprise the following:

- Survey of the existing and anticipated situation for the municipal water supply systems, namely the location and characterisation of the water intakes susceptible of being used by the Multimunicipal System, treatment stations, main water-mains and terminal reservoirs, their critical analysis and comprehensive data systematisation.
- Definition of the baseline data to be used (populations, water intakes and design flows).
- Establishment of the technical and economic criteria to be used in the design of the several components of the system.
- Design of the solution proposed for the Multimunicipal System, with the integration of the existing infrastructures.
- Presentation of the total costs of the system, and of the maintenance and operation charges.

Configuration of the System

Water Treatment Stations (WTS)

9 WTS near the reservoirs, from which two (Sabugal and Cortes) are to be newly designed; the Caldeirão WTS is to be replaced; the Santa Maria de Aguiar WTS is to be refurbished; the Meimoa WTS and the one in the S. Miguel Harbour system have come into operation recently; the WTS of the Vascoveiro system (in construction); and the Capinha and Ranhados WTS that need to be refurbished.

Water Conveyance System

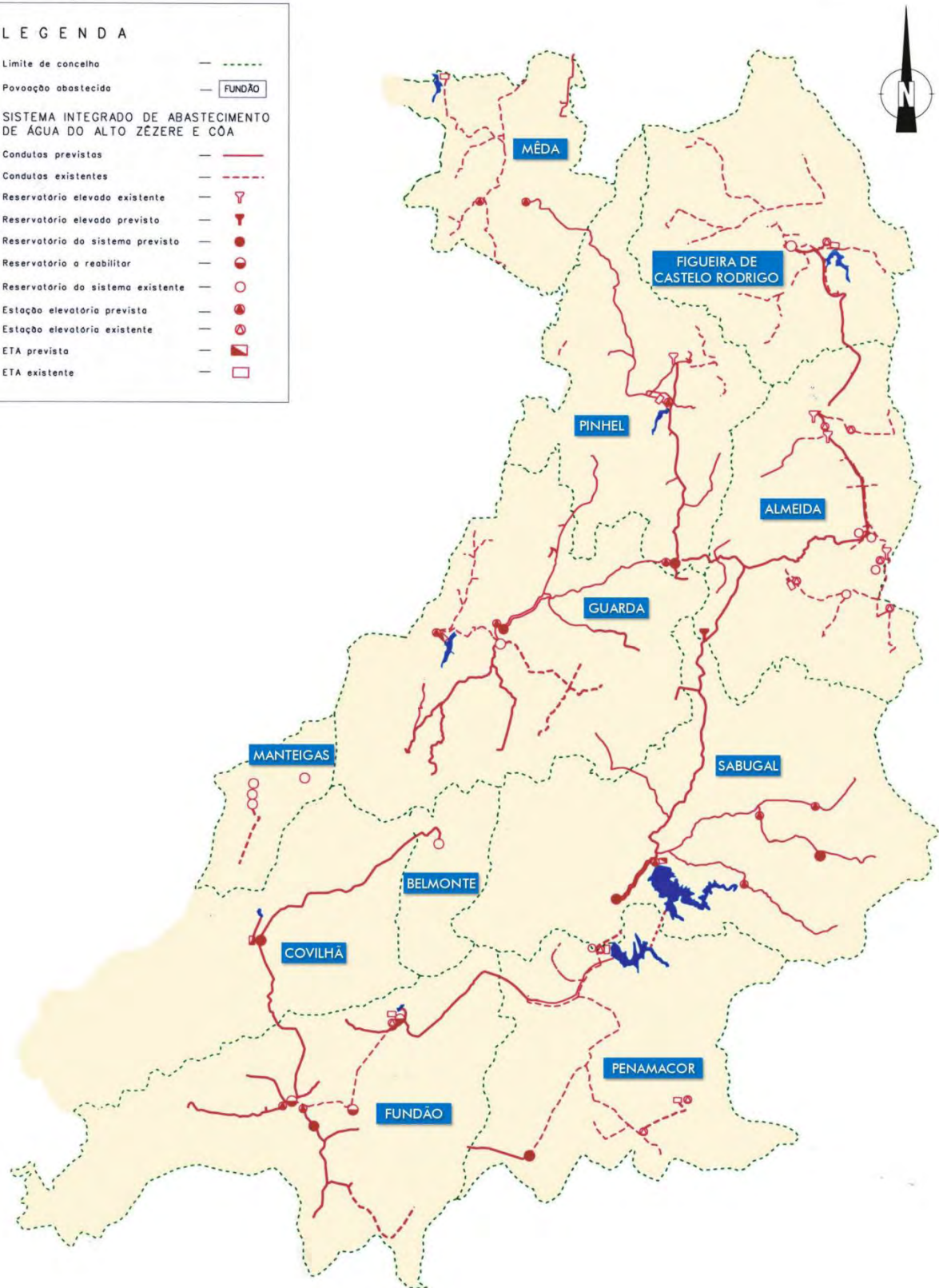
- Meimoa System, with its origin in the Meimoa reservoir, and water mains about 80,1 km total length;
- Cortes System, starting at the future Cortes reservoir, 27 km long;
- Sabugal System, the most important one, with its origin in the Sabugal reservoir, and a flow regulation capacity of about 70 hm³/year;
- 6 complementary municipal Systems;
- Reservoirs.



