PD-ABA-940
ISN 66251

SUDAN

GEDAREF WATER SUPPLY

Project Paper

650-0065

September 1983

Agency for International Development
Washington, D.C. 20523

September 22, 1983

ACTION MEMORANDUM FOR THE DIRECTOR, USAID/SUDAN

From: Steve Mintz, Associate Director for Project Operations

Subject: Project Authorization: Gedaref Water Supply (650-0065)

Problem: Your approval is required to authorize a grant to the Government of Sudan (GOS) in the life of project amount of $7,500,000 from the Migration and Refugee Assistance Act of 1962, the Foreign Assistance and Related Programs Appropriation Act, Fiscal Year 1982, together with related legislation, for the Gedaref Water Supply Project. The FY 1983 obligation for the project will be $7,500,000.

Discussion: The project will rehabilitate and improve the water supply system of the Es Showak-Gedaref area in the eastern Sudan province of Kassala. The system currently serves approximately 235,000 people, of which about 40,000 are Ethiopian refugees. The refugee population is growing at about 1,000 per month. The present water system is totally inadequate to serve the minimum needs of the people within the service area. About 100,000 of the population are purchasing water from water vendors for an exorbitant price; the others served by the system receive water intermittently. This has caused hardship in the area, political unrest, deterioration of relationships between the refugees and the local Sudanese and an increase in water-borne diseases. The total population in the area will be beneficiaries of the project.

In November, 1982, the local situation was so critical that UNHCR at the request of the GOS Commissioner of Refugees called an emergency meeting of bilateral donor governments to request assistance. USAID responded to the emergency situation by engaging a U.S. engineering firm to conduct a feasibility study. This was completed in July, 1983. USAID followed up by engaging the same firm to proceed with final engineering designs and preparation of the tender documents. This is currently being done and will be complete in November, 1983. This project is based upon the recommendations made in the above mentioned feasibility study.

The project is compatible with the GOS policy towards refugees of providing that assistance which permits the refugees to become economically self-sufficient. At the same time, it is compatible with the USAID policy of financing those projects which assist the overall development of Sudan and stimulate the productivity of both refugees and nationals.

The elements of the project are: (1) Replace the surface water source with a series of wells near the Atbara River, (2) Replace the pumps at the Es Showak booster pump station, (3) Install a new booster station in the Es Showak-Gedaref pipeline, (4) Rehabilitate and construct new wells in the Abu Naga well field, (5) Construct a well and improve the distribution system in the Tawawa refugee village, (6) Provide meters, spares, vehicles and a communication system, and (7) Provide technical assistance and training to assure the continual successful operation and maintenance of the system.

The project has a LOP of 40 months. At the end of the project and through 1987, the system will provide a minimum of 50 liters per capita per day for those with direct connections or near the source of supply and 35 liters per capita per day for all others. The significant input of institutional development training will leave a qualified organization to operate and maintain the system.

The project will be implemented under the overall guidance of the National Administration for Water (NAW). NAW has the necessary technical and administrative experience to successfully implement the project.

The total cost of the project over its three year four month life is $8,362,000 of which the AID contribution is $7,500,000. The GOS contribution of $ 862,000 is 10% of the total cost. This amount is equivalent to LS 1,120,000 of CIP generated local currencies. A life of project summary budget is as follows:

Item	US($000s) (FX)	GOS(000s)	
Construction Cost	4,120	Site location supplement	LS 830
10% Contingency	412	Monitoring, training	LS 290
Inflation Contingency	877		LS 1,120
Institutional Development, Training	901		
Construction Management, Services, Evaluations	1,185		
Total	$ 7,495		

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A negative determination was made at the time of the Initial Environmental Examination. The REDSO Environmental Officer served on the PP team. The environmental concerns have been taken into the system design and will be monitored in the evaluation.

The project was reviewed by the Project Review Committee on September 13, 1983, and recommended for authorization. An Advice of Program Change was submitted to Congress and expires on September 27, 1983.

Recommendation: Based on the authority delegated to you it is recommended that you sign the attached Project Authorization and thereby authorize the project.

PROJECT PAPER

GEDAREF WATER SUPPLY
650-0065

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Geographic Code 935) in accordance with the following order of preference:

(a) The United States (Code 000)

(b) The Cooperating Country

(c) Selected Free World Countries (Code 941)

(d) Special Free World Countries (Code 935).

(2) In applying the above order of preference the criteria set forth in A.I.D. Handbook 13, Chapter 4, Appendix 4C, Section 15(d) will be utilized.

(3) The procurement of goods or services of other than United States source, origin or nationality shall be subject to prior A.I.D. approval.

(4) Ocean transportation costs will be financed under the Grant only on flag vessels of the United States or Sudan, except as A.I.D. may otherwise agree in writing. If A.I.D. determines either that there are no vessels under flag registry of Sudan generally available for ocean transportation, or that Sudan has no access to U.S. flag service, A.I.D. in a Project Implementation Letter may agree to finance ocean transportation costs on vessels under flag registry of any country included in A.I.D. Geographic Code 941.

4. b. Covenants

The Government of Sudan as Grantee will covenant, in substance, to the following undertakings, except, as A.I.D. may agree in writing:

(1) In view of the government reorganization pending at the time of the signing of this agreement and the importance of having a continuing staff responsible for project implementation, the Grantee agrees that the National Administration for Water (NAW) will continue to be responsible for the Gedaref Water Utility through to project completion, except to the extent that A.I.D. may agree otherwise in writing.

(2) In recognition of the importance of compensation levels sufficient to attract and keep qualified and productive personnel, the Grantee agrees to work with the AID financed consultant to develop and install a program of compensation financed from the Project Account, that will accomplish this objective and further covenants that the program will be financed from the Gedaref Water Utility revenues after termination of the AID financed project.

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(3) The Grantee agrees to undertake those steps essential to assure a highly improved water revenue collection system, acting through the National Administration for Water or other relevant agencies. The Grantee agrees to support actively an enforcement of an approved water revenue system, including collection of revenues for water dispersed through public standpipes and agrees to the elimination of the procedure which permits the purchase of water from the supply system at posted rates and resale at higher rates.

(4) The Grantee, acting through the NAW, agrees that it will establish a Steering Committee for the Project. The functions of the Steering Committee will be as follows: assure proper coordination of activities among all agencies and parties concerned with the Gedaref Water Utility and with the status of refugees; set overall policy; and solicit cooperation. The Steering Committee will be composed of representatives from the NAW, Commissioner of Refugees, UNHCR, the Regional Government, the Gedaref Town Government, the Gedaref Water Utility, Regional Health Officer and A.I.D.

(5) The Grantee agrees that acting through the NAW and the Gedaref Water Utility, all key positions in its Gedaref Water Utility Organization will be filled with qualified personnel prior to the arrival of the consultant.

(6) The Grantee undertakes to incorporate the Tawawa refugee village water system within the Gedaref Water Utility organization and under the administration, operation and maintenance responsibility of the Gedaref Water Utility management.

DATE: 24 September 1983

William R. Brown
Director
USAID/Sudan

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AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT DATA SHEET

1. TRANSACTION CODE: A (A = Add, C = Change, D = Delete) — Amendment Number: _____

DOCUMENT CODE: 3

COUNTRY/ENTITY: Sudan

3. PROJECT NUMBER: 650-0065

4. BUREAU/OFFICE: AFR — 06

5. PROJECT TITLE (maximum 40 characters): Gedaref Water Supply

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 01 DD 30 YY 87

7. ESTIMATED DATE OF OBLIGATION (Under 'B.' below, enter 1, 2, 3, or 4)

A. Initial FY 83 B. Quarter 4 C. Final FY 83

8. COSTS ($000 OR EQUIVALENT $1 =)

A. FUNDING SOURCE	FIRST FY B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total						
(Grant)	(7,500)	( )	(7,500)	(7,500)	( )	(7,500)
(Loan)	( )	( )	( )	( )	( )	( )
Other U.S. 1.						
Other U.S. 2.						
Host Country		862	862		862	862
Other Donor(s)						
TOTALS	7,500	862	8,362	7,500	862	8,362

9. SCHEDULE OF AID FUNDING ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	2. Loan	D. OBLIGATIONS TO DATE 1. Grant	2. Loan	E. AMOUNT APPROVED THIS ACTION 1. Grant	2. Loan	F. LIFE OF PROJECT 1. Grant	2. Loan
(1) MRA	720	826				7,500		7,500	
(2)									
(3)									
(4)									
TOTALS						7,500		7,500	

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each)

11. SECONDARY PURPOSE CODE

12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)

A. Code: BU

B. Amount: 5.3

13. PROJECT PURPOSE (maximum 480 characters)

To assist the Government of Sudan in providing a reliable, adequate supply of potable water for refugees and local Sudanese in the Es Showak-Gedaref area.

14. SCHEDULED EVALUATIONS

Interim MM 02 YY 85 | MM YY | Final MM 03 YY 86

15. SOURCE/ORIGIN OF GOODS AND SERVICES

☒ 000 ☒ 941 ☒ Local ☒ Other (Specify) 935

16. AMENDMENTS/NATURE OF CHANGE PROPOSED (This is page 1 of a ____ page PP Amendment)

17. APPROVED BY

Signature: [signature]

