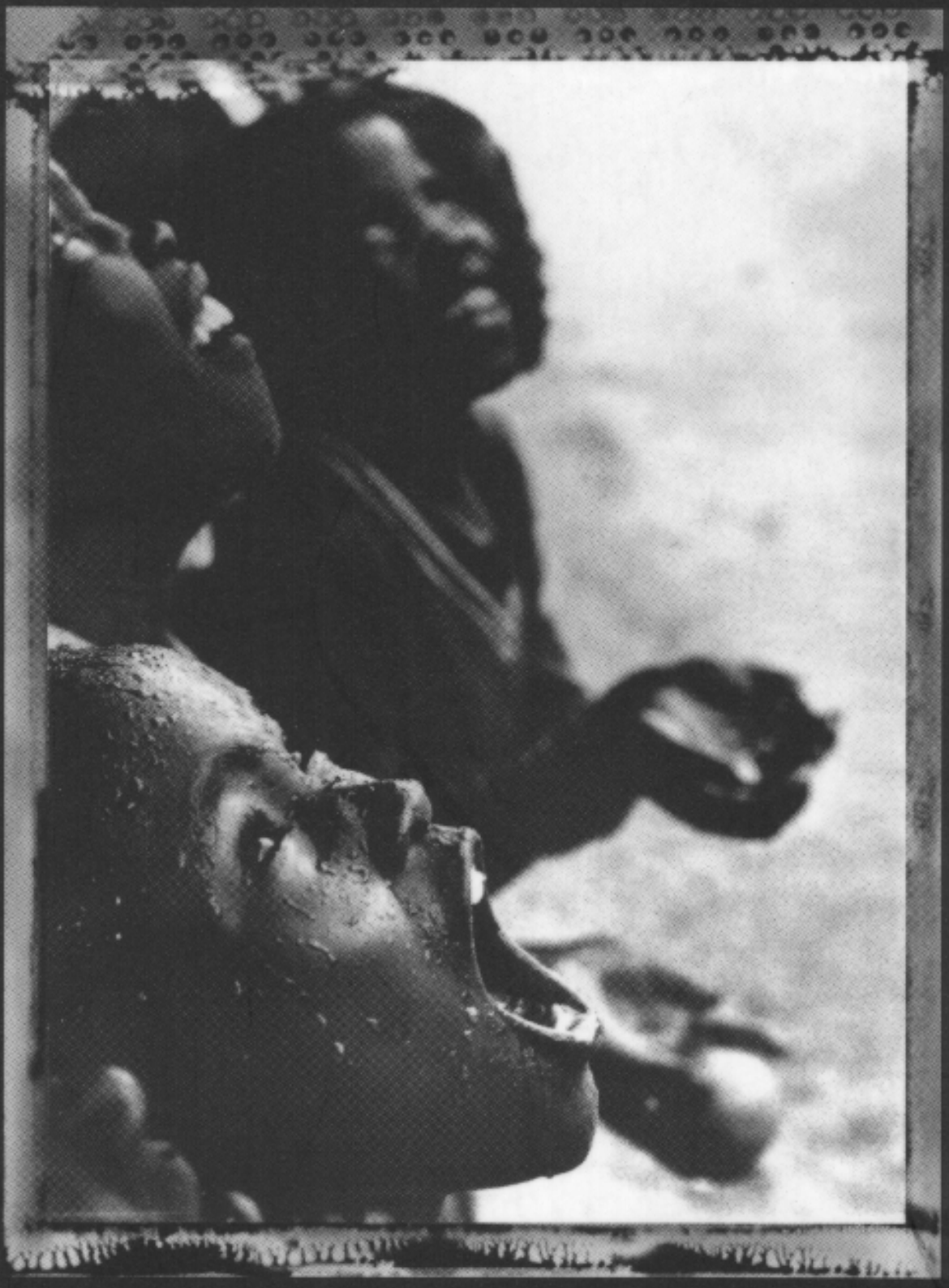

war and water

FORUM

ICRC PUBLICATIONS
INTERNATIONAL COMMITTEE OF THE RED CROSS / GENEVA

Pier Giorgio Nembrini

Cities in war: thirsty cities

Huambo (Angola)

Water supply in a war torn town: evolution and impact of the different interventions since 1985

Geneva Foundation

Occasional paper No. 3

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Development Workshop[1] (DW) *"inherited" an emergency water project in Angola from the ICRC[2] at the beginning of 1997. We deliberately use the word "inherit" because the transfer of responsibility for the project included the transfer of trained staff, vehicles and equipment. A common donor, Swiss Humanitarian Aid (SHA), facilitated the transfer of project management from the ICRC to DW. When SHA requested DW to assume continued management of the project, it clearly indicated that it attributed major importance to the introduction of strategies which would ensure sustainable management of the water points in the long term.*

[1] Development Workshop is a International non-governmental organization **(NGO)** which has been based in Luanda, Angola, since 1980. It implements programmes **in** conjunction with local NGOs and government agencies.

[2] International Committee of the Red Cross - Geneva

Huambo (Angola)

Water supply in a war-torn town: the evolution and impact of the different interventions in Huambo

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Background

The conflict in Angola has been one of the longest of the past century. It began in the seventies and went through different phases, with drastic changes throughout the years, from open war to periods of guerrilla warfare.

At the end of 1975, following the Alvor agreements, a transitional government was set up, including the former occupying power, Portugal, and the various liberation movements (FNLA – Frente National de Liberaçao de Angola, MPLA – Movimiento Popular de
Liberaçao de Angola, UNITA – Union National de Independencia Total de Angola).

Despite the agreement, the hostilities previously directed against a common adversary developed into a power struggle between the different liberation movements.

Gradually, the role of one of the movements decreased (FLNA) and the conflict became a confrontation between the government (MPLA) and UNITA, with the support of various foreign armies.

Thereafter, traditional relief activities were carried out in the areas controlled by either side. Just as they had been under colonial rule, most of the major towns of the country and especially those of the Planalto, Huambo and Kuito, were under the control of the government, with UNITA controlling the surrounding area. Displaced people started to gather in the towns, seeking protection and assistance, but only in 1979 was the ICRC able to establish a sub-delegation in Huambo.

In 1984 the intensity of the conflict increased drastically and a major relief operation was launched to care for the needs of the hundreds of thousands of displaced people arriving in the major towns of the Planalto and in most of the major municipalities still accessible by plane. All the roads were under the control of UNITA and were unusable due to mines.

The humanitarian agencies had to adapt to these changes and undertook lengthy negotiations with the different parties to obtain access to the affected areas, mainly the major towns, where many displaced people were gathering to seek protection and assistance.

The opinions expressed in this paper are those of the author and do not necessarily reflect the views of the ICRC, of DEVELOPMENT WORKSHOP or any other institution quoted.

[1] International Committee of the Red Cross

[2] Development Workshop

With the exception of the capital, which experienced only sporadic tension, all these towns went through months of blockades, with military pressure varying from intensive shelling to long periods of calm during which life was almost normal.

In May 1991, after 16 year of bloody conflict, the Angolan government and UNITA concluded a peace agreement. With "peace" returning to Angola, one of the ICRC's most extensive and longest relief operations of the last 13 years came to an end [3]. By the end of the year the ICRC had already cut back its infrastructure and most of the staff in Huambo and closed down its sub-delegation in Kuito. An emergency operation had to be launched to enable about 180,000 families to survive the interim period and efforts were concentrated on the sector of the Planalto that still required assistance, prior to the deployment of other organisations.

The United Nations agencies and other NGOs started to move in progressively and the ICRC
maintained only its traditional activities.

The social and economic situation gradually improved and general elections were organised at the end of September 1992. But troubles started almost immediately after publication of the results and the situation again deteriorated. Fighting broke out in Luanda at the end of October, and thousands were killed. The unrest soon spread to all the other provinces.

At the end of 1992, all efforts to bring UNITA and the Government back to the negotiating table failed and, as a result of growing insecurity, all the foreign aid agencies had to withdraw. Because of the intense and widespread fighting at the beginning of 1993, the ICRC was unable to carry out its humanitarian work. It was obliged to evacuate its expatriate staff from its offices in Huambo and Kuito, withdrawing from the Planalto for the first time since the start of operations in 1979. UNITA took full control of Huambo and most of the cities of the Planalto.

At the beginning of June of the same year the ICRC was finally able to re-establish its presence in Huambo, where the fighting had led to large-scale destruction, lack of medical care and shortages of essential goods.

Despite all diplomatic efforts to bring about a cease-fire, the armed conflict intensified in August with the government exerting growing pressure on UNITA, taking control of Huambo on 9 November and recapturing all the other provincial capitals.

The signing on 20 November 1994 of the Lusaka peace agreement between the Angolan government and UNITA paved the way for a slow move toward normality, bringing to an official end two decades of conflict[4].

In 1995 people were again able to move relatively freely around the country and domestic trade slowly picked up. Security improved and UN staff and other humanitarian agencies were able to return and operate more safely in many areas and begin the rehabilitation of a country ravaged by over 30 years of almost continuous warfare. By the end of the year, over 6,000 peacekeeping forces and military observers from UNAVEM III had been deployed in
Angola, as stipulated in the Lusaka peace protocol.

[3] ICRC Annual report 1991
[4] ICRC Annual report 1995

In 1996 and 1997, as the situation gradually stabilised, the general living conditions of the civilian population improved but remained precarious. Trade was less substantial than anticipated as the free movement of goods and people had not yet been fully restored. The programmes launched in 1995 were extended and gradually handed over to the relevant provincial authorities or to other agencies that were willing to continue them.

A series of delays in the implementation of the peace protocol and UNITA's unwillingness to conform to the provisions of the agreement caused the UN Security Council to threaten sanctions against the movement. Those sanctions finally came into force on 29 October 1997, due to the negligible progress that had been made by UNITA.

The insecurity prevailing in the Benguela, Huila, Huambo, Malange and Uige areas spread progressively in the latter half of 1998 and the situation further deteriorated in early December when open hostilities resumed between the government and UNITA troops in the Planalto area. In early 1999 the war appeared to be generalised throughout the country with varying degrees of intensity. Large population displacements were again observed, people having fled the rural areas to reach Huambo, Kuito and Caala, and IDP (Internally displaced people) camps were being set up in these cities, an unusual situation in Angola.