COBA

LEGENDA

Limite de concelho	- - - - -
Povoação abastecida	- - - - - FUNDÃO
SISTEMA INTEGRADO DE ABASTECIMENTO DE ÁGUA DO ALTO ZÊZERE E CÔA	
Condutas previstas	- - - - -
Condutas existentes	- - - - -
Reservatório elevado existente	- - - - -
Reservatório elevado previsto	- - - - -
Reservatório do sistema previsto	- - - - -
Reservatório a reabilitar	- - - - -
Reservatório do sistema existente	- - - - -
Estação elevatória prevista	- - - - -
Estação elevatória existente	- - - - -
ETA prevista	- - - - -
ETA existente	- - - - -





**CASTELO DE BODE WATER
SUPPLY MAIN.
DUPLICATION OF THE
SECTION BETWEEN QUINTA
DA MARQUESA AND THE
VILA FRANCA DE XIRA
PUMPING STATION**

Cliente:

EPAL – Empresa Portuguesa
das Águas Livres, S.A.

**Preliminary Study,
Tender Design and
Technical Assistance:
2001 / 2004**

**Investment Cost:
6.000.000,00 Euro**

DESCRIPTION:

The duplication of the Castelo de Bode Water Supply Main between Quinta da Marquesa and the Vila Franca de Xira Pumping Station was required so as to assure the continuous water supply to Lisbon whilst carrying out the rehabilitation works in this section of the pipeline.

In the section to be duplicated, the old 1,8 m diameter water supply main develops in a trench, comprising two 670 m e 140 m tunnels in its downstream end.

The fundamental aim of these studies comprised the analysis of alternative implantation solutions that assured the required hydraulic, structural and geotechnical strength. Various aspects were taken into consideration, not only regarding the functionality of the implemented solutions, but also construction and operation aspects.

Two alternative alignment solutions were studied. One along the EPAL expropriation strip and the other along National Road nr. 1, being the latter proposed by COBA. The studies carried out allowed for the selection of an alignment that develops essentially along the EPAL expropriation strip, proving to be the most interesting solution from technical, economic and social points of view. The strip occupation constraints, as well as the geotechnical difficulties encountered along the alignment, led to a systematic shoring of the water supply main in the open face sections – along about 2400 m of the studied alignment -, so as to assure the required safety of the works, and bearing in mind the seriousness of interrupting water supply because adjacent waterpipes were affected.

Upon analysis of various alternative solutions, it was considered wise to adopt a tunnel in the final section of the supply main – about 830 m – and the use of hydraulic drilling technology (pipe jacking) and of a micro tunnelling machine in three particular sections. These solutions have the advantage of minimizing the very important occupation constraints in the area that greatly condition the solution adopted.





**WATER SUPPLY AND
SANITATION SYSTEM
OF THE MUNICIPALITIES
WITHIN THE ALTO ZÊZERE E
CÔA REGION**

Client:
Águas do Zêzere e Côa, S.A.

Final Design:
2001 / 2004

*Studies undertaken in
association*

Investment Cost:
93.000.000,00 Euro

WATER SUPPLY SYSTEMS

Water Pumping, Transport and Distribution

WATER SUPPLY SYSTEM TO THE ALTO ZÊZERE E CÔA REGION

PORTUGAL

DESCRIPTION

The Water Supply and Sanitation System of the Municipalities within the Alto Zêzere e Côa Region is expected to serve, in the project horizon year, a population of about 210.000 inhabitants, distributed through the municipalities of Almeida, Figueira de Castelo Rodrigo, Guarda, Meda, Pinhel and Sabugal. It will comprise a total extension of about 800 km of pipes and water mains, remodelling and construction of a WTS and dozens of pumping stations, reservoirs and WWTS.

- **Preliminary Studies for Water Supply and Sanitation**, including survey of the existing and anticipated situation for the municipal water supply systems, namely the location and characterisation of the water intakes susceptible of being used by the Multimunicipal System, treatment stations, main water-mains and terminal reservoirs, their critical analysis and comprehensive data systematisation.
- **Final Design** of the following works:
 - **Water supply systems:** water mains, pumping stations and reservoirs;
 - **Sanitation systems:** Drains and sewers, pumping stations;
- **Basic Design of the Water Treatment Stations (WTS) and of the Waste Water Treatment Stations (WWTS);**
- **Studies and Designs for Protection and Arrangement of the Areas surrounding Water springs integrated in the System;**
- **Automation and remote control system** of both water supply and sanitation systems, embracing the several system components, such as pumping stations, reservoirs, waste water pumping stations, water supply pumping stations, valves and all communication points throughout the system;
- **Geographic Information System (GIS)** of the water supply system and of the sanitation system;
- **Land Expropriation Design**, encompassing the alignment of water mains and sewers, as well as sites for construction of pumping stations;
- **Technical Assistance to the Owner**, during the tender award phase and during the construction works.