Title: Director, USAID/Sudan

Date Signed: MM 09 DD 24 YY 83

18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION

MM DD YY

PROJECT AUTHORIZATION

Name of Country: Sudan

Name of Project: Gedaref Water Supply

Number of Project: 650-0055

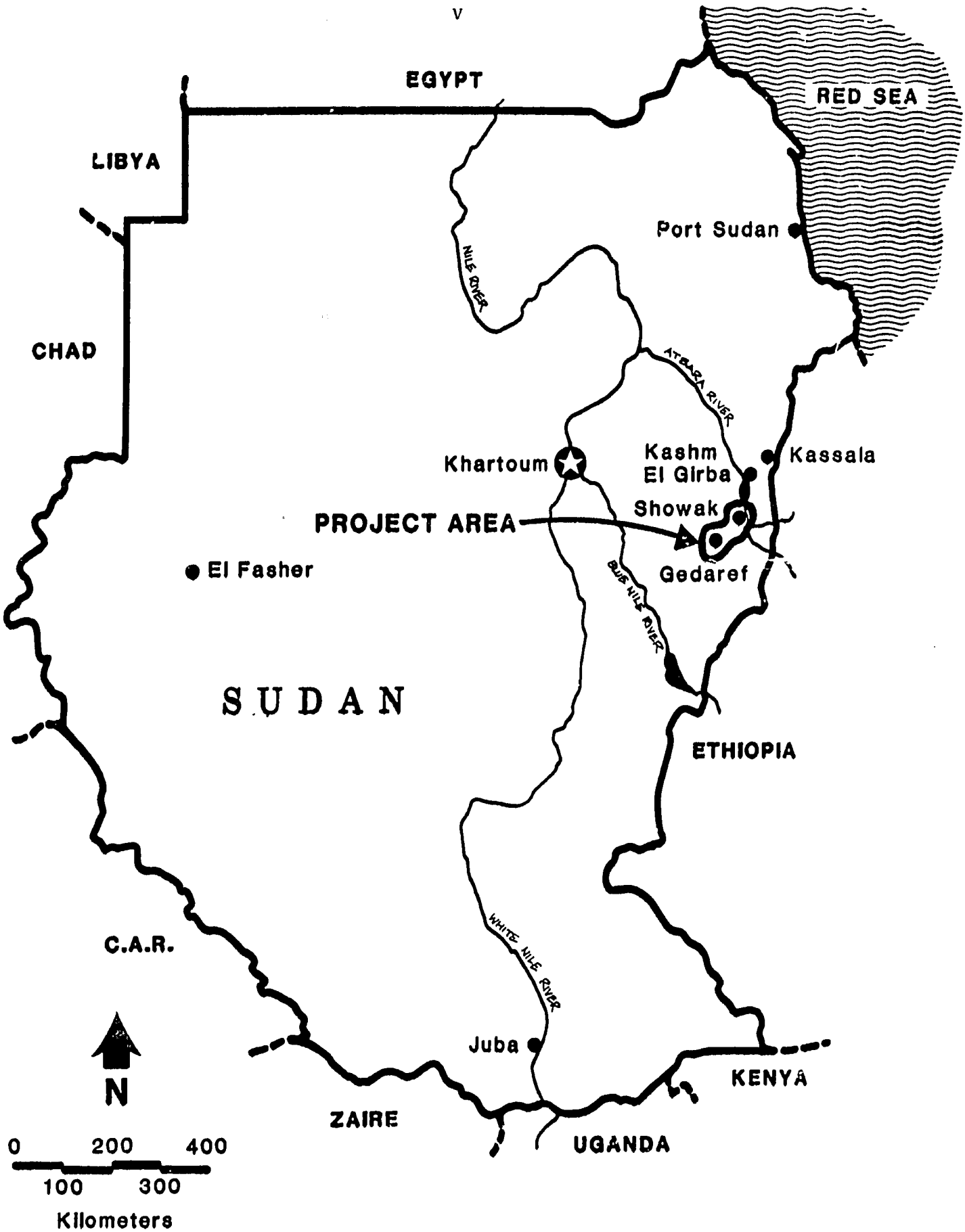
1. Pursuant to the Migration and Refugee Assistance Act of 1962, as amended, the Foreign Assistance and Related Programs Appropriation Act, Fiscal Year 1982, together with related legislation, I hereby authorize the Gedaref Water Supply Project for Sudan, involving a planned single obligation of not to exceed $7,500,000 in grant funds subject to the availability of funds in accordance with A.I.D. OYB-allotment process, to help in financing foreign exchange and local currency costs for the project. The planned life of the project is three years and four months.

2. The project consists of a series of activities designed to provide a reliable, adequate supply of potable water for refugees and the local Sudanese populace in the Es Showak-Gedaref area. The project supports the Government of Sudan policy for refugee assistance of fostering economic integration while contributing to regional and national development. It is compatible with the USAID strategy of targeting resources on activities that stimulate the productivity of both refugees and nationals. The project activities consist of the rehabilitation expansion of (a) Tawawa supply distribution, (b) Abu Naga well field, (c) Main reservoir, (d) Atbara River Supply, (e) Es Showak Water System, (f) Metering waste control; in addition to: (g) Communications, (h) Operating equipment, materials and (i) Long and short term technical assistance/training.

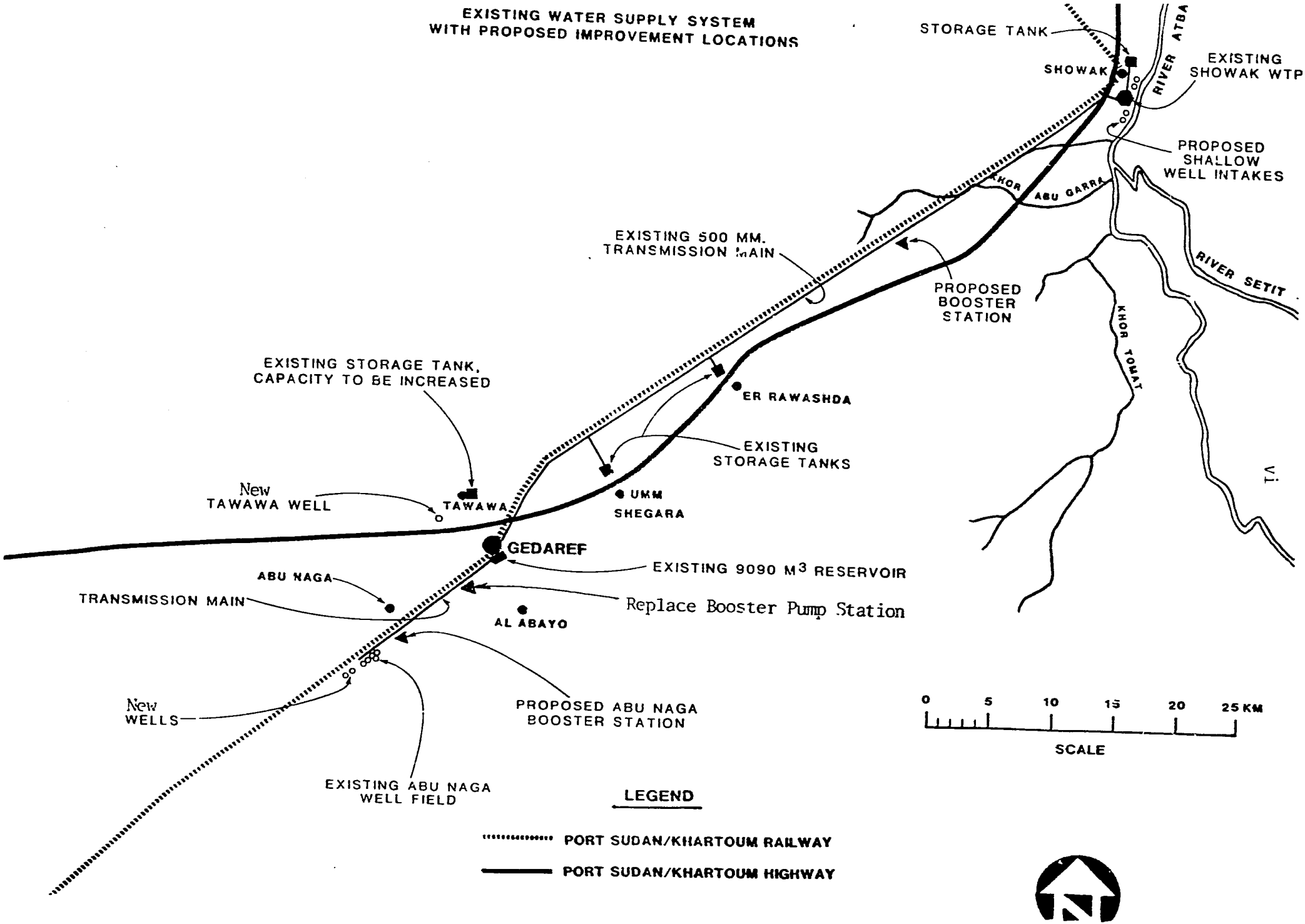
3. The Project Agreement(s) which may be negotiated and executed by the Officer(s) to whom such authority is delegated in accordance with AID regulations and Delegations of Authority shall be subject to the following essential terms and covenants and major conditions, together with such other terms and conditions as AID may deem appropriate.

4. a. Source and Origin of Commodities, Nationality of Services.

(1) Except as A.I.D. may agree otherwise in writing, all goods and services financed by A.I.D. under the project shall have, with respect to commodities their source and origin, and with respect to services, their nationality, in Special Free World countries (i.e.



PROJECT LOCATION MAP


EXISTING WATER SUPPLY SYSTEM
WITH PROPOSED IMPROVEMENT LOCATIONS
STORAGE TANK
SHOWAK
RIVER ATBA
EXISTING SHOWAK WTP
PROPOSED SHALLOW WELL INTAKES
KHOR ABU GARRA
RIVER SETIT
KHOR TOMAT
EXISTING 500 MM. TRANSMISSION MAIN
PROPOSED BOOSTER STATION
ER RAWASHDA
EXISTING STORAGE TANKS
EXISTING STORAGE TANK, CAPACITY TO BE INCREASED
New TAWAWA WELL
TAWAWA
UMM SHEGARA
GEDAREF
EXISTING 9090 M3 RESERVOIR
ABU NAGA
TRANSMISSION MAIN
Replace Booster Pump Station
AL ABAYO
New WELLS
PROPOSED ABU NAGA BOOSTER STATION
EXISTING ABU NAGA WELL FIELD
0 5 10 15 20 25 KM
SCALE
LEGEND
PORT SUDAN/KHARTOUM RAILWAY
PORT SUDAN/KHARTOUM HIGHWAY

I. PROJECT RATIONALE AND DESCRIPTION

A. Introduction

The project is to rehabilitate and expand the water supply system of the Es Showak-Gedaref area in the eastern Sudan province of Kassala (See Project Location Map, page v and Gedaref Water Supply Schematic, page vi) and to provide the necessary training and technical assistance to ensure its continued operation. The service area of the system is approximately 70 km in length and currently contains an estimated 40,000 Ethiopian refugees (increasing at around 1,000 monthly), approximately 30,000 migrant workers and a sedentary population of about 165,000. The present water system is unreliable, totally inadequate, by design and its deteriorated condition, to meet the minimum daily consumption requirements of the current population.

The situation was so critical in the last half of 1982 that there was political unrest, a sharp increase in incidence of water-borne disease and, while the refugees clearly are not the sole cause of the present inadequacies of the water supply system, they contribute significantly to the problem (and are, in fact, perceived by many in the area as a major factor). In November, 1982, the UNHCR, acting at the request of the GOS Commissioner of Refugees, called an emergency meeting of bilateral donor governments to request assistance. USAID responded to this emergency situation by engaging a U.S. engineering firm, James M. Montgomery, Consulting Engineers, Inc. (JMM), to conduct a feasibility study, which was completed July 1, 1983*. This was followed up with a contract to the same firm for detailed engineering design and cost estimates. This phase is currently being executed and will be completed in early November, 1983. The project analyzed and described in this PP is the implementation of the recommendations made in the feasibility study. Following the implementation plan, the construction and rehabilitation phase will be completed by June 30, 1985.

B. Compatability with USAID, CDSS and GOS's Development Plan

It is the policy of the GOS that refugees are to become economically self-sufficient. Because of limited resources and the tremendous burden the refugees place on Sudan's economy, the basic infrastructure needed to permit refugees to become self-sufficient is not always available. The GOS has specifically identified the lack of an adequate and safe supply of water as the number one constraint to productivity of refugees in the Eastern region. On the other hand, USAID in the FY 1984 CDSS recognized the economic and social impact of the refugee population on Sudan. The strategy set forth is to assist the GOS to realize the productive potential of the refugees and at the same time incorporate refugees into the overall development of Sudan by supporting projects that stimulate the productivity of both refugees and nationals.

* Gedaref Water Supply and Solid Waste Disposal Feasibility Study-Sudan James M. Montgomery, Consulting Engineers, Inc., Pasadena, California. July, 1983.

The impacted-area approach to refugee assistance supports the GOS policy of fostering economic integration while contributing to regional and national development. At the same time, this approach helps assure that USAID projects are developmentally sound and do not depend on the long-term continued presence of refugees in particular locations.

The present project is an example of this strategic approach to refugee assistance: it is aimed at relieving a major infrastructural constraint to productivity; it is based on appropriate technologies; and it benefits refugees and nationals alike. The project will provide a long-term capital asset contributing to regional development. It will serve national as well as refugee priorities.