The evolution of the conflict and its implications for the programmes undertaken to address the water supply problems in Huambo

The water supply situation of the town has evolved with the conflict. Before the war and during the initial phases of the conflict a classical system of production and distribution to almost 50,000 customers was in place.

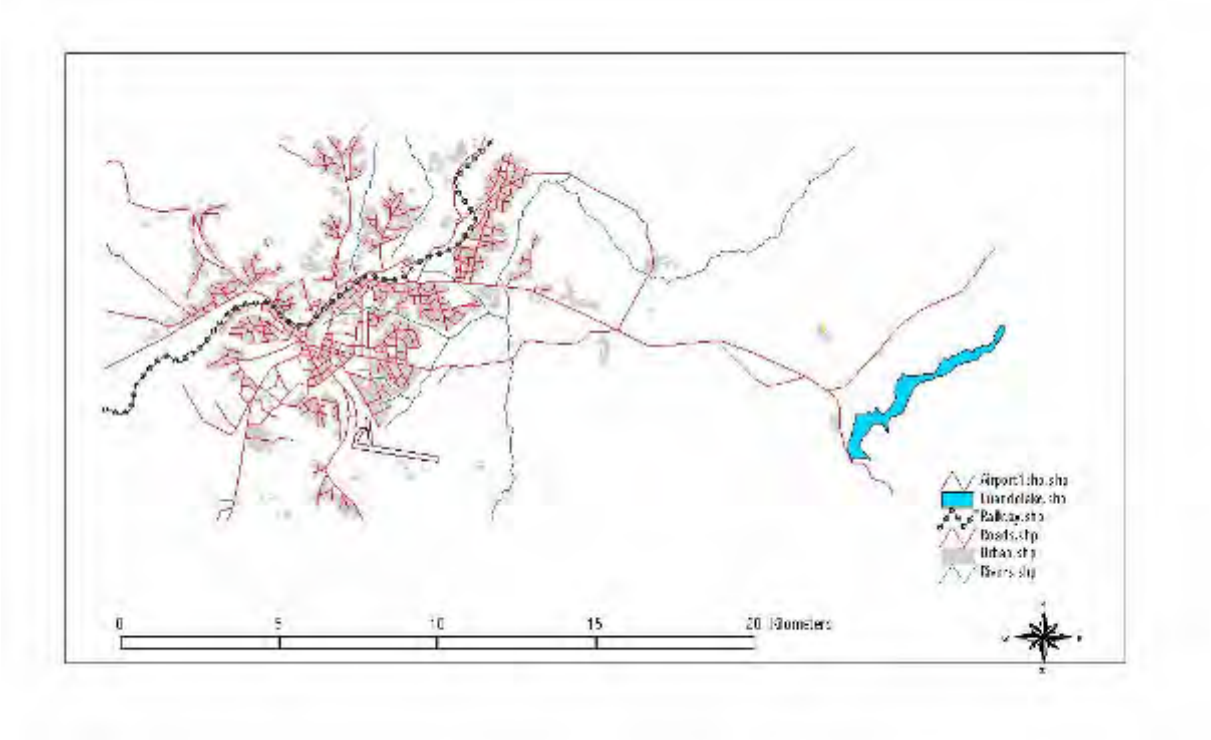


Figure 1. General map of the town of Huambo and the Cuando lake.

It was totally dependent on the availability of power from the Cuando hydropower station owned by the CFB (Camino Feral de Benguela), with which the water utility (Empresa de

Agua) had specific agreements based on an exchange of water for power. The situation of the Cuando hydropower station became increasingly precarious and it finally had to cease operating, bringing water distribution to a standstill. The Kulimahala water treatment station ceased operating at the end of 1992. The station was further damaged during the war of 1993/1994.

This report covers the water and sanitation activities of the ICRC in the town of Huambo from
1984 until the end of 1999, but also describes those of other organisations that gradually became involved following the signature of the Lusaka peace agreement in November 1994. The major project for the town of Caala will be described in another report[5].

Table I shows the type of problems faced by the ICRC and other organisations and the specific activities carried out during this period. Whenever possible the links with the conflict situation are also given, albeit succinctly, together with a list of the constraints it imposed.

We can identify several phases:

The initial phase, from 1984 until the end of 1991, characterised by the control of the cities and municipalities by governmental forces, within a **security** perimeter. The territory surrounding this perimeter was entirely controlled by UNITA. The main activities were in support of medical and nutritional programmes, with hand-dug wells located in nutrition centres, communal kitchens, health posts, etc., which were also supplied by tankers. In only a few situations was the general population assisted with programmes aimed at improving its access to water. Springs were protected because of the need for water in the health posts and other medical structures, but the people also benefited from the steady supply of water. This was also the case when water was obtainable from wells, once "medical" needs were covered. During this phase some water was still produced and distributed to the inhabitants of the town, although coverage was limited and depended on the power supply. The latter was already poor at the beginning of 1985 and became increasingly erratic from year to year, stopping altogether when the town was taken by UNITA in 1993.

At the end of 1991, after the Bicesse peace agreements, there was a noticeable improvement in the situation and the accessibility of Huambo by road was becoming a reality. The ICRC began to hand over its programmes to other organisations, as its mandate had become obsolete.

During this period, no attempts were made to address the problem of the water treatment station, as the main concern of the water unit was to support classical emergency health activities.

The main reasons are historical and easily understandable: the ICRC's water section was created in 1983 as part of the medical division, later renamed the 'health division'. Its main goal was to provide water to all the health facilities: hospitals, health posts, orthopaedic centres, etc. Its approach to general water supply was not yet fully developed and was particularly difficult to implement in a context where logistics had to be secured with the use of planes, and priority given to purely medical material and food. For **institutional** reasons, but also due to a lack of experience and credibility within the institution, the impact of the assistance in the water sector was quite limited.

[5] Water supply for the town of Caala (Angola)

Table I
Chronology of the activities carried out to address water needs in the town of Huambo since 1985.

Period	**Town's political and military control**	Activities	**Constraints**	**Remarks**
End 1984	First survey	--	Security perimeter Logistic	
1985	Government	Hand-dug wells for feeding centres and support to the expatriates	Security perimeter Logistic (planes and materials) Institutional	Water activities to support medical activities
1987-1991	Government	Creation of a water point (well or protected spring) per area and in the municipalities	Security perimeter Logistic (planes and materials,, many municipalities targeted) Institutional	Water activities to support medical activities
1991 -1992	Government Peace agreement (Bicesse)	Hand-over tentative to other organisations	No more security perimeter Institutional	ICRC activities focused on emergencies and not development-like ones
1993	UNITA	Expatriate staff Evacuated	Security and re-negotiations	
Mid-1993	UNITA	Return of the ICRC in Huambo		
1994	UNITA	Re-assessment Water distribution by tankers Hand-dug wells Water supply for the hospital	Re-negotiation of the cooperation with the water authorities	Water and sanitation for the general population as well as to sustain health activities
Lusaka Peace Agreement Nov. -Dec. 1994	Government	Evacuation of ICRC staff	Re-starting of the activities	Extension of the goal of the sector
1995	Government	Hand-dug well programme Kulihamala water treatment plant Caala water supply Boreholes for the hospital	Logistic (extension to Huambo province)	Extension to other towns and project proposals for Kuito, Ganda and Bailundo (delegated projects)
1996-1997	Government	Extension of well project in Huambo and hand-over to Development Workshop Completed rehabilitation of Kulimahala WTS	Difficult involvement of the authorities Security improves	Hand–over policy as "peace" is generalized
1999 -	Government	Water supply for displaced people in towns Assistance to authorities for Improvement of the Water treatment station	Security perimeter around towns as in former years Logistics	Other organisations well established. Coordination problems

The second phase, when the town was taken by UNITA and kept under its control from the beginning of 1993 until the end of 1994, when government troops took control of almost the whole country. The ICRC resumed its presence in Huambo in mid-1993 with new objectives that ranged from the support of health facilities to the more general support of the water needs of the whole population. This was done in agreement with the new water utility, a remnant of the old ones, which had been understaffed and lacking in resources. The old part of the Kulimahala water treatment station was partially rehabilitated to produce roughly 250 m3/day of potable water to be distributed by tankers, and preparations were made to launch a larger well-digging programme.

The third phase started when the city was taken over by the government army at the end of 1994. All the expatriates where evacuated from Huambo for about a month. In mid-1995 it was possible, after a period of reorganisation, to implement the objectives defined during the second phase. From 1995 until the end of 1997 an impressive job was done to make significant improvements to the Kulimahala water treatment plant and extend the well programme to Caala, Bailundo, Ganda and other municipalities. During that period the water utility (Direçao Provincial de Agua) became functional and participated in these activities. Several projects were run as 'delegated' projects by a national Red Cross society, in an effort to involve such institutions in situations where improved security allowed it and to foster the transition from emergency to development-oriented programmes, enabling a smoother hand-over.
At the beginning of 1997 the entire well programme in Huambo was handed over to Development Workshop, a Canadian non-governmental organisation, with financing from the Swiss Development Co-operation Fund, more suited to managing such programmes. The 'urban' projects of Caala, Bailundo, etc., were placed under the responsibility of the water utility (Empresa de Agua).

The **present phase (4th phase**) is characterised by renewed military pressure by UNITA on several towns, harking back to a situation similar to that described under phase one, with a much wider security perimeter around the towns and the municipalities. Logistics are once again difficult and have to be carried out by air, security is volatile and the presence of a huge number of displaced people puts a further burden on the utilities. The presence of NGOs and UN agencies is however better established and the programmes of all the humanitarian agencies are also better co-ordinated and implemented. Major efforts have been made to address the needs of these displaced people, particularly in Huambo, Caala and in Kuito. A series of boreholes have been drilled and better management of the water points has been set up.

The authorities have also become more involved and are now in a better position to subcontract projects to private local companies (from Luanda), using funds made available by various donors, and assisted in their management by the NGOs present in Huambo since late 1997.

The initial phase (from 1984 to 1992)

Following a general survey carried out in 1984, activities started in Huambo in 1985 with the construction of several wells to supply water to the nutrition centres, the orthopaedic facilities and, last but not least, the houses of the expatriates, supplied poorly or not at all by the erratic

water distribution network. Hand-dug wells were sunk using basic techniques, owing to the lack of material and the logistical difficulties. As is the case in the initial phase of such programmes, the output was poor, with only a dozen wells built and protected during the first years. Some of these wells were merely dug and not lined, only their tops being fitted with an apron and a wall. Only a few were equipped with hand pumps. Where power was available, submersible pumps were installed. Activities were not limited to the town of Huambo but extended to the whole Planalto, including other areas such as Ganda and Kubal. All in all, about 70 wells and 26 springs were protected. In Huambo, wells were dug at the nutritional centres of Camussamba, Sao Pedro, Macolocolo and at the Abrigo (orthopaedic centre). The two springs at Fatima and Ciudade Baixa were protected and washing facilities were also built. During all of 1992 the search for a suitable institution or NGO in a position to maintain or develop these activities proved unsuccessful, despite the existence of a well-trained team equipped with digging material.

The second phase (1993 - 1994)

The ICRC re-established a regular presence in the Planalto only at the end of 1993, when a general survey was conducted. The ICRC's approach to coping with the needs of the displaced people and affected inhabitants of the town changed significantly during this period, when the town was under UNITA control. Eighteen kitchens and two feeding centres were operating in March 1994 and more were due to be opened, to cope with the needs of about 10,000 vulnerable people scattered around the town and roughly 2,500 in the nutrition centres. Most of the kitchens could rely on existing hand-dug, albeit poorly protected, wells, and the feeding centres on the wells dug during the previous period and on water delivered to collapsible storage tanks by a water-tanker. As the programme expanded, it was necessary to improve the pumping and filling station located at the old Kulimahala water treatment plant, where water was obtained directly from the river. After being chlorinated, the water was distributed to the feeding centres by tankers. The next figure shows the quantities supplied daily to the centres and kitchens that had no regular water supply.

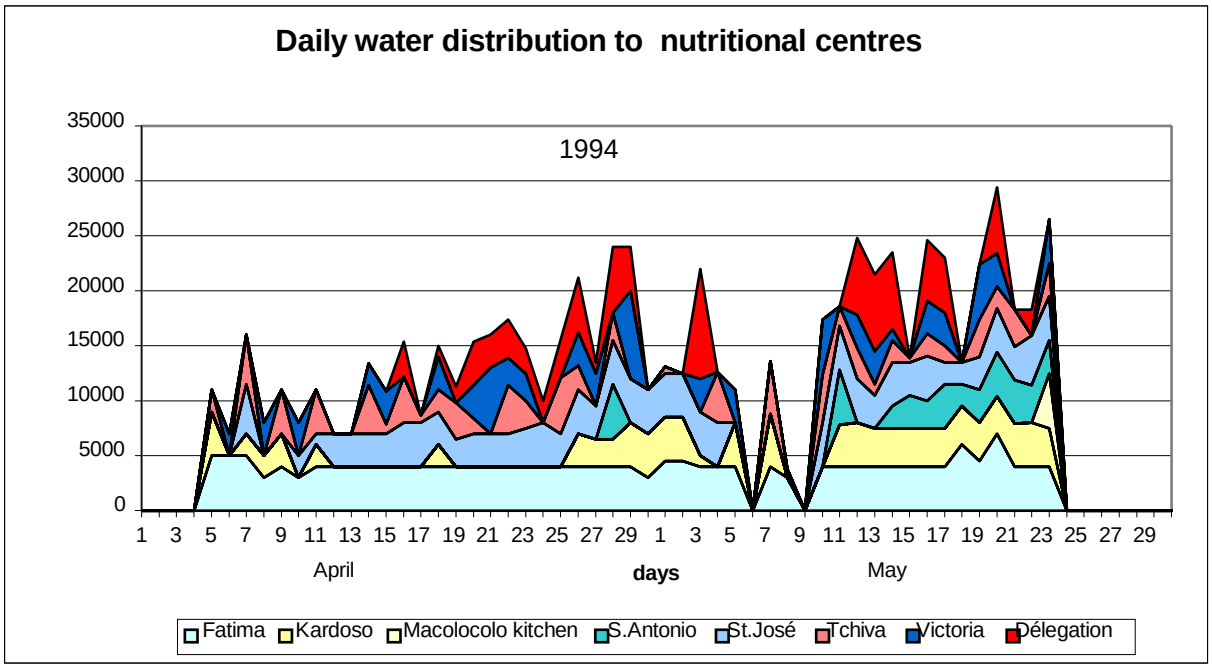


Fig. 2 Daily water distribution to nutritional centres

A detailed assessment carried out jointly with OXFAM showed that the town water treatment plant was technically repairable but only in the context of a stable political situation. Some of the treatment procedures of the old station had to be improved and the new one, in operating condition but lacking certain spare parts, could easily be put into operation if power could be made available from the Cuando hydropower station, located about 15 km from the town. Valuable information on the water distribution network was obtained from the newly formed Water Department. Attempts were also made to improve the premises of the Water Board, in order strengthen its future operating capacity.

The joint assessment also examined the drilling programme to be undertaken in Huambo following the encouraging results obtained in Kuito, where the light drilling rig was successfully used to drill nine boreholes at strategic locations. Some thirty initial sites were selected but work finally began with a new drilling rig brought to Huambo at the end of June. Eight boreholes were drilled but only five were successfully developed and equipped. At the end of 1994 government forces again took control of the town and a new approach had to be defined. Most of the equipment was looted or destroyed.

The third phase (1995 - 1997)

A new strategy was adopted in the belief that a fairly stable period was beginning. Furthermore, the situation had changed quite dramatically. Most of the displaced people had returned to their villages (*municipios*). Almost all the communal kitchens were gradually closed down as a result of the improvement in the nutritional situation, thanks to ICRC food distributions and to the agricultural programmes carried out in 1994.

The Kulimahala water treatment plants and the CFB water treatment station

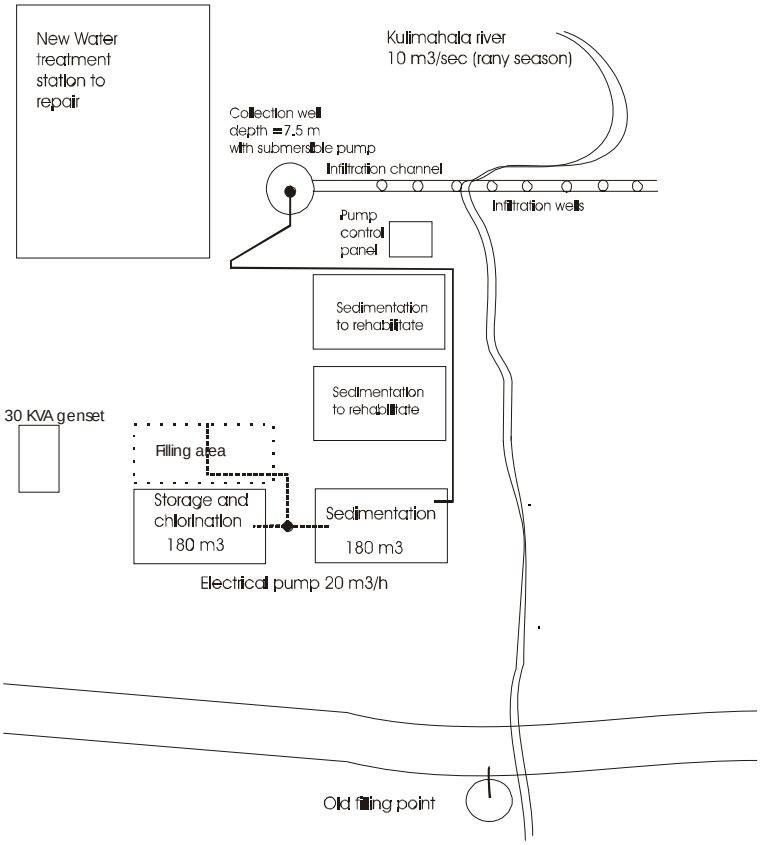
The initial pumping station, presently named 'Central Velha,' was built by the Portuguese around 1950 close to the Kulimahala River, near Bomba Alta, in the western area of the town. The total raw water pumping capacity of 100 m3/h was increased to 500 m3/h by 1960 but, as the intake was not sufficient to cope with demand, the station started to take water directly from the river. The raw water pumping capacity was than increased to 900 m3/h, which the river flow was able to supply. Only during the drought of 1979 did the river prove insufficient.

The construction of a new station (Nova Station) began in 1971/1972. It was damaged in
1983, when a pump was destroyed, but was finally completely renovated in 1991. By 1992, two new pumps were installed, one with a capacity of 500 m3/h and another of 360 m3/h. They operated regularly throughout 1993, delivering an average of about 600 m3/day.

During the latest confrontation most of the equipment of the old station had been vandalised or looted but that of the Nova station remained almost intact, with the exception of the electrical control panel.

The CFB station (Camino Ferral de Benguela) operated until January 1993, when it stopped. Both stations were able to pump water to the Cuca water tower (and to Tchiva) to supply the industrial area and the domestic users of the 'barrio' of Tchiva through a 150 mm line, and to the town, using a 350 mm pipe to supply the Rua do Comercio water tower, from which the water was distributed to the users and to a small industrial area. Another line, 300 mm in

diameter, supplied the booster station at San José from which the main city storage reservoir, located on the water board premises, was supplied.



The main problem in running the water distribution was the lack of power, and any attempt to run the system without a reliable source of power would lead to poor results. Much of the equipment required large amounts of spare parts and maintenance. The state of the network would also have to be taken into account and many sections would probably need total reconstruction.

Fig. 3 Schematic layout of the temporary Kulimahala WTP

Temporary rehabilitation of the old station (Velha)

Even though it was quite clear that the communal kitchens and the CRN would be closed down gradually during the year, owing to the improvement in the situation, their immediate water needs had to be covered. At the beginning of the year the decision was made to improve the quality of the water distributed by tankers by shifting the direct intake point at the river to an improved one based at the old station, in order to take advantage of a possible rehabilitation of the treatment process.