C. RELATIONSHIP OF PROJECT OBJECTIVES

The project is essentially a construction and training project; the relationship of inputs to the outputs and the relationship of the outputs to the project purpose is clear and direct. With the input of the proper amount of funds, material and equipment and technical assistance, the Gedaref-Es Showak water system will be rehabilitated and expanded. The beneficiaries in the service area will receive an adequate supply of potable water on a continuing basis. On the assumption that the engineering was accurate, the planned outputs (i.e. the physical facilities) will provide a reliable, adequate supply of potable water, which is the purpose of the project. The period of time over which the purpose will be sustained depends upon receptivity of the Gedaref water utility management and personnel to accept the training and guidance of the input of technical assistance for institutional development. The extent of the outputs of institutional development also depends upon the assumption that the GOS will support the enforcement of a rate structure and other covenants in the Project Grant Agreement. The relationship of the project purpose (reliable adequate supply of potable water) to the project goals of improved health status of resident population and increased potential for productive economic development, is not as obvious. A supply of potable water, in itself, does not assure improved health. Many other factors also affect health. However, in so far as a supply of potable water does affect health, it must be accompanied along with a user education program. A user education program will be a part of this project and detailed elsewhere. The relationship between better health and increased potential for productivity is quite obvious.

D. PROJECT DESCRIPTION

This project is the rehabilitation and expansion of a waterworks system, thus the project elements are generally physical structures. The project is designed to serve the estimated projected 1987 population in the service area of approximately 300,000 people. The proposed system is designed to provide 50 liters per capita per day for those with direct connections or near the source of supply and 35 liters per capita per day for all others. Currently approximately 100,000 people in the service area purchase their water from water vendors. (For a technical description of the project element, see Annex D-1). Starting at the north end of the project site: (1) The project will finance and replace a surface water source through the construction of a series of wells near the Atbara River near the existing water intake caisson and Es Showak water treatment plant. The existing intake caisson has been out of use because of a change in the river flow pattern and the adjacent existing water treatment plant will be abandoned because it will no longer be needed, except for the existing clearwell reservoir on the intake side of the existing Es Showak booster pump station. The new wells are to be located near the river bed to take advantage of ground water flowing from the river. This new bank of wells will supply some 70% of the system's supply. The advantage of ground water over river water is that it has been naturally filtered and purified and requires appreciably less treatment. These wells will be equipped with pumps, electrical controls and supply pipes to the intake reservoir and standby auxiliary power. The water will then be chlorinated to provide residual protection during transmission before it enters the Gedaref reservoir and distribution system. The existing pumps, in the Es Showak booster pump station will be replaced with three new reliable pumps. (2) A new pump at the Es Showak booster pump station will be installed to pump water directly into a new elevated steel tank at Es Showak. Es Showak community has a rudimentary distribution system which is under the administration of the Gedaref water utility. It will be part of the overall metering rate structure/water control improvements. (3) From the Es Showak booster station the water is pumped through a 500 mm transmission main to the Gedaref reservoir, 64 km away. The project will provide a new mid-point booster station on the Es Showak-Gedaref pipeline with pumps and motors, electric service and auxiliary power. Approximately, 41 km from Showak, water is taken from the pipeline for the village of El Rawishda and the village of Umm Shegara. These two villages plus Es Showak Community total about 28,000 people and like Es Showak, are under the administration of the Gedaref water utility. (4) Since the quantity of water from the proposed new bank of wells on the river at Es Showak through the existing 500 mm transmission line, is not sufficient to provide the total systems' requirements, an existing but abandoned

well field at Abu Naga, 11 km southwest of Gedaref, will be rehabilitated. The feasibility study recommends rehabilitation of 11 wells at Abu Naga and construction of two new wells in that field. These will be equipped with pumps, motors, electrical service, auxiliary power and transmission facilities plus a booster station to pump water to the Gedaref reservoir. Due to the urgency of the situation, the GOS has already done some of this work. That work, done to an acceptable quality standard, will replace work units proposed for the project. These two sources of water, the Es Showak wells and the Abu Naga well field, not only provide an adequate quantity of water but provide an emergency source should one or the other experience problems. (5) The water system planned for the refugee village of Tawawa in the service area consists of an independent system which will include a new well and transmission main to an already existing storage tank that must be enlarged, chlorination equipment, electrical power plus auxiliary diesel power generator. Because of the emergency situation, some of the work has been done by UNHCR. This completed work will be reviewed to confirm its quality and reliability. Tawawa does have a partial distribution system that will require rehabilitation, with some expansion and the addition of meters and standpipes. In Gedaref Town itself, new chlorination equipment will be provided, plus replacement and/or installation of meters and standpipes to control use throughout the system. (6) In addition to the physical facilities described above, the project will attend to maintenance needs through the provision of spare parts, vehicles and a communication system. (7) Construction management service and the dollar costs of evaluations are financed under the project and a considerable input of technical assistance/training to ensure the institutional development of the Gedaref Water Utility staff capabilities.

II. COST ESTIMATES AND FINANCIAL PLAN

A. Introduction

As explained in the PID for this subject, the draft feasibility study was completed in February, 1983. At the time, the plan was to proceed with system design and preparation of construction tender documents concurrently with preparation of the PP with firm cost established during system design. Because of the urgency of the Gedaref water situation vis-a-vis the refugees and overall deterioration of the water supply system and the use of FY 83 funding; it has been necessary to proceed with the PP prior to completion of final system design. As a result, the cost estimates used are not from the final design but are rather from the feasibility study and subsequent adjustments based on discussion between the PP team and the JMM consultant design team. This project will require $7.5 million rather than $7.2 million stated in the PID.

Because of the urgency of the situation, the GOS and UNHCR have proceeded to implement some of the recommendations made in the feasibility study. Wherever these have been done and to an acceptable standard, the project estimate is revised with the funds then available for use elsewhere. In general the savings realized from work already performed and the additional funds, are now structured to finance a larger input of technical assistance for institutional development. The PP team has concluded that a much larger input for institutional development than recommended in the feasibility study, was necessary.

B. Source and Use of Funds

There are two sources of funding for the project. An AID grant of $7.5 million and a Sudanese contribution equal to LS 1,120,000 which included LS 830,000 for the site location supplement and LS 290,000 to finance local cost of monitoring and training. The GOS contribution is from CIP generated local currency. The actual GOS contribution is understated in that it does not include the salaries and related cost of NAW staff and other GOS agencies who will be involved and make a contribution to the project.

USE AND SOURCE IN DOLLARS

	AID*	GOS**
1. Rehabilitation, Construction Materials, Equipment	5,136,031	-
2. Technical Assistance	2,363,969	-
3. Training, Monitoring, Evaluation (CIP)	-	223,000

4. Site location supplement (CIP)		639,000
TOTALS	7,500,000	862,000
Percent of Total Project Cost	90%	10%

C. Project Cost by Project Component - A.I.D. Funded

	Total Cost Dollars	Dollars	Local Cost Component (L$
1. Tawawa Water Supply and Distribution-100 mm transmission pipeline, additional elevated storage capacity, improved distribution network, public standpipes and appurtances.	273,623	186,700	113,000
2. Abu Naga Well Field Supply-New submersible pumps plus new control panels, restore and equip booster pump station, replace and reinstall a portion of recently installed 200 mm PVC transmission pipeline and install well field collection pipeline.	1,483,846	1,136,000	452,200
3. Improvements at Gedaref Reservoir-New chlorination equipment.	15,615	13,000	3,400
4. Atbara River Supply-Drill and equip infiltration wells, install electric service and auxiliary power at infiltration wells, install collection piping, replace motor pump units at Es Showak pump station, provide chlorination equipment, new booster station at midpoint at Es Showak-Gedaref pipeline with electric service and auxiliary power, and miscellaneous equipment and appurtances.	1,553,577	1,280,500	355,000

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5. Es Showak Town System-new service pump and miscellaneous appurtances.	46,385	20,000	34,300
6. Metering and Waste Control-10,000 new 5/8 X 3/4 inch domestic and 400 - 1 inch and larger water meters.	571,615	540,000	54,100
7. Communications-Reestablish telephone and provide radio communications equipment.	57,000	50,000	9,100
8. Operating Equipment and Materials-Vehicles and equipment.	91,616	90,000	2,100
Total Construction Cost	4,103,277	3,316,200	1,023,200
Msc. Training Costs	16,000	15,000	1,300
10% Contingencies	411,966	333,120	102,500
Total Capital Improvements Cost	4,531,243	3,664,320	1,127,000
Inflation Contingency	877,292	549,648	425,937
Institutional Development Assistance	901,000	901,000	--
Construction Management Services, Evaluations	1,184,600	1,184,600	--
TOTAL	7,494,135	6,299,568	1,552,937
Rounded	$7,500,000	$6,304,498	LS1,554,152

* Values include allowances for contingencies and escallation of costs through disbursements.

** Conversion rate $1 = LS 1.3

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D. PROJECTED EXPENDITURES BY FISCAL YEAR

82/83	$ 137,000	Feasibility Study
83/84	791,000	Detailed Design, Test Well Drilling
84/85	6,122,000	Construction Materials, Technical Costs
85/86	450,000	Technical Assistance
	$ 7,500,000	

II. GOS CONTRIBUTION

LS 830,000	Site location supplement.
LS 290,000	For training and monitoring programs
LS 1,120,000	TOTAL (From CIP generated local currency)
$ 862,000	(Converted at LS 1.3 = $1)

III. IMPLEMENTATION

A. Introduction

Implementation is divided into two parts. The first part is that which USAID must do up to the point where a contract is signed with a consulting firm to provide the supervision of construction services, procurement services and technical assistance or institutional development training. All of these services would be preferably with one firm. The second part is primarily those actions that must be taken by the consultant, NAW, the general contractor and the sub-contractor. USAID will contract with the consultant, the NAW will contract with the general contractor and the general contractor will contract with the sub-contractor. In all cases the AID contracting procedures will be followed to the extent practicable and in all cases NAW will participate in preparation of scopes of work, proposal review, contractor selection and contract negotiation. NAW will assign personnel to work along with the US consultants on the project. The US consultant will have the responsibility to provide on-the-job training to his NAW counterpart along with the Gedaref water utility personnel in every aspect of his duties. This transfer of technology will be a subject of the mid-project and end of project evaluation.

B. USAID Actions Prior to Consultant's Contract

USAID has prepared a request for a non-competitive procurement waiver to permit the engineering firm (JMM) which is currently preparing the detailed engineering designs, specification and procurement documents*, to provide the technical assistance, i.e. supervision of construction, procurement services and institutional development. Since the outcome of the request will not be known prior to project authorization, a schedule with and without the waiver is illustrated.

C. Subsequent to Consulting Contract

Various items such as pumps, generators, control panels, telecommunications gear, and meters may require long lead time for delivery. In consideration of the time lag indicated to

* These documents are scheduled for delivery to USAID in November, 1983. This review will be conducted jointly by AID and NAW.

secure the services of a construction contractor and to avoid unnecessary delay in construction, the consultant may be authorized under the terms of his contract to act as procurement agent for AID on such items. Procurement may be initiated in the Consultant's home office prior to mobilization in the project site.

As soon as negotiations have been entered with the nominated consulting firm, the NAW will advertise the project for expression of interest by qualified construction firms. This advertisement will be placed in the U.S. Commerce Business Daily and selected news media of the Sudan and neighboring countries. Interested firms will be invited to submit data in the AID format indicating their qualifications to undertake the construction contract.

This qualifying data will be submitted directly to the consulting engineer who will compile and analyze the data and submit a short list of the interested firms which he considers qualified. The engineer will note his analysis of each firm and the reasons for inclusion or exclusion from his list. Following AID and NAW concurrence in this recommendation, the NAW will release the IFB to the qualified bidders.