The collection channel and the collection well at the river were cleaned and repaired. A new submersible pump was installed in the collection well. After addition of aluminium sulphate, the water was allowed to settle in a sedimentation tank. The overlying clear water was then pumped into a storage tank and chlorinated. The same pump was used to supply the filling line. A 60 KVA power generator was installed to run the system. This makeshift treatment system was operating by the end of January 1995 and began to supply the water tankers of a few organisations as well as those of several private water vendors later in the year. The system was fully managed by the ICRC, which supplied the fuel to operate the generator and the chemicals, and paid the salary of the two operators, as most of the water was used for its operations (hospital) and to supply the residences of the expatriates. The running costs amounted to about 450-500 USD/month. In early 1995, MSF (Médecins sans Frontières) also used this water to supply its residences and various health and nutrition centres supported by them.

In late June 1995, UNAVEM (United Nations Angola Verification Mission) arrived in Huambo and from then on most of the water produced at the station was used to supply their tankers. At the end of the year an average amount of 1000 m3 per week was distributed, of which UNAVEM used about 60 %. Other users, including NGOs, religious and governmental

institutions, as well as private companies, were using the water, including the FAA (Fuerças
Armadas de Angola). Their respective consumption is given in the next figure.

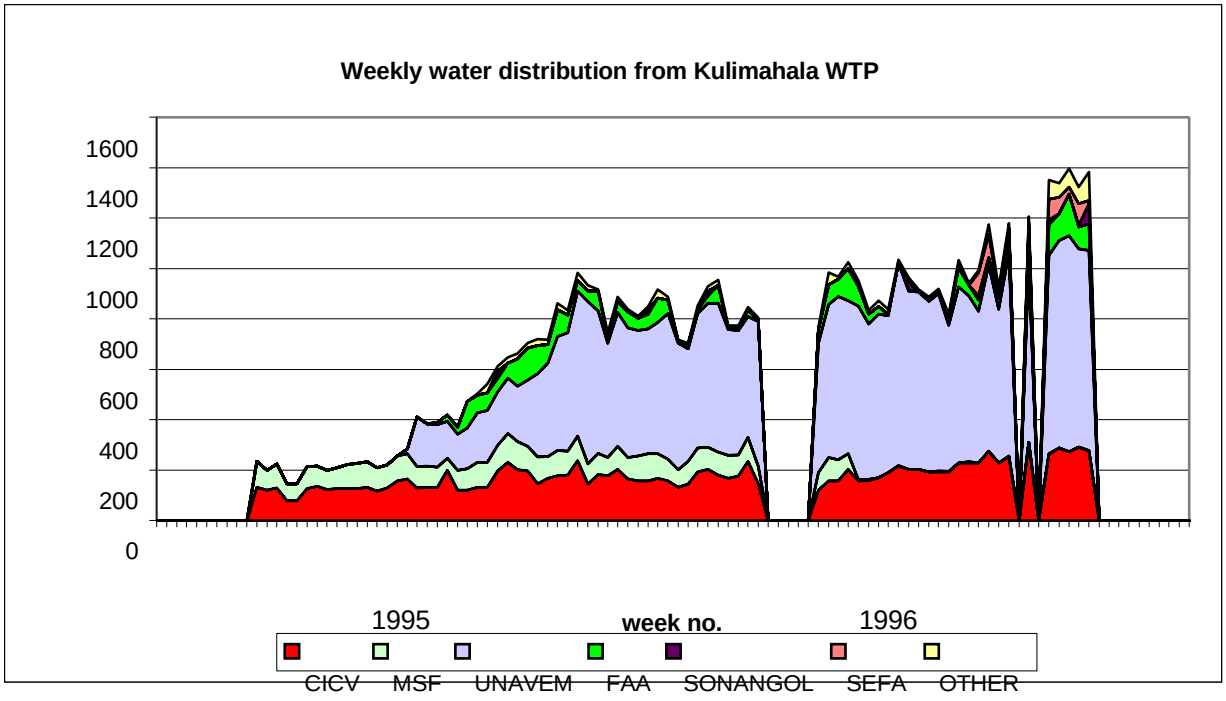


Fig. 4 Weekly water distribution from Kulimahala WTP

As the ICRC would not continue its activities in 1997, negotiations were initiated in late September with "Empresa de Agua", the local Water Company, to hand over the management of this plant. The hand-over took place on 20 October 1996 but problems arose almost immediately due to confusion as to who would be responsible for supplying fuel, chemicals and the wages for the operators. The management of the plant became quite difficult, with distribution exceeding treatment capacity, resulting in poor quality of the water produced. An agreement was finally reached between the main users and the government but the long-term role of the plant to supply treated water until a better solution was found, remained unclear.

New shallow well programme

A new water and sanitation programme was launched in July 1995 to provide most of the health posts with a protected and permanent water supply. A survey carried out to define the needs of the town's inhabitants showed that a large number of people living in the ‘barrios’ lacked a safe water source. A programme was therefore designed to address the needs of the people living too far from a safe and reliable water source, by rehabilitating old colonial public wells and by digging new ones. At the same time, due to the poor permeability of the soil and in order to increase the recharge rate of most of the wells, the diameter of the reinforced culverts was increased from 1.2 metres to 1.5 metres. The storage capacity of each well was almost doubled and the deepening procedure was also made easier, as more space was given to the teams to install the inner permeable rings used to re-line the well at end of the dry season. But the usual constraints remained, i.e. access to the coast and to essential materials such as cement, steel, etc., was only possible using air transport.

Material and equipment problems at the beginning of the programme

Because of the increased consumption of materials to cast the rings used to build the plain lined column of concrete rings and the porous ones inserted for the deepening procedure, it was necessary to install and repair an old rock-crusher, as appropriate aggregates could not be sourced in sufficient quantities. A ring-moulding factory was set up and several teams were formed and trained first in the rehabilitation of the existing wells. Only when all the necessary equipment and materials had been made available did the construction of new wells began. A target of about 40 wells of which at least 2/3 would be rehabilitated, was set for the end of 1995.

The same programme was continued throughout 1997 with better results. A total of 80 water points (72 wells and 8 springs) had been built since the beginning of the programme in July 1995. Most of the wells were equipped with hand pumps (SWN 80 type). At the end of 1996, when it was clear that the ICRC would be reducing its activities at the beginning of the next year, the project was handed over to the authorities in charge (Provincial Water Company). Training and spare parts were provided to ensure proper continuation of the maintenance.

The hand-over of the programme to DEVELOPMENT WORKSHOP (an International NGO)

Having learned from previous unsuccessful hand-overs, the ICRC already contacted several NGOs during the last months of 1996. The aim was to find a suitable partner capable of continuing the project in and around Huambo and of strengthening and managing it in such a way as to make it relatively sustainable. A Luanda-based NGO was finally chosen that was known for its experience in the urban context of Luanda in the field of water supply and management. Material, equipment and staff support were provided and a 2-year urban water and sanitation programme, designed jointly with their engineers and the water authorities in Huambo. The overall project was funded by Swiss Aid (Aide Humanitaire Suisse) and by CIDA (Canadian International Aid Agency). Four vehicles and equipment worth around 55,000 USD were made available to allow smooth continuation of this programme, aimed at further improving the environmental health conditions of the urban and peri-urban population of the town.

Development workshop programme (1997 -2000)

During the hand-over process, the whole approach had to be changed. Despite the impressive results of the ICRC programme, several problems had to be faced as the situation evolved from strictly emergency to a more development-oriented situation requiring a more sustainable approach. The main problems to tackle were:

- The development of community responsibility for- and management of the water points.
During the ICRC's involvement all wells and springs were built or repaired free of charge. The materials and manpower costs were covered by the institution's budget. The introduction of community-based participation proved difficult at the beginning as communities did not understand why they had to contribute not only their labour for the construction of the wells, but also financially, at least to support normal maintenance of the premises.

- The modification of some of the technical approaches to guarantee a permanent and reliable source of water.

A survey carried out at the beginning of the involvement of DEVELOPMENT WORKSHOP (DW), showed that of 72 wells and 7 springs, 46 were considered to be working satisfactorily, but that some were not deep enough and were being used by too many families. This problem was not really unknown to the ICRC's engineers and the technique developed allowed in principle for the further deepening of the new wells which needed it, an operation which would be carried out gradually during the dry season, as it always has been in the Planalto. But the density of such water points was not sufficient.

Whereas in 97/98 the intervention was carried out in a period of relative peace, in March 1999 the country was again plunged into war, with the city once more under siege, and a huge number of IDP were seeking refuge in the towns. The next figure gives the estimated number of IDP arriving in Huambo and in two other cities.

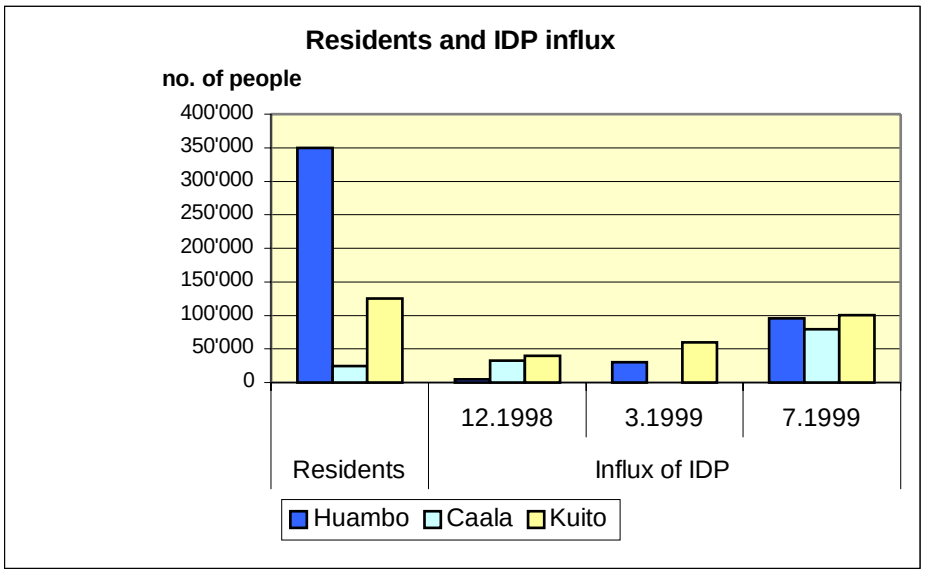


Fig. 5. No. of IDP seeking security in several town of the Planalto

In April 1999, the objectives of the project changed slightly. They were adapted to respond mainly to the needs of the **displaced people**, as well as to support the activities of other organisations in the field of water and sanitation, thanks to the experience gained in the first two years of the project.