The construction contractor will logically sub-contract features such as well drilling and development, however, his contract will provide the provisions of materials, construction, testing, and a maintenance period for all project features, including installation of new meters and the recovery of existing meters to the service shop of the operating utility.

Such equipment as may be subjected to early direct procurement will be stored by the NAW and supplied to the contractor when required. There are advantages to the project in generally effecting procurement through the contractor who thus remains responsible and the case for direct procurement will be examined closely as the work proceeds.

The consulting engineer will initiate advisory/training services to the NAW and the operating utility incident to supervision of the construction contractor. These services will continue into the first year of operation of the system.

PROPOSED SCHEDULE

	Action	W/O Waiver	W/Waiver
1.	Grant Project Agreement Signed	30 Sept. 83	30 Sept. 83
2.	Issue PIO/T, Prepare RFP	15 Oct. 83	15 Oct. 83
3.	Advertise CBD	30 Nov. 83	-
4.	Receive Qualification Data	15 Jan. 84	-
5.	Release RFP	30 Jan. 84	
6.	Receive Proposals	30 Mar. 84	
7.	Evaluate Proposals	30 Apr. 84	-
8.	Negotiate, Sign Contract	30 May 84	30 Nov. 83

C. Schedule of Actions Subsequent to Consultant's Contract

	Action	W/O Waiver	W/Waiver
1.	Consultant Mobilizes	30 June 84	30 Dec. 83
2.	Initiate Procurement Long Lead Time Items	15 June 84	15 Dec. 83
3.	Advertise for Construction Contractor (NAW)	30 Mar. 84	30 Nov. 83
4.	Receive Qualification Data	15 July 84	15 Jan. 84
5.	Prequalify Short List	15 Aug. 84	15 Feb. 84
6.	Release IFB	15 Aug. 84	15 Feb. 84
7.	Receive Bids	15 Oct. 84	15 Apr. 84
8.	Evaluate, Sign Contract	15 Nov. 84	15 May 84
9.	Begin Construction	15 Dec. 84	15 June 84
10.	Evaluation	28 Feb. 85	28 Feb. 85
11.	Complete Construction	15 Dec. 85	15 June 85
12.	Evaluation	30 Mar. 86	30 Mar. 86
13.	Consultant Leave	30 Sept. 86	30 Mar. 86
14.	PACD	30 Jan. 87	30 Jan. 87

D. User Education to Ensure Health Benefits

1. Introduction

A sub goal of the project is to improve the health of the refugees and local Sudanese within the system service area. The provision of a reliable supply of safe, convenient water is not sufficient to guarantee improved health. A variety of social and cultural attitudes affect the pattern of water usage. People must use it properly to discourage contamination. To the extent that potable water can affect health conditions, it will only happen when the initiation of potable water is coordinated with hygiene education. Examples of user education are: advice on protection of stored household water, promotion of handwashing (particularly by food handlers), promotion of hygienic food preparation, and proper use of water for cleaning utensils.

User education can be provided in a variety of ways; by local primary health care workers by especially trained water agency workers, in primary schools or by extension workers. Sporadic information campaigns have not resulted in behavioral changes. A user education program must be incorporated in a continuous education program effort.

2. Course of Action

Preliminary discussions have been held with NAW and the regional and local health officials on a user education program. The course of actions has not yet been finalized. The health officials are interested in formulating a program with USAID cooperation. They fully appreciate the importance of coordinating a user education program along with the implementation of the project. Prior to the arrival of the consultant, the USAID project officer will formulate a program with the responsible health officials. Some elements of the user education program will be: Trained Sudanese to carry out the program throughout project implementation, a plan for its continuation after the LOP by the regional health officials, a course of action that will ensure that everyone in the service area is exposed to the program, promulgation by posters, classroom talks, information at clinics, health offices, public buildings and in conjunction with other health delivery services.

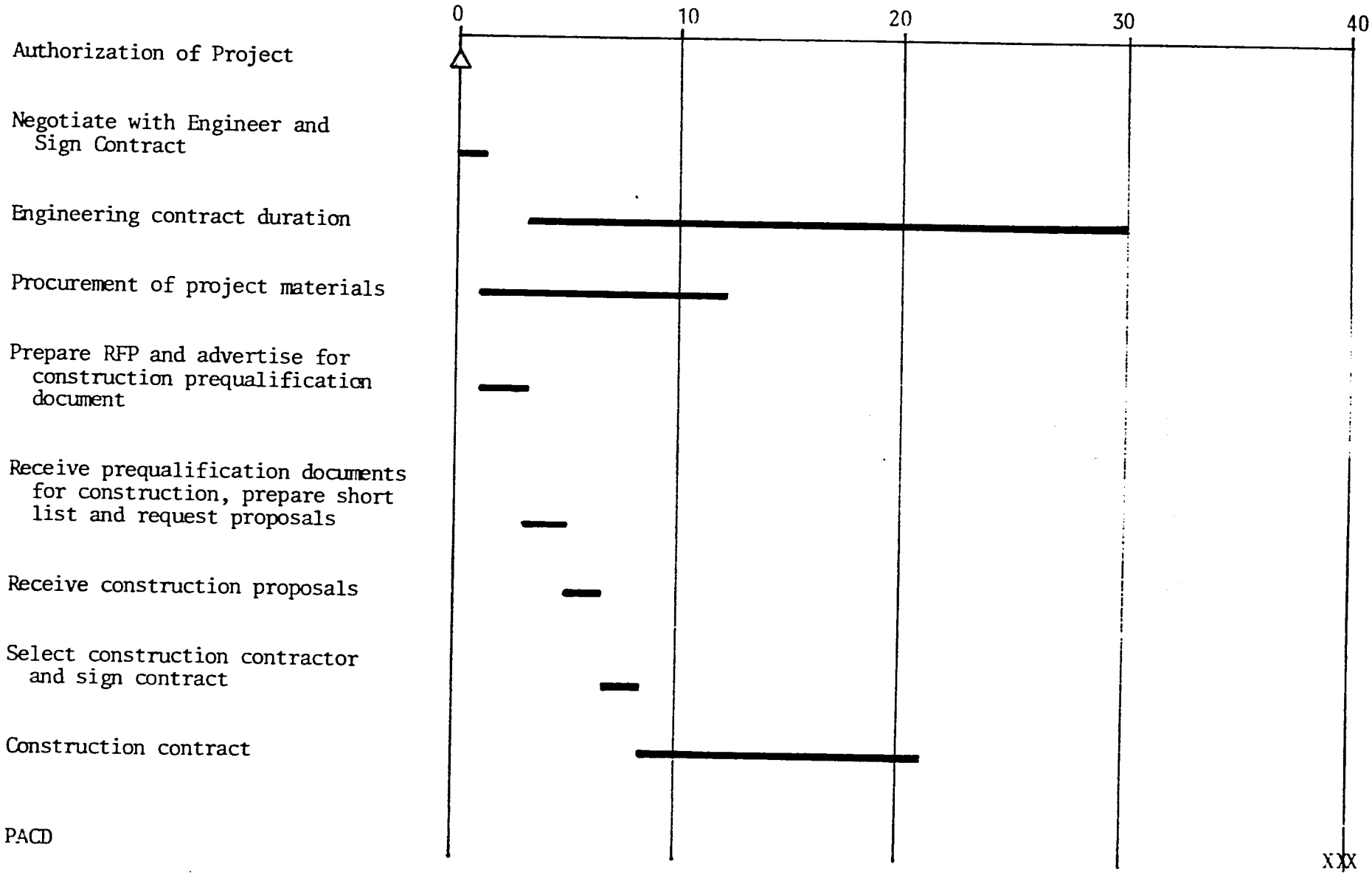
To ensure coordination of project activity with regional health officials, the Regional Commissioner for Health will be represented on the Project Steering Committee.

It has not yet been determined, however, whether the user education program will require some financial input from the project account. Funds are budgeted in the GOS contribution from the CIP. The program will be a subject of the mid-term and final evaluation.

GEDAREF WATER SYSTEM IMPROVEMENTS PROJECT

Schedule (Months)