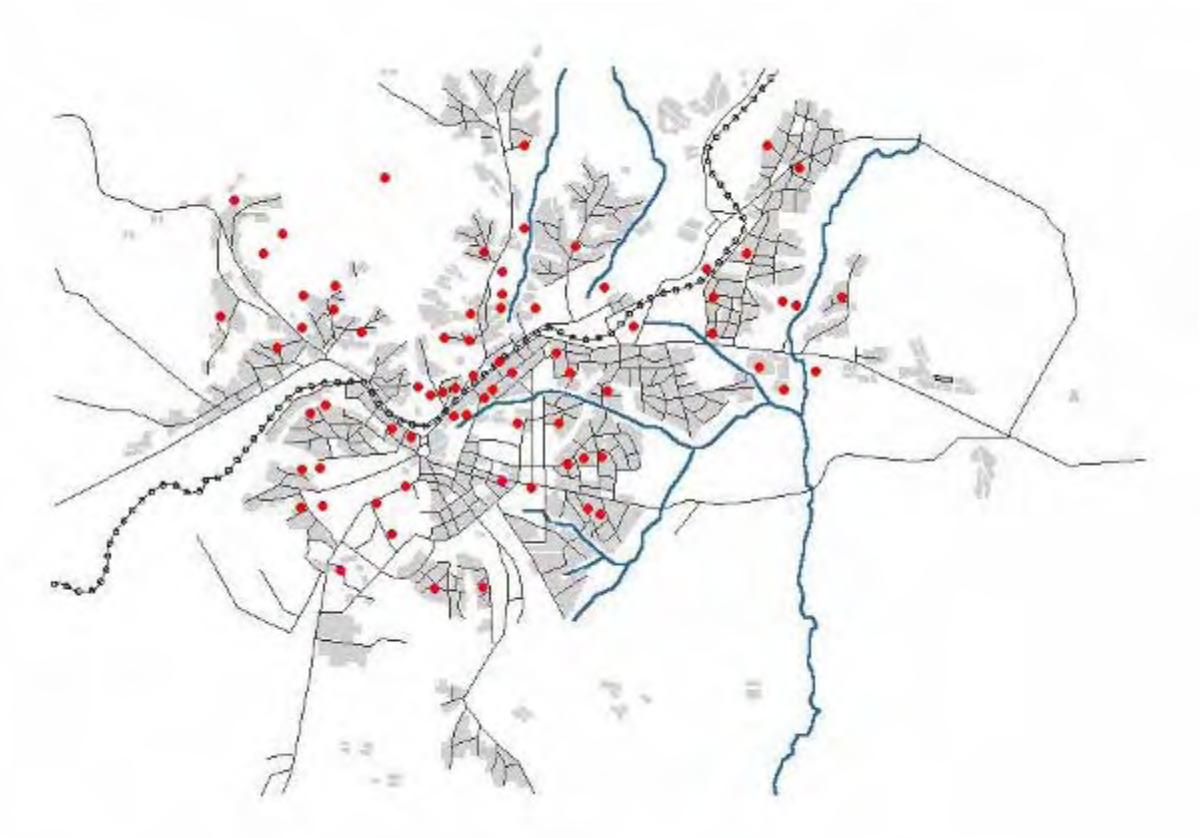
During the two-and-a-half-year project, DEVELOPMENT WORKSHOP did an impressive job. A total of 230 wells were built during this period, benefiting an estimated 160,000 people[6,7]. Technical support and materials were also provided for the construction of 64 latrines.

A database was set up and updated on a monthly basis. Previous data on ICRC wells and on their programme were stored using GIS (Geographical Information System) software, allowing easier consultation and better monitoring of the evolution of the different parameters.

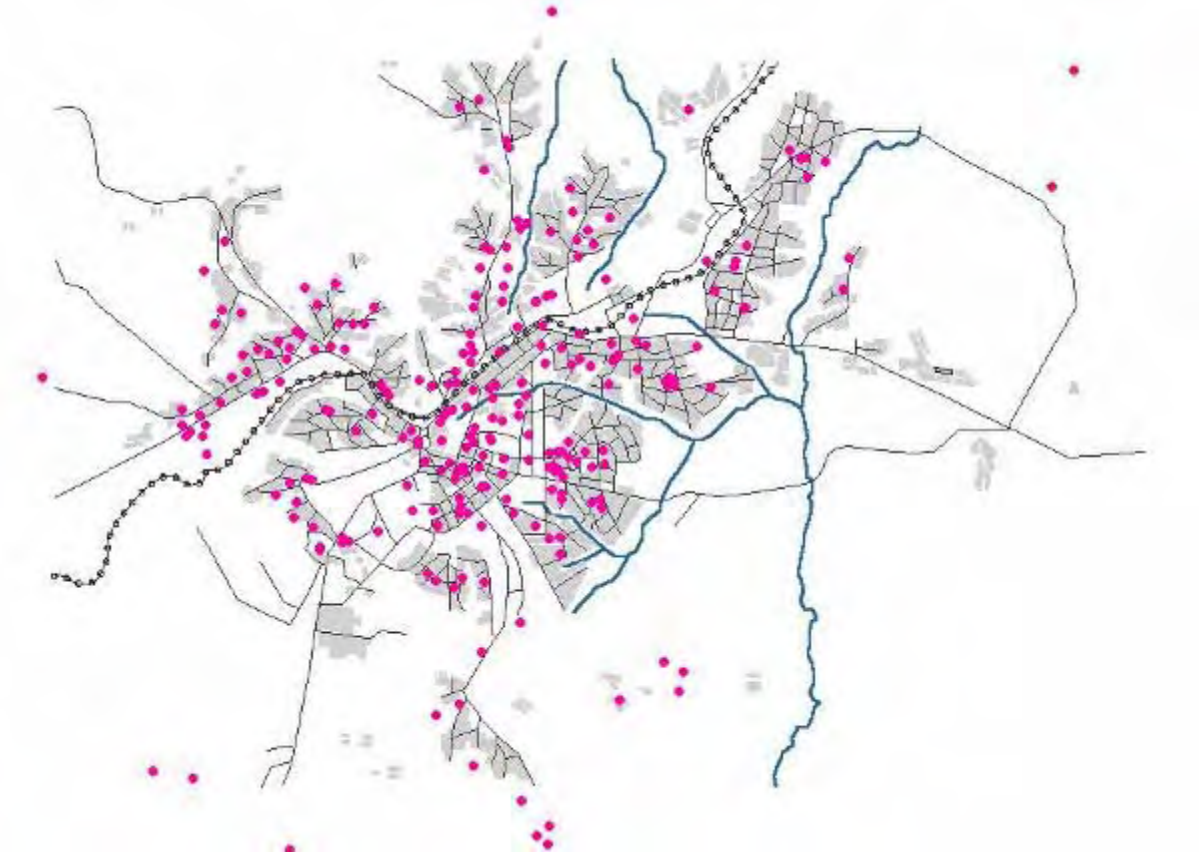
The next figure gives the number of wells completed during the ICRC programme by the beginning of 1997, when the programme was handed over to DEVELOPMENT *Figure 6, 7*

[6] Emergency Water and Sanitation Project, Final Report, April 1999 to March 2000. Development Workshop, March 2000

[7] Huambo Water and sanitation Project Reports, 1997-1998 and 1998 - 1999. Development Workshop



***Above**: HUAMBO (Angola) ICRC-protected wells and springs as handed over to Development Workshop end of*
1996 after a two-year programme. The location is tentative. No database was yet available for GIS software.
***Below**: DEVELOPMENT WORKSHOP protected wells end of 1999.Exact location. Database completed.*



WORKSHOP, together with those completed by that agency during the time frame of their project, until mid-2000. A total number of 275 water points have been included in the database and are regularly monitored.

GIS database and thematic maps

GIS software was used to manage the information of the whole project. It made it possible to monitor the evolution of the water points, their characteristics (type of water point, equipment, depth, depth of the water, number of people supplied, etc.). In this report, MAPINFO data from DEVELOPMENT WORKSHOP were translated in ARCVIEW (ESRI). New shapefiles, digitised from the geo-referenced topographic maps, have been added to simplify reporting and to produce the thematic maps shown below. Urbanised areas, roads, and rivers have been added, shown in the next figure.

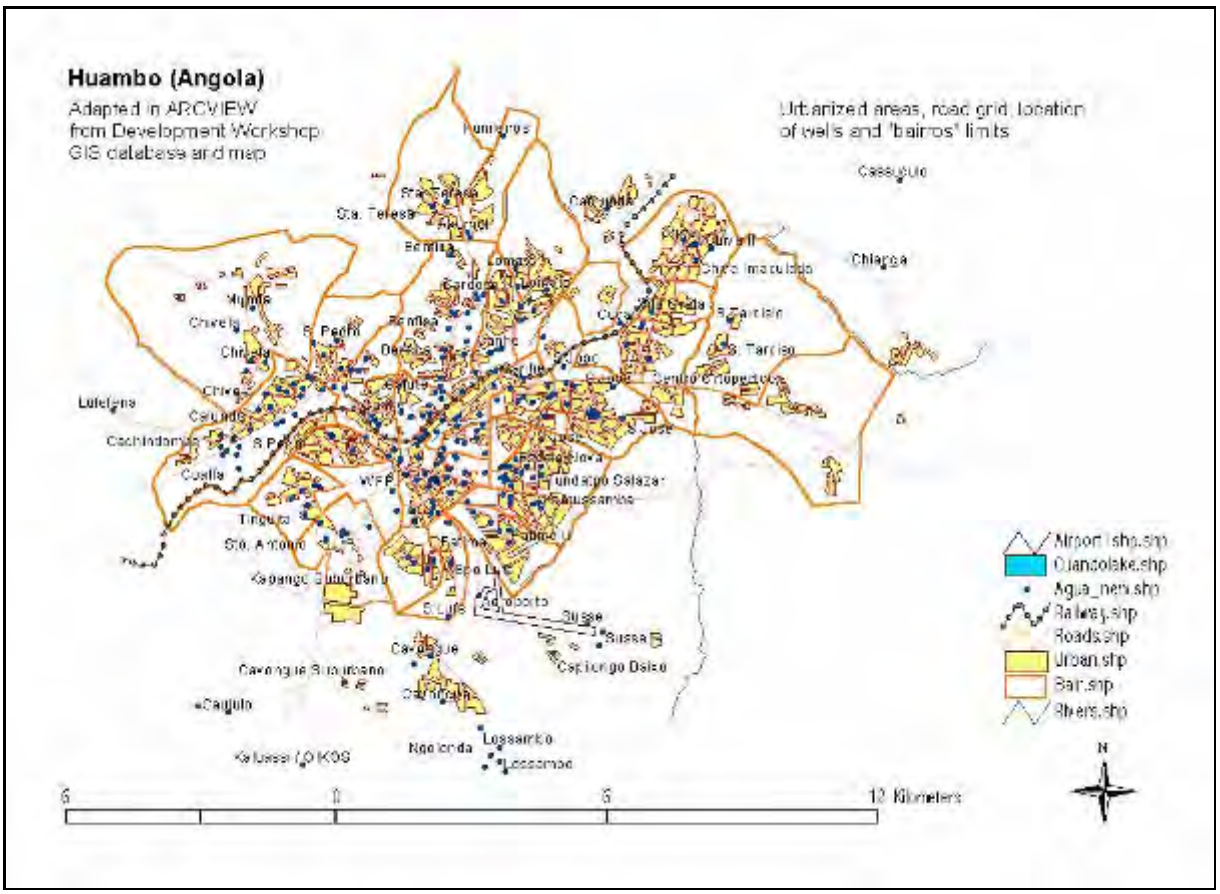


Fig. 8 Urbanised areas, road grid, location of wells and limits of the "barrios."

In the next figure, the type and the equipment of the water points are shown. As far as access is concerned, out of a total of 275 wells, 166 are communal, 80 are institutional (schools, health posts, etc.) and 24 are private. Five of them have no specific attribution. The majority of the communal wells (114) were managed by a water committee and continuous efforts were made by the social mobilisation teams of DW to increase this proportion. Most of the water points are shallow wells (239), 21 are protected springs and 15 are boreholes. After an initial attempt by the ICRC to drill boreholes at the end of 1995 using a technique aimed at speeding up the coverage of water points, a second attempt was initiated by OXFAM in 1999, mainly to cope with the needs of displaced people. A total of 26 boreholes were drilled but

only half of them are reported in the DW database. A total of 53 wells are still equipped with the SWN 80 series (Van Rekkum) hand pump used by the ICRC in its programme and installed between 1995 and 1996. DW decided to move to a more VLOM (Village level operation and maintenance) pump and installed AFRIDEV on a total of 123 wells. Only about 10 wells are reported to be equipped with INDIA MK II, part of a consignment supplied by UNICEF that was left in the EPASH stores and partially looted at the end of 1994, when the government once more took control of the town and UNITA had to leave.

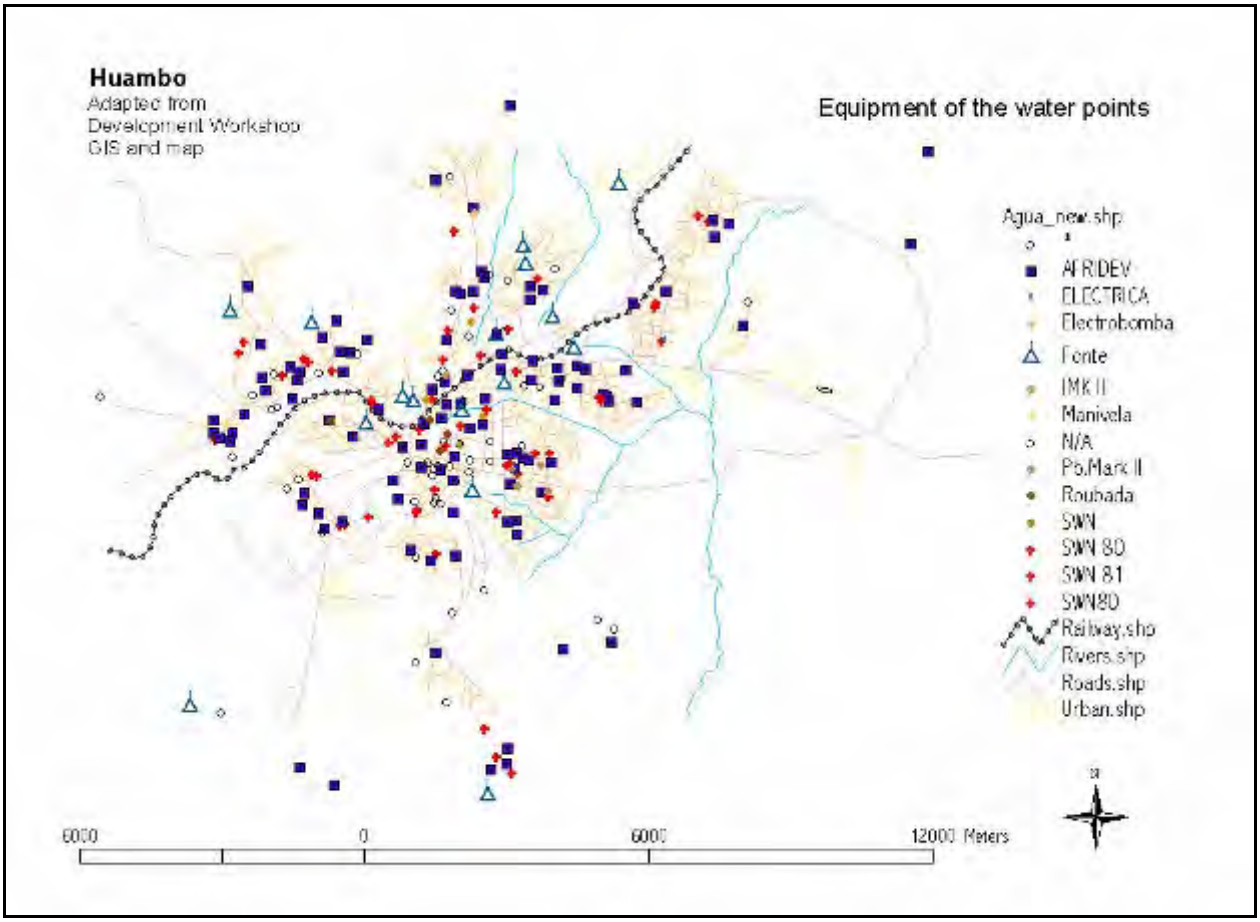


Fig. 9 Type of equipment of the wells

Coverage

When the hand-over took place it was found that most of the wells were being used by far more than 125 families, i.e. one well for 500 to 600 people, depending on the average size of a family. There was an obvious need to increase the density of the water points to allow for a better coverage, and to decrease the collection time. The next figure shows the number of wells being used at the end of 1999 by less than 125 families (yellow dots), together with the density of water points /km2 and the urbanised areas (red surfaces). At the end of 1999, according to the database, about 236 wells met this target, of which only about 20 were overused. It is estimated that a total of 156,000 people were benefiting from this programme, even if it not known how this figure was obtained. Unfortunately, data on population density were not yet known. Otherwise, it would have been easy to compute a relative density of water points per inhabitant and plan for future interventions.

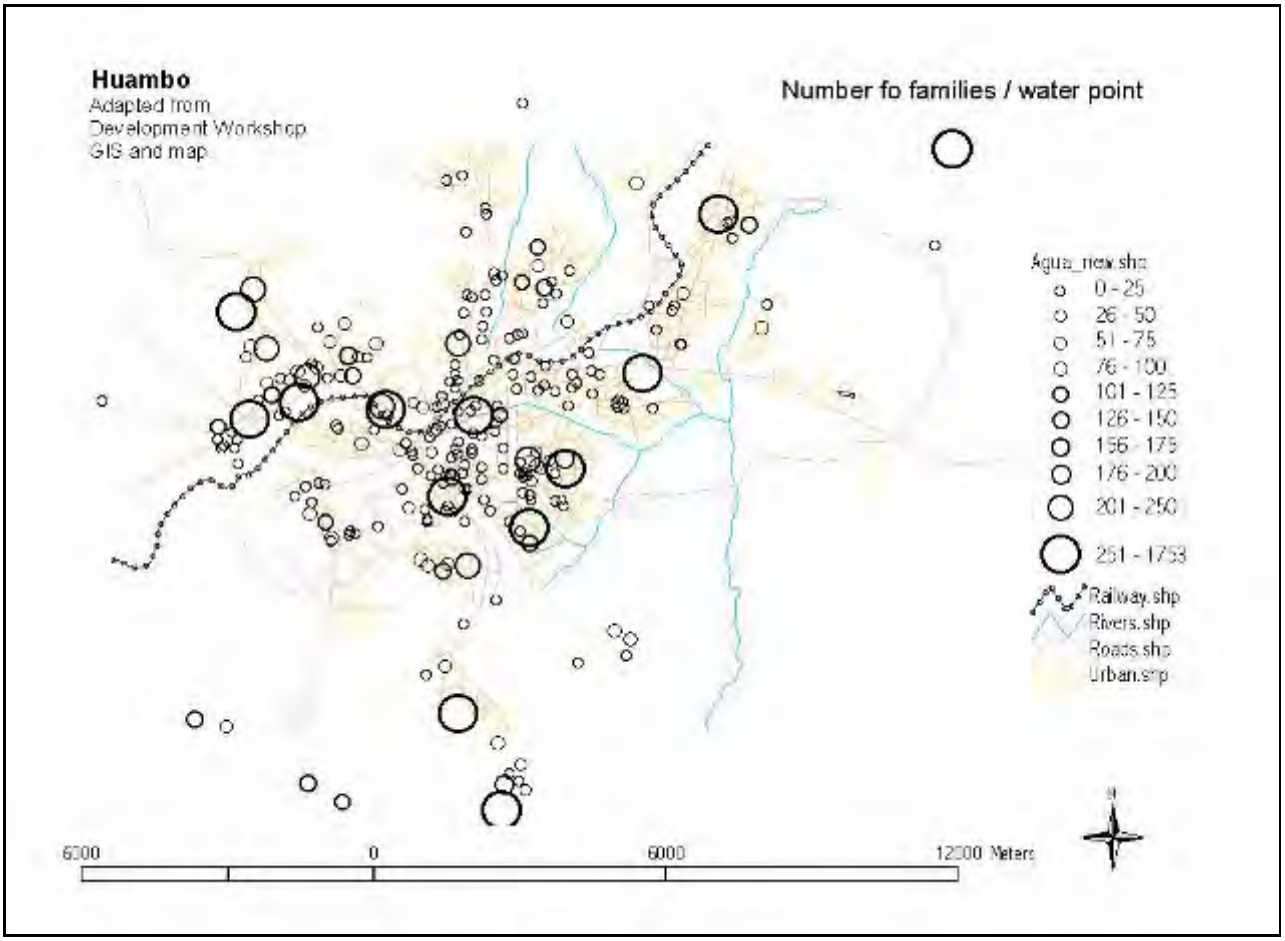


Fig. 10 Number of wells used by less than 125 families

The present phase (2000 - 2001)

Previous attempts to resume the distribution network

Although the well programme covered the city's needs during the periods of instability, it became evident that the city could not continue to rely on the wells as the only water supply for its inhabitants.