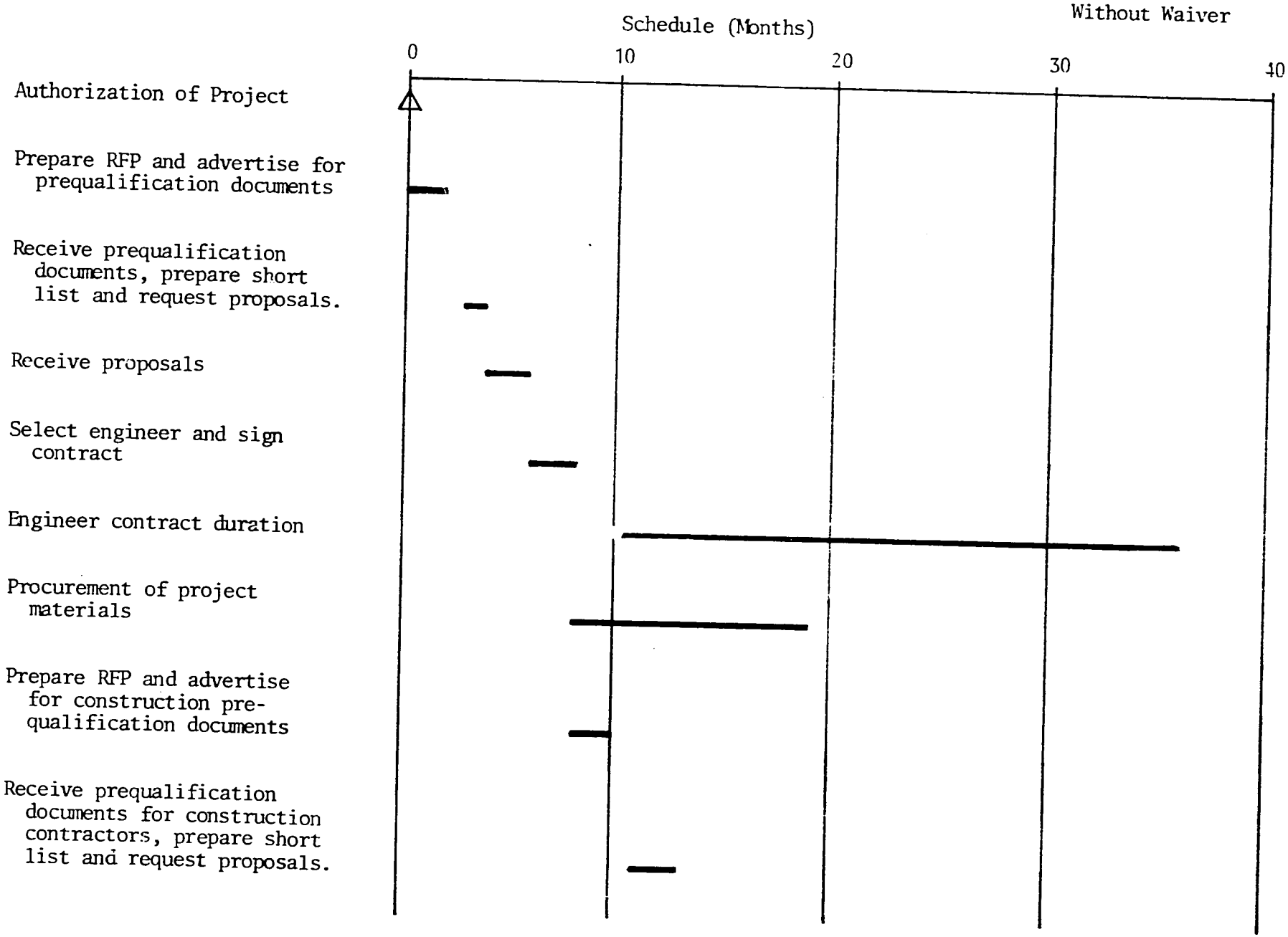
With Waiver



42

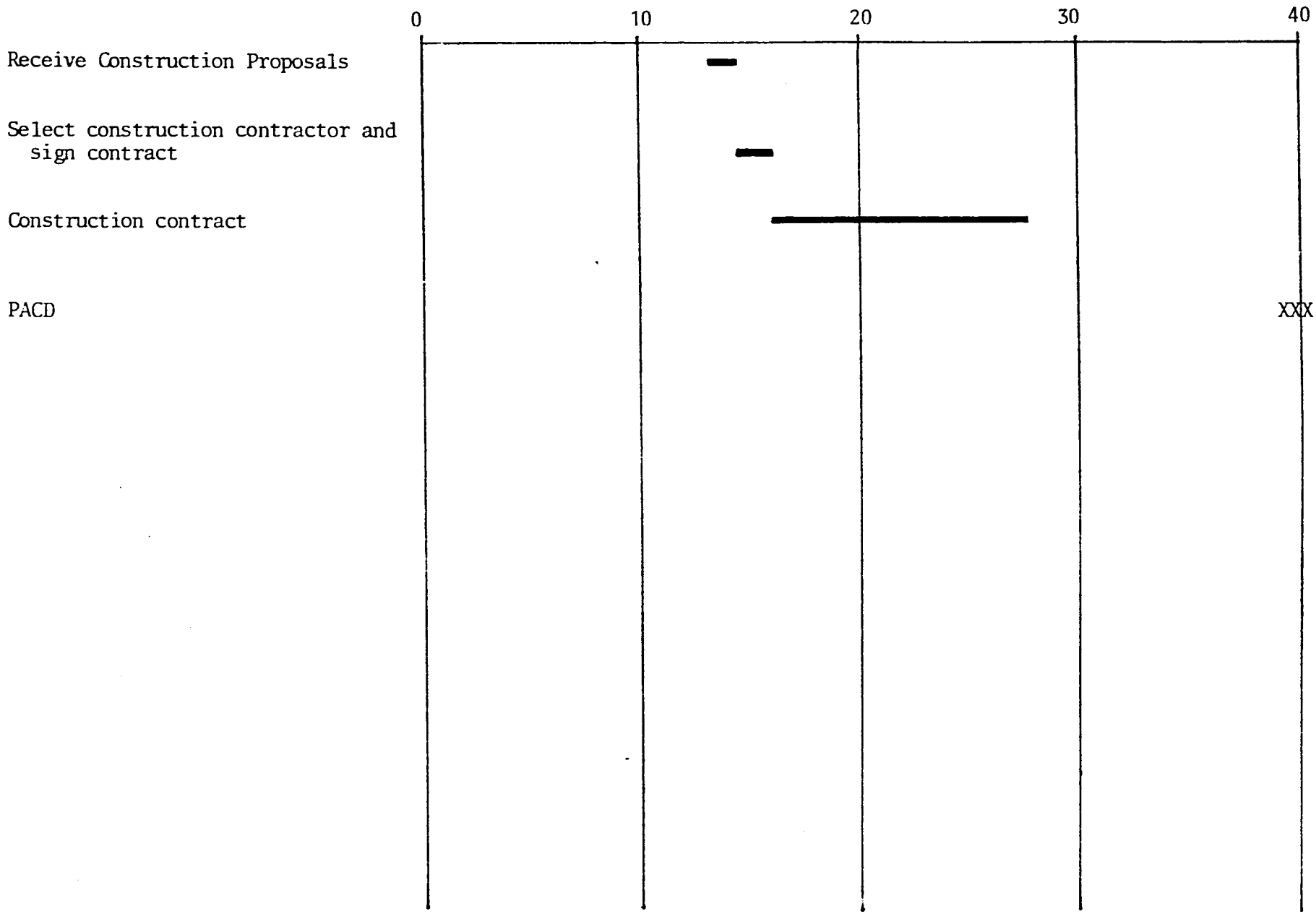
GEDAREF WATER SYSTEM IMPROVEMENTS PROJECT

Without Waiver



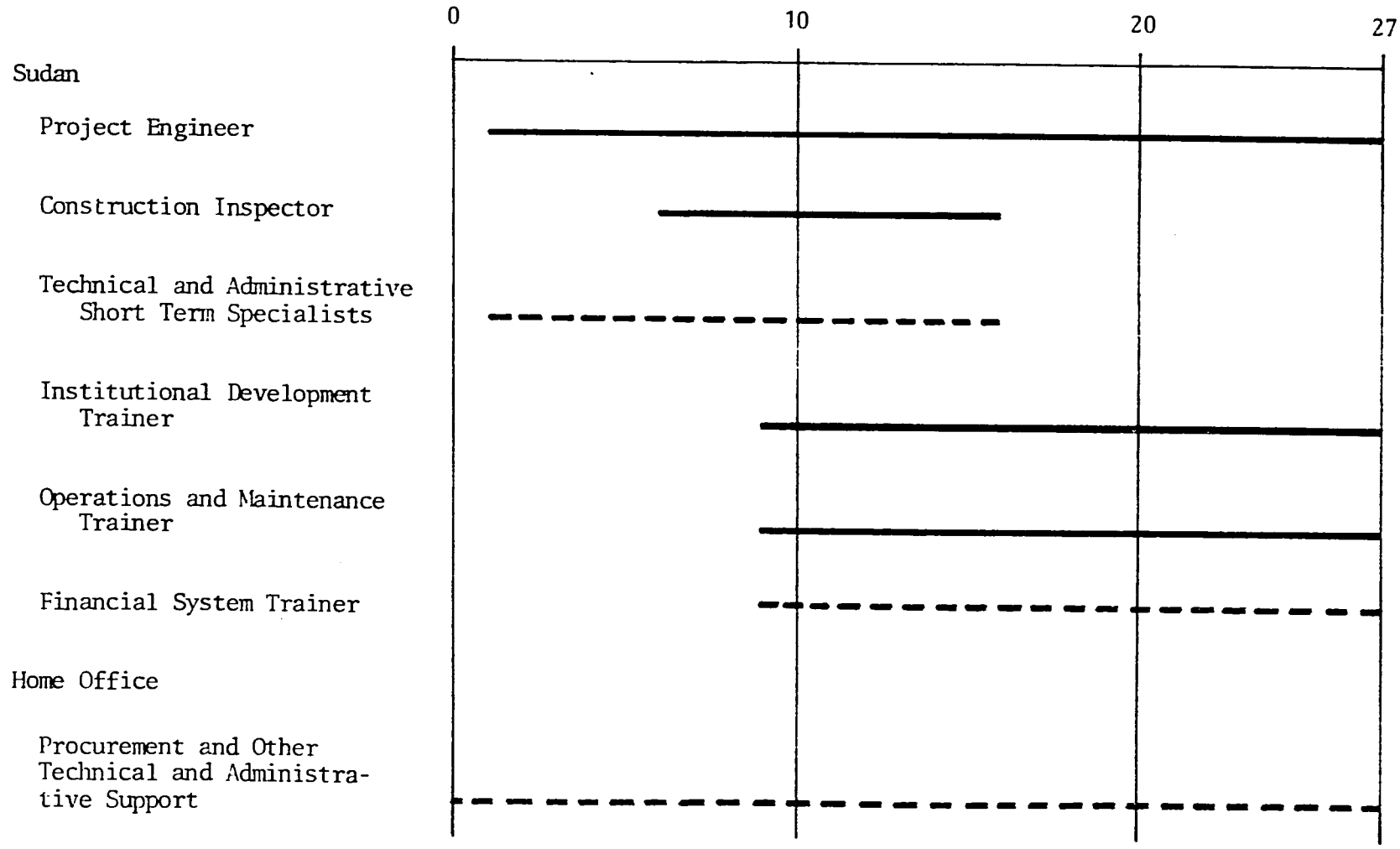
24

(Continued)


0
10
20
30
40
Receive Construction Proposals
Select construction contractor and sign contract
Construction contract
PACD
XXX

PROJECTED CONSULTANT'S STAFFING SCHEDULE

Months



Note: Time "Zero" coincides with signing Consultant Agreement.

IV. MONITORING PLAN AND EVALUATION ARRANGEMENT

A. Monitoring Plan

The Mission will monitor the project directly by assigning the responsibility to a direct hire engineer. (There are two such positions in the Mission staffing pattern. One position is filled and there is a SPAR for the other position which AID/W is currently attempting to fill.) The Mission will also receive assistance from the regional engineering office of REDSO/ESA in periodic consultations and coverage at such time as the Mission engineer(s) may be absent. The incumbent engineer will monitor the project by: (1) Establishing a relationship with the project consultant and NAW, (2) Site visits, (3) Periodic reports prepared by the consultant, (4) By membership on the Project Steering Committee. (The Project Steering Committee is described in Administrative Arrangements.)

B. Evaluation Plan

There will only be two scheduled independent evaluations. One after construction begins and one after the completion of construction. The evaluations will be arranged by the Project Officer and the Mission Evaluation Officer. They will be conducted by an independent member* (AID/W or contractor), and representatives from USAID, NAW and the Institute of Environmental Studies (IES)** The mid-term evaluation will focus primarily on actual physical progress in relation to the implementation schedule, consultant or contractor performance in relation to their contracts, progress in institutional development, fulfillment of GOS obligations in relation to the Project Grant Agreement covenants and environmental concerns. The final evaluation will be made by a team similar to that for the mid-term evaluation except that it will also have as member, a health officer, and a social scientist. It will evaluate the same factors as for the mid-term evaluation in addition to the status of the refugees in terms of their participation in the project purpose and the health benefits to the extent that a comparison can be made of the health statistical records just before and at the end of the project.

* $30,000 budgeted to finance two person months.
** Funds provided from CIP and budgeted in GOS contribution.

V. SUMMARY OF ANALYSES

A. Technical Analysis Summary

(For a detailed technical analysis see ANNEX D-1.)

The PP team first finds the overall project as presented by the engineer as technically sound and feasible and will reliably provide potable water in nominally adequate quantities to all the residents of Gedaref and the Tawawa refugee settlement. The final design of the improvements to eliminate the shortage of potable water is underway and several test wells are now being drilled and pumped to confirm water quality and production rates of the selected aquifers.

1. Water Demands

The permanent population of the Tawawa refugee settlement, Gedaref and the other smaller villages receiving water from the system are estimated to increase from 202,000 in 1982 to 278,000 in 1987, the projected design period as defined by A.I.D. An estimated 40,000 refugees live in Gedaref plus another 7,000 in the Tawawa refugee settlement. There is no evidence to indicate that the population projections are unreasonable. The project water demands are projected to be 17,180 m^3 per day using A.I.D. guideline of 50 lpcd for minimum water requirements plus a factor to represent reasonable improved health and living conditions. The service rates can and should be increased as soon as funds permit.

The principal beneficiaries are the refugees in the Tawawa refugee settlement and the refugees and low income persons living in and around Gedaref, who are currently forced to pay highly inflated rates for meager quantities of water. Under this program, a total of approximately 135,000 people will have direct access to water service connections while the remainder will have ready access to public standpipes. This is an increase of approximately 70,000 persons with direct access, of which almost all will be refugees and low income families, the primary goal of this program.

2. Availability of Water Resources

The Tawawa refugee settlement is isolated from Gedaref and a separate source is provided to assure that it receives a continuous supply. At a distance of one to two kilometers a reliable but limited source has been located. This source,

an underground aquifer, has sufficient quantity to supply the needs to Tawawa, an estimated 600 m^3 per day. No other source of water is readily available. The Abu Naga well field, the original source of water for Gedaref, abandoned when the Es Showak-Gedaref transmission pipeline was constructed, is being rehabilitated. It is located 11 kilometers from Gedaref. Eight of the original eleven wells have been rehabilitated and four new wells have been drilled. This source of water is existing and available for use. It is estimated to be capable of producing at least 3,800 m^3 per day.

The third source is the Atbara River which has an almost unlimited sub-surface flow. The key limiting factor at the river is the capacity of the existing 500 mm diameter Es Showak-Gedaref transmission pipeline. The capacity is approximately 12,500 m^3 per day. The existing water intake structure on the Atbara River in Es Showak is not functional. Since construction, the river, which during certain times of the year transports and deposits large quantities of silt, has changed its course leaving the water intake structure as much as 300 to 500 meters from the edge of the new river channel. This program includes a series of infiltration wells that will take water, naturally filtered by the ground and pump it to the Es Showak booster pump station that pumps the water to Gedaref. This process bypasses the existing water treatment plant which will be removed from service. This method is technically sound. The capacity of the proposed infiltration wells is presently being tested. The results will determine the number of wells needed to meet the desired capacity.

The estimated capacity of each of the three sources slightly exceeds the total needed to serve the 1987 water demands and must be exploited.

3. Modes of Meeting the Water Demand

Water transmission, storage and distribution systems exist to serve Tawawa and Gedaref from all three sources except Tawawa, where a transmission pipeline from the well field to the refugee settlement does not exist. In all cases the water supply systems are in need of repair and expansion to minimize water losses and adequately serve the consumer.

The rehabilitation and expansion of these systems is the most efficient and cost effective method to achieve the

nominal service norm of 50 lpcd. The long term planning for growth of the system should follow the pattern of this project, i.e. the extraction of groundwater and pumping/transmission to user zones. Delivery costs will vary according to depth and distance in obtaining the water. In this project for instance, water is delivered from infiltration wells at the river at a development cost of roughly $\$100/m^3$ pd while water from the Abu Naga field is brought in at a development cost of roughly $\$400/m^3$ pd. These figures have directed maximum utilization of the transmission line from the river.

B. Institutional Analysis Summary

(For a detailed analysis of the institutional development program, see ANNEX D-2.)

1. Current Status of the Gedaref Water Utility Organization

The existing basic organization structure of the Gedaref water utility appears to be reasonably functional. The utility is headed by a senior water engineer and several deputies. Below the upper administrative level, operations are divided into four clearly defined groups: (1) administration, (2) source of supply-treatment/pumping, (3) water distribution, and (4) billing/accounting.

The principal institutional problems of Gedaref water utility are more related to the number of middle management vacancies that presently exist, and the lack of properly trained operations people. The responsibility for direction of approximately 200 employees rests entirely with the senior water engineer and one senior foreman. This is inadequate and the consequences are evident throughout the organization. Maintenance programs are disorganized or non-existent primarily due to the lack of direction and secondarily the lack of training. Improved operation and maintenance procedures will not be realized until proper supervision is established and fundamental know-how is developed through comprehensive training programs.

2. Proposed Program

In order to maximize the benefits of the project, it is essential that the proposed capital facilities enjoy a long and useful life. To accomplish this end purpose, forty-seven (47) person months of technical advisory assistance are proposed over an eighteen month time frame.

Additional technical assistance will also be provided under the construction management activities.

Institutional improvements included in the project contain technical assistance in the development of administration and management procedures, internal systems, records, reports, service policies and regulations, accounting and financial planning, operation and maintenance of the water system facilities, and the development of human resources through comprehensive training. A particularly strong emphasis will be placed on preventative maintenance, an expanded metering program, and the provision of reliable safe water supply for both the refugee population and the local Sudanese residents in the area.

Technical advisors will provide assistance in four principal categories, (1) organization and management, (2) revenue collection and sound financial policies, (3) operation of the system and the maintenance of physical facilities, and (4) engineering planning. Formal and informal training programs will be developed and conducted in all of these assistance categories.

C. Financial Analysis Summary

(For a detailed financial analysis see ANNEX D-3.)

The Gedaref Water Supply Project is financially feasible. The utility is currently losing money, and will continue to do so until the additional revenues from the Project, plus the operating and management improvements brought about by technical assistance, have exercised their full impact. With the project complete and the proposed water service rates put into effect on July 1, 1985, the Gedaref water utility should show a positive net income in the fiscal year 1985-86.

The financial analysis is based on the implementation of the Project, reduction in unaccounted-for-water, an increase in collection efficiency, and increased production and water sales.

Net income is negative through FY 1984-85, becoming positive in FY 1985-86 and remains positive through FY 1989-90 when the expenses exceed revenues at which time a new rate increase should be considered. Due to expenses rising more rapidly than income, it decreases steadily throughout the analysis period. By FY 1989-90, a new rate increase will probably be required. If all targets are met, it is possible that the Gedaref water utility may find that it need not adopt the full rate increase proposed for July 1, 1985, though it will still need another one later. That decision should be postponed until early 1985, when the actual situation will be clearer.

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D. Economic Analysis Summary

(For a detailed economic analysis see ANNEX D-4.)

The project proposed for the Gedaref water supply is economically feasible. Using the incremental value of the new water produced and consumed, very strictly defined as benefits, and using the incremental costs to the system in operations and maintenance, plus the capital investment, a benefit-cost analysis has been performed. Using the discounted present value method of analysis, the project has a very favorable benefit-cost ratio of 1.90 to one, with a 10% discount rate, and a ten year period. The benefit-cost ratio is still a very favorable 1.69 to one using a 15% discount rate and a ten year period. The short time period tends to understate the total benefits, so the results are felt to be conservative.

The project suffers from minor costs which are unquantifiable, the largest of which is some loss of income to water vendors as consumers begin to purchase more water from the system. The project also has a number of unquantifiable benefits, among which are: increases in public health, increased economic activity, increased personal incomes for some people, increases in land values, and a considerable consumer surplus of value created by the system improvements.

E. Social Soundness Analysis Summary

(For detailed social soundness analysis see ANNEX D-5.)

From a sociocultural perspective, this is a highly beneficial project which addresses a basic human need inadequately met presently. Aside from the requirement to institute conservation and public health educational measures, there is little or nothing in the existing social system which will cause friction with project activities.

Aside from the provision of water per se, the project has the added advantage of helping to reduce tension between the national and refugee communities by demonstrating to the former a tangible benefit they receive from hosting the latter. During March 1983 hundreds of Sudanese rioted in Gedaref when the water system went dry. Luckily, the rioters did not vent their frustrations at the refugees. Yet some Sudanese do believe that many or most of the economic and social problems they face, from lack of sugar to rising rents, are caused by the refugees. Over the past year or so, as economic problems continue to bear down with unrelenting force on the average Sudanese family, the attitude of many Gedaref and eastern Sudanese has hardened towards the refugees. We believe that initiating the present project and linking it publically with USG assistance to Sudanese efforts to assist refugees may help redress the balance somewhat towards the traditional attitude of hospitality.

F. Summary of Environmental Considerations

(For a detailed environmental assessment see Chapter 14 of the JMM Feasibility Study.)

1. Impacts and Their Mitigation

The Feasibility Study sets out the details of the significant impacts expected. The project originally received a negative determination based on: (1) the understanding that the project design will consider long-term concerns; and (2) that water meters will be installed. The actual details of meter installation will be reviewed by the Regional Environmental Officer when the Final Engineering Design is ready in early November.

One concern of the Regional Environmental Officer during his recent site visit was that in several large refugee settlements individual home metering will not be possible. Instead the settlements will be provided with: (1) standpipes and spring-level taps; and (2) master meters and master billing. Both of these above measures should prevent indiscriminate use of the water supply. However, to insure that this is so, these project activities will be monitored during and after implementation as described below.

Long-term concerns in this project center around the secondary effects to be expected as human populations gradually expand in the Gedaref area. Such concerns will be addressed by insuring that local regional planners be made aware of what the future holds in this regard. There must be a training effort made here to train these planners in proper management of resources as described below.

2. Monitoring Program

During and after meter installation, the USAID project manager will insure that a brief environmental review be carried out by the Institute for Environmental Studies (IES)*. This review will consider: (a) status of meter installation program; (b) general indication of user patterns and any significant change in this pattern; (c) metering and user patterns for the refugee settlements; and (d) any evidence of trends leading toward long-range problems (e.g., water borne sewage, local pollution effects,

*Funds are provided to finance these activities in the GOS contribution from the CIP.

excessive livestock watering, etc.) The review will be scrutinized by the Mission Environmental Officer who will notify the Regional Environmental Officer of any significant impacts. The review will form the basis of USAID evaluations (mid-and end of project) and will also serve as a general guide for IES in designing the training course described below.

3. Training

The USAID project manager and the implementation agency will coordinate with IES* to design and conduct a course in the proper use and management of water resources. The course should be specific for the Gedaref area's long-term needs, and should stress topics such as water conservation, new sources, data collection, analysis, and planning. The course should be repeated if needed during the life of the project. It will be important to insure that regional people at several levels are well represented in this course. The ultimate goal here will be to the level of awareness so that long-term planning on a regional level can begin.

G. Administrative Analysis

The level of institutional development required to ensure the capabilities of the Gedaref water utility staff to successfully maintain and operate the system are analyzed in the sections V-B and ANNEX D-2. In summary, the staff is basically in place, it needs a substantial input of technical assistance in all areas of water system management and administration. It requires a salary supplement to ensure continuity of trained personnel and to maintain the morale of the staff to a level that provides pride and discipline in their duties. The current status of the staff capabilities have been discussed with the concerned agencies, and the level and type of inputs required (technical assistance and salary supplement), to raise those capabilities, agreed upon are provided for in the project design.

The responsibilities of the implementing agency, i.e. NAW, are described in Section III, Implementation. The NAW is a qualified and motivated agency under which the project can be successfully implemented. NAW has been given the responsibility, by the GOS, to coordinate the activities of this project with its own efforts and those of UNHCR to alleviate the emergency situation that exists in the Gedaref Water Utility service area. NAW has worked closely with JMM making the final designs; they have followed the development of the project development and met frequently with members of the PP team. They reviewed and participated in the Project Paper.

*Funds are provided to finance these activities in the GOS contribution from the CIP.

For the purposes of this project, overall coordination between concerned GOS agencies such as the Commissioner of Refugees and Regional Government, will be provided by membership on the Project Steering Committee. NAW will form a steering committee. The purpose of the steering committee will be to ensure coordination of project activities and to solicit cooperation and participation of the various agencies. The committee will consist of NAW, Commissioner of Refugees, Regional Government, Gedaref Town Council, Gedaref Water System, UNHCR, Regional Commissioner of Health, and USAID.

H. Analysis of the Energy Efficiency, Cost Implications and Appropriateness

1. Construction Energy

The water system construction techniques respond to the design of this project, i.e. deep water well drilling and pipeline installation and the permanently installed equipment are the most effective approach to achieving project outputs considering the implementation constraints of both time and money. The basic construction technology being applied must utilize fossil fuel non-renewable energy resources. This represents foreign exchange capital costs for both equipment and fuel.

The use of capital intensive technology is predicated upon: (a) the inability to construct deep water wells with labor intensive means, (b) the urgent time frame in eliminating the shortage of water for the refugees and residents of the Greater Gedaref Area. Construction operations will require that all agencies concerned act in concert to assure and secure the availability of POL products to the contractor.