The main problem facing the new water treatment station was the lack of power. Therefore, a survey was carried out to assess the feasibility of resuming the production of electricity by the Cuando hydropower station in mid-1994, during UNITA's rule, when the station was again accessible.

The power station is supplied by the Cuando dam, which is located at about 13 km from the Kulimahala WTP (see map). The dam was considered in good condition and only a few repairs on the sluice gates were necessary to bring it on-line.

The hydro-electrical station, built by the British in 1937, had an initial capacity of 1.1 kW produced by four turbines. The installation had been done by General Electric and they had carried out some repairs in 1983/84. During the survey, two turbines (500 kW and 200 kW) were found in working condition, one (200 kW) required some repairs and the fourth (200

kW) was under service. It was estimated, with some optimism, that it would take roughly a month's work to re-commission the whole plant, provided that the ICRC supplied about 5,000 litres of insulating oil to step-up the transformer (from 550 kV to 22.5 kV of the high tension line), as well as lubricant for the turbines.

As the station was repeatedly targeted and since nobody knew how the situation would evolve, the request was considered with some reluctance, even though everybody believed that this was the only way to restore a regular water supply to the town.

The events at the end of 1994 proved that the project was premature.

Recent rehabilitation

The water treatment plant was re-commissioned in 1997. The repair work was carried out by EPASH (Empresa de Agua e Saneamento do Huambo). The main problem was power. The station was tested and found to be in working condition but, due to a lack of power, was not able to pump any water into the two main delivery lines supplying the town or to the one supplying the water tower located in Cuca. The main pipeline, 350 mm in diameter, delivers water to the Rua do Comercio booster station, to the water tower (250 m3), and fills up the 1,900 m3 storage reservoir. The other pipeline, starting from Central Velha, but interconnected with the new station, supplies the St. José booster station from which the water is pumped to the city's main underground reservoir and water tower (Estacao de Alta), located on the premises of Agua e Saneamento. A smaller line, 150 mm in diameter, supplies the water tower located in Cuca (brewery), which supplies not only the industrial area but also the domestic users of Tchiva. The pumping station and water system located in Rua do Comercio were attacked and damaged in 1983 and were never repaired. They were included in the second phase of the rehabilitation project of Tecnico Electrico. At the St. José booster station, two out of three pumps were operational but, again, not functioning due to the lack of power. The city's main storage system, located at Agua e Saneamento, was considered, although in a precarious state, to be in working condition.

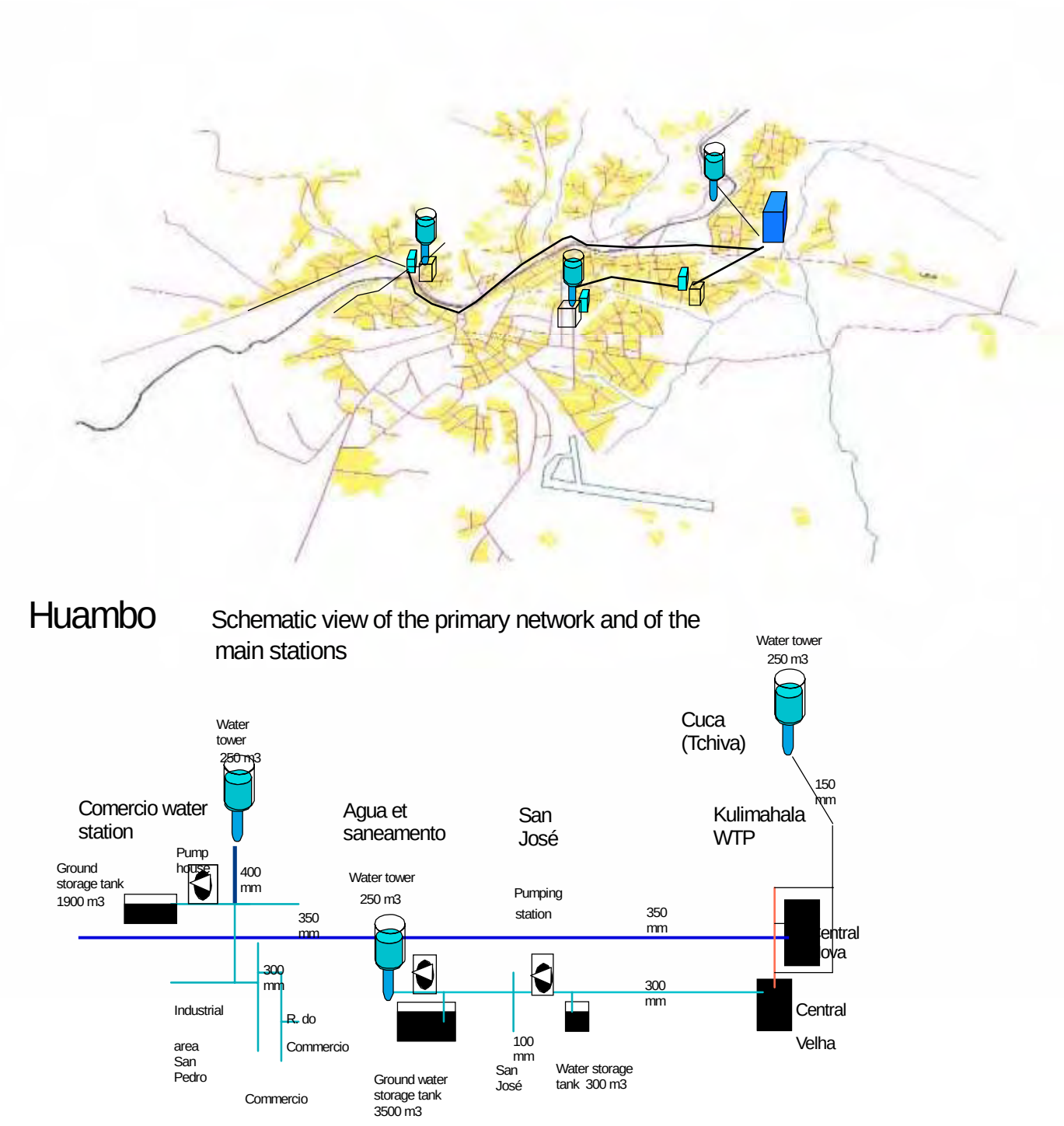
The different distribution lines and the network were found to be in great disrepair and would need to be rehabilitated and probably completely reconstructed in many sections. A total of 50,000 private connections were active throughout the town.

The next figure gives a schematic view of the system and the approximate location of the main stations.

The rehabilitation of the station

Due to a lack of power and fuel to operate the existing stand-by generators in town, almost no water distribution had been functioning since November 1998, and only the section of the Central Velha, rehabilitated by the ICRC in 1995, was still operating. The town residents had access to limited quantities of water from the wells and springs managed by the DW program. The IDP were concentrated at the boundaries of the town, at Coalfa and at the CFB site. The majority, located at Coalfa, received an average of 20,000 litres/day, supplied by water-tankers managed by SHA (Swiss Humanitarian Aid), but also used the nearby wells. It was clear that these quantities were not sufficient to cover their needs, estimated to be as high as 500,000 litres/day, and that a solution would have to be found.

Fig. 11 Schematic layout of the pumping and distribution system



An initial proposal was made by DEVELOPMENT WORKSHOP at the end of May 1999. The idea behind it was to solve first the problem of the displaced people, but also to ensure a regular and permanent supply for the town. As a first step, power for the Water Treatment Station of Kurimahala would be secured with the installation of a transformer to step down the nearby 22.5 kV line, then the electrical control panels would be repaired and the line supplying Sao Pedro from Rua do Comercio rehabilitated.

In mid-1999, when the influx of displaced people in Huambo was at its highest, and to prevent the possibly disastrous effects of the onset of the wet season, when outbreaks of water-washed diseases would appear, an evaluation study was made by the ICRC. The aim was to re-assess the water supply situation of the displaced people but also that of the resident population. The conclusions were similar to those outlined by DEVELOPMENT WORKSHOP and EPASH.

A plan of action was prepared to resume water distribution to the whole town, thus allowing Empresa do Agua to extend distribution to the IDP camp, pumping from the Rua do Comercio water storage, booster and elevated tank system.

After a technical review meeting, the following decisions were made:

- To re-establish production at Central Nova and Velha (nominal capacity 20,000,000 litres/day) by connecting the power line to CFB from the hydroelectric plant of Cuando with the installation of a transformer;
.
- To re-commission the Rua do Comercio booster station and rehabilitate the supply line to
S.Pedro and Coalfa in order to supply the main IDP camp;

- To re-commission the pumping and booster station at St. José and Estacao de Alta (Agua e
Saneamento);

- To bring the "zona industrial" pumping station on line;

- To rehabilitate the main distribution network which showed important leaks in various places.

It was determined that almost all the necessary equipment was available within EPASH, CFB and the Ministry of Energy, and that DEVELOPMENT WORKSHOP would assist the government bodies with their technical and logistical know-how. On the other hand, the ICRC was asked to assist EPASH in the rehabilitation of both the water treatment stations located at Kurimahala.

The implementation of the project

An agreement was signed at the end of 1999 between the different partners. They included the Provincial Government, which also contributed financially; DEVELOPMENT WORKSHOP, which was in charge of the co-ordination of the whole project; EPASH – the implementation partner of DW, mainly in the field of water; CFB – the owner of the hydroelectric power plant at Cuando, and involved in a bilateral agreement with EPASH; ENE (Empresa National de Electricidade) – the implementation partner for all the electrical interventions; and USAID – the main donor for the entire project, estimated at close to 400,000 USD.

The ICRC was not formally part of this agreement. Its involvement was limited to the rehabilitation of the water treatment station, namely in the following tasks:

- desilting the various abstraction systems supplying raw water to the new station
- replacing one 37 kW electrical motor of the three 500 m3/h low-lift pumps
- installing one air compressor unit to carry out the backwash of the filters
- supplying and installing several dosing pumps for the chemicals
- supplying chemicals (Aluminium sulphate, calcium hydroxide and calcium hypochlorite) to cover 3 months of production, from October to December
- replacing a 230 kW electrical motor for the high-lift pumps.

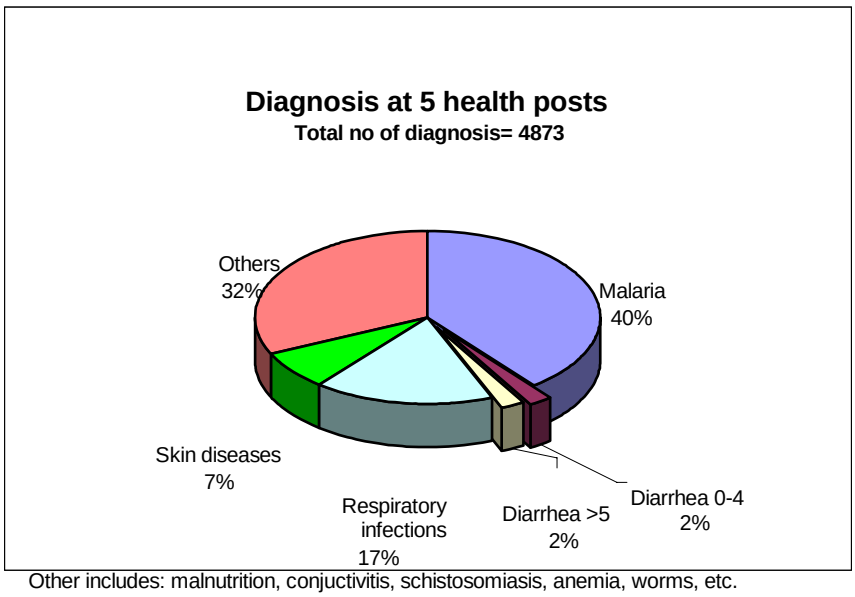
By the end of 2000, most of the work outlined in the agreement was completed. Several transformers were installed to supply the stations and all the high-tension lines were installed to power the different pumping stations within the town.

When power was available from Cuando, which was not yet fully rehabilitated, or from the town, an average quantity of 14,000 m3/day of potable water was pumped into the distribution network, reaching about 70 % of the nominal capacity of the Kurimahala station.

As foreseen, it became clear at the beginning of 2001 that the distribution network would have to be rehabilitated and a specific evaluation targeting that particular point was undertaken.

The impact on health

Properly protected and managed shallow wells are in principle not contaminated by pathogens responsible for water-related diseases. To test the wells, the presence of more than 10 thermo-tolerant bacteria was used as an indicator for faecal contamination, as it is almost impossible to reach a zero value, owing to possible preferential infiltration routes during the recharge process. Bacteriological tests carried out regularly by DEVELOPMENT WORKSHOP teams showed that most of the wells were free of thermo-tolerant bacteria contamination. On average, 78 % of the wells tested were free of faecal coliforms throughout the year (four campaigns) with only a slight increase after the onset of the rainy season. This is confirmed by the low proportion of diarrhoeal diseases observed at the health posts. Data from five health posts



Other includes: malnutrition, conjuctivitis, schistosomiasis, anemia, worms, etc.

Fig. 12 Diagnosis at five health posts

supported by the ICRC showed that in July 2000 the proportion of attendance for diarrhoeal diseases in children under four years of age was low, less than 3%, at is shown in the next figure, with malaria and respiratory infection respectively up to 40% and 17 % of all the diagnoses. This proportion is almost the same for January, when a slight increase in "contaminated" wells was observed.

Discussion

The evolution of the city's water supply has changed drastically during the last 15 years. From a quite normal supply at the onset of the war it came to a complete stop during the power struggle for control of the city. Obviously, the operation of the station depended mainly on the possibility of supplying it with power and on the pressure UNITA put on the governmental perimeter around the town. Adding to the lack of power, the damage inflicted on the various installations by both the warring parties made the resumption of water distribution quite problematic.

The impact of the initial activities

Between 1985 and 1994, the ICRC's activities had limited impact. This reflected the role played within the institution by its water and sanitation section, which was mainly devoted to the support of classical health programmes, providing water to health posts, hospitals, feeding centres and prisons.

The approach chosen by the ICRC in 1995, which was to address the needs of the town's population, was triggered by the precarious state of water distribution within the town, but also by the larger role the water and sanitation section was able to play within the institution, having been recognised for its recent successful programmes. Indeed, during the Gulf war and in other contexts (Rwanda, Liberia), it addressed the needs of the whole population of affected towns, thus reflecting a more "public health"-oriented approach and not just a classical "medical" approach. When one of the main problems is malnutrition, it is quite difficult to convince the hierarchy of the institution that access to clean water is as important in the prevention of malnutrition as food, and that cement, pipes, iron bars, and pumps are among the items that must be transported by plane. Strictly medical supplies do not really compete for logistics, as their cargo requirements are modest.

This approach was also possible thanks to the experience gained during the previous years, when about 70 wells and springs were protected throughout the Planalto. During that period the methodology was improved and a better understanding of the constraints made it possible to launch a more ambitious programme in 1995.

Other not very well-known crucial steps were important: for instance the repair and installation of a rock-crusher. This made it possible to produce aggregates to cope with the larger quantities needed for a more extensive programme involving more sustainable technical options, such as the complete lining of the wells with concrete rings and larger diameters to increase the amounts of water available daily to the people.

The hand-over

The hand-over to DEVELOPMENT WORKSHOP in 1997 allowed the latter, which was specialised in more development-oriented projects, to boost the outcome and to set up a well-

managed programme extensively involving the users of the water. The setting-up of the users' committees proved quite difficult at the beginning due to the purely assistance-oriented approach used by the ICRC, where almost everything was provided to the users to sink and equip the wells. The transition to a more participatory approach, where the community was asked to contribute to well digging and maintenance was difficult and long. At the same time, some of the wells were considered private wells and the setting-up of a users' committee was difficult. Participation was also weaker in the more urban areas and the collection of fees more problematic during the rainy season when water, albeit of doubtful quality, was easier to fetch.

The final aim was also explored of achieving partial cost-recovery for the maintenance and management of all the water points. The onset of the war in 1999 resulted in a drastic increase in market prices and in a weakening of the local currency against the dollar, as shown in the next figure. This added further to the burden on the already low economic status of the families, leading in turn to a low rate of contributions.

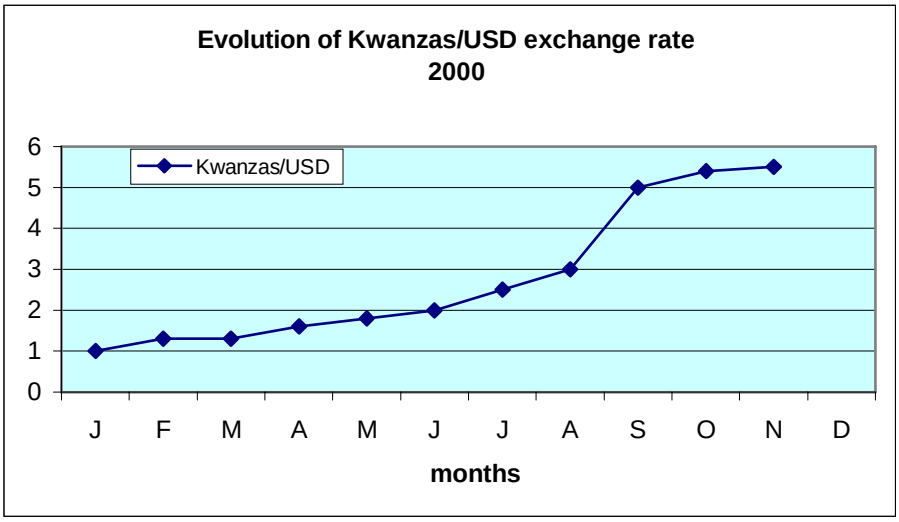


Fig. 13 Evolution of the Kwanza/USD exchange rate.

One of the strengths of the programme was its social mobilisation component. The creation of a large number of functional water committees (179 out of 181 functional by March 2000) was essential to the maintenance of the various premises. Moreover, it also created a basis for a network of community-based organisations that would serve as a departure point for community development initiatives.

The transition to a centralised distribution system

Although the shallow well approach was appropriate during the difficult years, making it possible to cope with the needs of the inhabitants as well of those of the displaced people, it was evident that the town's central distribution network had to be resumed. The re-commissioning of Central Nova in late 1997 was an important step, but power remained a problem, as fuel could not be secured in sufficient quantities to run the city's 4.2 MW generator, to which the station was connected. Distribution of water has been erratic since February 1999.

In early 1999 a first proposal was made to tackle the rehabilitation of the Cuando hydropower station and an agreement was reached between the different partners, with funds secured by USAID. In 2000, minor repairs were made on the water treatment stations as well as on the power lines and on the installation of the transformers. Work on the power station began only in mid-2000. By the end of 2000 it was expected that work on the four turbines would be

completed by April 2001 but that the main turbine, which produced 500 kW, would be put in operation already in January 2001.

By the end of 2000 most of the major problems linked with the production of power and, consequently, the production of water, were solved or were due to be solved in the following months.

From the time when the ICRC decided to stop its activities in the Planalto in early 1997, four years were necessary to reach a final agreement and take the necessary steps to resume water distribution through the existing network. Only in 1999, after two years of relative stability, was a precise proposal put forward. Some work had been done in between but without any continuity, whenever equipment could be found and transported to Huambo. It took another two years to bring on-line a sufficient and regular production of power and to secure a regular production of water.

But the problems linked with the distribution network are still not solved and it is clear that they can be tackled only once the system is put under pressure.