2. Operating Energy

The technology selection for the project was made on the basis that no effective options exist to obtain the project outputs. In the future, marginal options may exist for the utilization of alternate energy sources. These include solar photovoltaic cells for sunlight to electricity conversion. Recent advances indicate that this option may eventually be feasible for operation of water well pumps during daylight hours.

The operation of the system rests on sharing of the energy produced from hydro-electric generation on Atbara River, augmented by diesel generators on site. Maximum utilization will be made of hydro-electric sources, however, the seriously deteriorated condition of many features of the power grid means that fairly long-term priority channels must be established for obtaining scarce diesel fuel and guarding it against diversion to other users.

Marginal options exist for the use of solar cells to operate low power units such as the project communication systems. To install sufficient alternative energy sources, such as solar cells for the entire system, would be prohibitively expensive at present cost levels. Intensive research underway on solar cells throughout the scientific community may yield units within cost reach of the project and enable future installation of such units to operate project pumps during sunlight hours.

VI. CONDITIONS AND COVENANTS

No conditions are proposed and six covenants are to be included in the Project Authorization and Project Grant Agreement. All have been discussed with the implementing agency.

1. The GOS is currently going through a reorganization and decentralization. It has not yet been determined which central or regional agency will ultimately be responsible for the development and administration of municipal water systems. At present, the National Administration for Water (NAW) is responsible for the Gedaref Water System. NAW has the capability to provide the necessary technical and administrative assistance needed during project implementation. To ensure that the project is not transferred to a less qualified agency during implementation without the concurrence of the USAID, the following covenant is included:

> "In view of the government reorganization pending at the time of the signing of this agreement and the importance of having a continuing staff responsible for project implementation, the Grantee agrees that the National Administration for Water (NAW) will continue to be responsible for the Gedaref Water System through to project completion, except to the extent that A.I.D. may agree otherwise in writing."

2. The GOS salary scales are very low, it is common for government employees to hold two or more jobs. In addition, trained personnel are in demand and frequently, once trained, seek other employment. To augment the situation, Gedaref is not considered a very desirable place to live. This project proposed to develop a Project Account financed (during LOP) salary site supplement to ensure that the project attracts and retains qualified personnel. This is being done on other GOS projects and has the concurrence of the concerned agencies. This plan will require approximately LS 830,000 during the project life and the supplement has been included in the water system operating cost. Upon completion of the project, the supplement will continue and be provided from the system's revenues.

> "In recognition of the importance of compensation levels sufficient to attract and keep qualified and productive personnel, the Grantee agrees to work with the AID-financed consultant to develop and install a program of compensation financed from the project account, that will accomplish this objective and further covenants that the program will be financed from Gedaref Water System revenues after termination of the AID financed project."

3. The third covenant ensures GOS support for enforcement of the rate structure and elimination of water contractor's who purchase water from the system at the standard rate and sell to those (usually the poor) who do not have access to the system. This project will only succeed if all water is metered and all water paid for. If that is accomplished, the system will be financially viable and water will be sold at a very low rate.

> "The Grantee agrees to undertake those steps essential to assure a highly improved water revenue collection system, acting through the National Administration for Water or other relevant agencies. The Grantee agrees to support actively an enforcement of an approved water revenue system, including collection of revenues for water dispersed through public standpipes and agrees to the elimination of the procedure which permits the purchase of water from the supply system at posted rates and resale at higher rates."

4. Since the project does involve refugees in addition to the local residents and in addition, is a concern of the national as well as the regional governments, it will be necessary to coordinate the activities to ensure that all interests are served and that all participate. Therefore, a covenant that NAW will establish a steering committee to accommodate this need.

> "The Grantee, acting through the NAW, agrees that it will establish a Steering Committee for the project. The functions of the Steering Committee will be as follows: assure proper coordination of activities among all agencies and parties concerned with the Gedaref Water System and with the status of refugees; set overall policy; solicit cooperation. The Steering Committee will be composed of representatives from the NAW, Coordinator of Refugees, UNHCR, The Regional Government, the Gedaref Town Government, the Gedaref Water System, Regional Health Officer and A.I.D."

5. Certain key positions need to be filled within the system's organization and a covenant is included to assure this.

> "The Grantee agrees that, acting through the NAW and the Gedaref Water System, all key positions in its Gedaref Water System Organization will be filled with qualified personnel prior to the arrival of the consultant."

6. The Tawawa Refugee Village water system is really an independent system. However, to ensure that it is administered and maintained as an efficient system, that water is not wasted and that the refugees have the benefit of potable water at a charge within their ability to pay; the PP team concluded that the system should be under the administration of the Gedaref Water System.

> "The Grantee undertakes to incorporate the Tawawa Refugee Village water system within the Gedaref Water System organization and under the administration, operation and maintenance responsibility of the Gedaref Water System management."

ANNEX A

ACTION: RAC-1 INFO: AFR [illegible] [illegible]

VZCZCNROZ[illegible]
PP RUEHAN
DE RUEHC [illegible]
ZNR UUUUU ZZH
P 240[illegible]Z MAR 83
FM SECSTATE WASHDC
TO AMEMBASSY KHARTOUM PRIORITY [illegible]
BT
UNCLAS STATE 08[illegible]

24-MAR-[illegible]
TOR: [illegible]
CN: [illegible]
CHRG: AID
DIST: AID

AIDAC

E.O. 12356: N/A
TAGS:
SUBJECT: SHARBEF WATER SUPPLY ([illegible])

REF: A) KHARTOUM 1[illegible]7, B) KHARTOUM [illegible]

1. ISSUES MEETING OF SUBJECT PROJECT HELD 17 MARCH WITH PARTICIPATION OF MISSION DIRECTOR PURSE.

2. MEETING FOUND PROJECT TO BE WELL ORGANIZED AT PID STAGE AND HAS RECOMMENDED PROJECT GO TO ECPR WEEK OF 28 MARCH. FOLLOWING CONCERNS WERE SURFACED AT MEETING AND MAY BE DEALT WITH IN PP DESIGN:

A. IN RELATION TO PID ISSUE NO. 1 AT PAGE 19, IN VIEW OF EXPECTATIONS THAT THE PROJECT WILL SUBSTANTIALLY STRENGTHEN BOTH REGIONAL AND LOCAL INSTITUTIONS INVOLVED IN WATER SUPPLY, MISSION SHOULD ENSURE PRIOR TO OBLIGATION OF FUNDS (1) THAT ORGANIZATIONAL ARRANGEMENTS AND RESPONSIBILITIES ARE CLEARLY DEFINED AND (2) THAT KEY STAFF OF GOS AGENCIES INVOLVED IN PROJECT IMPLEMENTATION ARE IN PLACE.

B. AS WITH OTHER PROJECTS UNDERTAKEN WITH REFUGEE FUNDS, AID/W BELIEVES INFORMATION GATHERED IN COURSE OF PROJECT

EVALUATIONS SHOULD NOT ONLY (1) ASSIST IN MONITORING PROGRESS AND EVENTUAL SUCCESS OF THE PROJECT, BUT ALSO (2) PROVIDE INSIGHT ON EFFECTIVENESS OF ASSISTANCE OF THIS TYPE TO REFUGEE POPULATIONS, ESPECIALLY AS PART OF ATTEMPTS TO PROMOTE REFUGEE SELF SUFFICIENCY AND INTEGRATION INTO HOST COUNTRY ECONOMIES. MISSION IS THEREFORE INSTRUCTED TO INCLUDE ADEQUATE BUDGET RESOURCES IN PROJECT TO COVER EVALUATION OF PROJECT OUTPUTS, BENEFICIARIES, AND TYPE OF BENEFITS AS WELL AS ACHIEVEMENT OF PURPOSE. PROVISION SHOULD ALSO BE MADE TO ENSURE CONTINUED COLLECTION AND ANALYSIS OF BASELINE DATA ESSENTIAL FOR LONG-TERM EVALUATION, ESPECIALLY HEALTH DATA FROM TAWILA REFUGEE CAMP. EVALUATION OF LONG TERM IMPACT OF REFUGEE ASSISTANCE WILL BE FUNDED FROM OUTSIDE THE PROJECT.

3. REVIEW QUESTIONED NEED FOR NONCOMPETITIVE PROCUREMENT WAIVER (ATTACHMENT 2 TO PID) AND HAS PROPOSED AS ISSUE FOR ECPR. AID/W FOLLOWING UP ON POSSIBILITY OF OTHER EXPEDITIOUS METHODS FOR SECURING CONTRACT. WILL ADVISE.

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4. IN LIGHT OF UNDER CITED INTER ALIA IN REFTEL, AID/W AIMING FOR APPROVAL OF FY 71 PROGR AND CONTRACTED ENGINEERING DESIGN TEAM ARRIVING IN COUNTRY TO COMMENCE TECHNICAL DESIGN BY LATE JULY, OR EARLIER IF POSSIBLE. SHULTZ
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SUBJ T GEDAREF WATER SUPPY PROJECT #83-2755

REF: A. KHARTOUM 9099 B. KHARTOUM 8859
C. STATE 188846 D. KHARTOUM 8861

1. SUBJECT PROJECT COMMITTEE MET SEPTEMBER 15, 1983 WITH POST REFUGEE ADVISOR WEAVER TO DISCUSS PROJECT INSTITUTIONAL DEVELOPMENT CONCERNS RAISED IN REF (C) AND (D) PP PROPOSES PROJECT TO DEAL WITH SAME.

A. PROJECT COMMITTEE CONCURS WITH MISSION ASSESSMENT PER REF (B) THAT INSTITUTIONAL/MANAGEMENT ISSUES HAVE BEEN ADEQUATELY IDENTIFIED AND AN APPROPRIATE RESPONSE HAS BEEN DESIGNED. PROJECT COMMITTEE RECOGNIZES THAT THERE IS ELEMENT OF ROLLING DESIGN TO PROPOSED PROJECT AND RECOMMENDS THAT PROCEDURES FOR HOW ANY CHANGES IN PROJECT IMPLEMENTATION SHOULD TAKE PLACE BE CLEARLY SPELLED OUT IN PP/PRO AG. BASED ON REF (B), AID/W CONCURS THAT MISSION DIRECTOR MAY AUTHORIZE PROJECT WHEN PP DESIGN COMPLETED.

B. THE ADDITIONAL USD 300,000 BEING ADDED TO THE INSTITUTIONAL DEVELOPMENT ELEMENT OF THE PROJECT WILL BE INCLUDED IN THE ALLOCATION OF FUNDS TO AID FROM STATE/RI, BRINGING TOTAL LOP TO USD 7,500,000 PER PARA 2 REF (B). WILL ADVISE FUNDING CITATION AND WHEN USAID CAN OBLIGATE PROJECT UPON EXPIRATION OF CR EXPECTED SEPTEMBER 27, 1983.

2. AID/W WILL PROCESS REQUEST FOR WAIVER OF COMPETITIVE PROCUREMENT PER REF (A). WILL ADVISE WHEN COMPLETED. SHULTZ
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LOGICAL FRAMEWORK

Project Title: Gedaref Water Supply

Program Goal: The broader objective to which this project contributes: To increase the potential for productive economic activities in the Gedaref area. Subgoal: To improve the health status of the residents of the Gedaref area.	Measures of Goal Achievement: Decrease in incidence of water-related diseases.
Project Purpose: To assist the Government of Sudan in providing a reliable, adequate supply of potable water for refugees and local Sudanese in the Es Showak-Gedaref area.	Conditions that will indicate purpos has been achieved: End of project status. 1. A minimum of 35 liters per capita per day available for system users. 2. Water supplies available when needed. 3. Water quality of acceptable standard. 4. Institutional capacity to operate and maintain water supply system.
Outputs: 1. Water system at Tawawa refugee settlement constructed 2. Abu Naga well field developed 3. Chlorinator replaced at main reservoir. 4. Water source improvements 5. Es Showak system improvements 6. Installation of water meters 7. Communications system 8. Administrators, managers, operators and maintenance crew trained and in place. 9. System maintenance program developed and operational.	Magnitude of Outputs necessary and sufficient. See James M. Montgomery Feasibility Study.
Inputs: 1. Institutional Development and Training 2. Construction (Rehabilitation and Expansion) 3. Technical Assistance 4. Equipment, materials and vehicles	$ 901,000 5,299,155 1,184,600 109,380 $ 7,494,135

13

Means of Verification: GOS Ministry of Health records. Tawawa Medical Unit records.	Concerning long term value of program/project. Other programs-projects will be in place to reinforce the long range objectives of increased economic potential and improved health status.
1. Project reports and evaluations. 2. GOS records.	Affecting purpose-to-goal link: 1. Recurrent costs can be covered in order to keep the system operating effectively and efficiently. 2. Sufficient managerial resources will be made available to keep system operating. 3. GOS agencies will support rate structure enforcement.
1. Contract and project reports evaluations. 2. USAID's site visits.	Affecting output-to-purpose link: 1. Trainees are available and will remain in jobs for which trained. 2. GOS staff available to complete construction activities. 3. Timely mobilization of engineering design contractor and construction contractor.

[illegible] A/2/12 Dated 8th. Jan. 1983 Appendix C

Sayed Osman Mustafa,
Under-Secretary of [illegible],
Ministry of Finance [illegible],
KHARTOUM.

Dear Sayed/Mustafa,

Subject:- [illegible]

Since the start of Gedaref water supply problem, many actions have been taken; [illegible] least of which is the formation of a high ministrial committee, conducted by his Excellency the first vice president.

His excellency [illegible] that [illegible] Authorities [illegible] the solution of the problem. [illegible] Administration for [illegible] in this matter.

The National [illegible] for [illegible] Agency for International [illegible] extensive discussions with respect to the above project. [illegible] of the project is to rehabilitate the Gedaref water supply System and supply potable water for the local [illegible] and refugees in the Ed Dhamk-Gedaref area. [illegible] a feasibility study, conducted by James [illegible], Consulting Engineers, Inc. The study has been completed and HAW has reviewed and made some amendments and comments on the study, which were approved and incorporated in the final recommendations of the project.

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[illegible] will provide technical and administrative assistance to the project and will coordinate the project activities with other concerned agencies by the formation of a steering committee. We shall ask the following agencies to be represented on the steering committee: Commissioner of Refugees, Eastern Regional Government, Gedarif Water System, Gedarif town council, UNHCR, and Health commissioner for Gedarif district.

On behalf of the National Ministerial Committee for Gedarif Water Supply and the Ministry of Energy and Mining. We would appreciate your making a formal request to USAID for financial assistance to develop and execute the above project.

With best regards.

Yours Sincerely,

Sheikh Ia M. Sheikh
Director General
National Administration for Water

Copy to:-
Office Manager, First Vice- President
Khartoum.
Office Manager, Governor of Eastern Reg.
USAID Mission, Khartoum
ATT. Mr. A. Thervingo

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TECHNICAL ANALYSIS

I. Water Supply

A. General

The greater Gedaref water supply system serves the town of Gedaref plus the villages of Es Showak, Er Rawashda and Umm Shegara directly from the Es Showak-Gedaref transmission pipeline. The villages of Al Abayo and Ghubeisha receive their water supply directly from the Gedaref distribution system. The Tawawa refugee settlement is equipped with a water distribution system and small elevated reservoir that was at one time connected to the Gedaref system. The connecting pipeline is broken and the Tawawa refugee settlement only receives water via water vendors.

The primary water sources are, the Atbara River located approximately 60 km northeast of Gedaref and the Nubian sandstone aquifer that underlies the entire Gedaref area.

B. Existing Water Supply Systems

1. The Atbara River system carries a major portion of runoff draining from the eastern region of Sudan. Annual river flows, measured at the Kashm el Girba Dam, 75 kilometers north of Es Showak are recorded to be 12 cubic kilometers (1.2×10^{10} m^3). Flow records from the dam indicate that 74 percent of the annual flow is carried during the wettest months of July through October while the 26 percent, or base flow, is carried during the remaining 8 months of the year. Recorded daily flows at the dam range from 180 million m^3 to a reported zero flow during the dryest month. Flow records maintained at the two gaging stations on the Setit and Atbara Rivers, 35 and 22 km respectively upstream from Es Showak indicate minimum river flow of 1.7 million m^3 per day.

   Water quality data for the Atbara River is limited. Total dissolved solids (TDS) are reported to range from 100 to 400 milligrams per liter. Suspended solids (SS) in the form of silt may range to as high as 16,000 milligrams per liter during the high runoff periods. A recent sample taken in November, 1982, showed a TDS of 320 milligrams per liter and a total hardness of 155 milligrams per liter (as $CaCo_3$). This water is suitable for domestic water supply purposes in accordance with the World Health Organization (WHO) Guideline for Drinking Water Quality.

The limits set by WHO are TDS not to exceed 1000 milligrams per litre and hardness as $CaCO_3$.

2. The river intake structure was built in 1967-1970 to serve the water treatment plant being built at the same time and located near the intake structures. It is located on the west bank of the Atbara River near Showak. The structure is no longer in use due to the siltation of the river which has deposited over seven metres of silt on the west side of the river. The original intake ports are buried in a silt bank that extends well out into the river. The siltation process has occured during the past 10 years. The current methods of getting water to the intake structure is via portable pumps and by digging a ditch in the silt from the structure to the flowing water. During the dry season the ditch has been known to reach 150 metres in length, 20 metres in width and 5 metres deep.

3. The Showak Water treatment plant is located near the river intake structure. It was constructed with an initial rated capacity of 12,500 cubic metres per day. The plant is conventional water treatment plant with an alum dose sedimentation clarifier, three filter, a clearwell reservoir, chlorination facilities and a high lift pump station that pumps the treated water to Gedaref via the 500 mm pipeline.

   Current operation of the water treatment plant involve manual dosing of aluminum sulphate to the sedimentation basins. The use of alum was discontinued in 1981 due to the lack of chemical supplies and manual application is required because all six of the chemical feeders are inoperative. The suspended solids in the form of silt create a serious operational problem because of their high concentration during the wet season and the hand dug diversion ditch through deposited silt in the dry season. During these periods backwash water requirements are purported to be as high as 40 percent of production. The filters are equipped with rate of flow controllers, however, the plants pneumatic controls are non-functional and the filters must be manually controlled. Electric power is supplied by the Ksahm El Griba power generation station which currently varies in output from 1 MW to 12 MW during the year. Agriculture demans take precedent for electric power. As a result electric power is available to the treament plant and high lift pump station only 16 to 20 hours per day.

4. The Showak high lift pump station is equipped with two pumps. Each is rated at 420 m^3 per hour capacity with a 240 metre total dynamic head (TDH). With the treatment plant operating at full

capacity, 12,500 m^3 per day, a combined total of 29.75 hours of pumping time is required each day. Until the demand exceeded 8400 m^3 per day, one pump operating 20 hours per day was sufficient, and a second pump acted as a spare unit. Agriculture uses have priority for electric power, and the project availability of power for the water system was established at 20 hours per day. In reality, 16 hours of electric service per day is more realistic. The installed motors at the pump stations are 415 volt, 172 ampere, three phase, 50 hertz units rated at 460 kilowatts at 2550 rpm. When the high lift station was constructed, only two motors were provided. Following installation, frequent failures were experienced due to overheating and voltage drops requiring rewiring at the factory in Austria. Because of the frequent failures, a third stand-by motor was purchased. In November of 1982, only one unit was in operation. One unit was being repaired at the factory in Austria and the third unit was burned out.

A single pump exists at the water treatment plant to serve the town of Es Showak. The pump is no longer operational and Es Showak is being served through a blow-off valve on the discharge side of the high lift pumps.

5. Es Showak-Gedaref Transmission Pipeline

The transmission pipeline is a 500 mm diameter bitumastic lined and coated, welded steel pipe, 68.4 kilometers long. It originates at the water treatment plant at an elevation of 480 meters and terminates at the reservoir in Gedaref at an elevation of 636 meters. The high point of the pipeline is 645 meters approximately 11.1 km before the terminal point in Gedaref. The condition of the pipeline is thought to be fairly good, however, it is felt that some of the bitumastic liner may have peeled off.

C. Abu Naga Well System

The Abu Naga well field was constructed in 1968 in an area approximately 13 km southeast of the city of Gedaref adjacent to the Sudan railroad tracks. The well field consists of 11 boreholes drilled to depths ranging from 180 to 222 meters deep. It was equipped with 11 KVA electric power and stepdown transformers. The well field was the principal source of water for the city of Gedaref until 1972 when the Es Showak-Gedaref transmission pipeline was completed and became the principal source of water. It was the intent to maintain the Abu Naga well field as an alternative source of water to the Es Showak-Gedaref system.

1. The wells of the Abu Naga well field all penetrate and receive their water from the confined Nubian Sandstone Aquifer. It has localized pockets of poor quality water and varies significantly with location, however, the ground water is generally considered to be of good quality and suitable for domestic consumption. Water quality records from 41 different wells in the vicinity, show TDS ranging from 240 to 2,848 with the majority falling between 300 and 700 milligrams per liter. The water is generally hard to very hard with total hardness, as $CaCo_3$, ranging from 60-900 milligrams per liter. Nitrates, as NO_3 are generally well below WHO guidelines.

   When in operation, the well field was reported to produce up to 1900 m^3 per day. The wells were equipped with submersible pumps that pumped the water to five elevated 49 m^3 steel storage tanks and pump station located near the well field. From the storage tanks, water was pumped through a 250 mm diameter asbestos cement pipeline 13 km to the reservoir in Gedaref. Since 1972 when the Es Showak-Gedaref system went into operation, most of the well pumps and equipment from the pumping station have been removed. Subsequent to the removal of the well pumps, wells were filled with stones and debris. The 250 mm asbestos cement pipeline was installed in what is referred to as "cotton soil", a highly plastic soil that expands and contracts greatly with changes in moisture content. As a result the pipe has broken in numerous places and leaks principally at the joints.

2. Beginning in 1980, UNHCR provided funds to the Rural Water Administration which later became the National Administration for Water (NAW), for rehabilitation and redevelopment of the Abu Naga well field. At that time, two of the wells had been totally abandoned while several others, filled with rocks and debris, were being considered for rehabilitation. By late 1982, three wells had been put back into operation but the production was considerably reduced from previous production. This was assumed to be due to encrustation of the slotted well casings. The transmission pipeline was not operational, although attempts were being made to repair it. The water produced by the re-equipped well was being distributed to local water vendors for resale to consumers at greatly inflated prices. Because the pipeline was not usable the actual production of the well fields was estimated to be no greater than 100 m^3 per day.

   Since late 1982, four new wells, financed by the UNHCR have been drilled. The production capacity is not known,however, it is anticipated they will be equipped and eventually put into service.

II. WATER DISTRIBUTION SYSTEM

A. Gedaref Distribution

Gedaref is equipped with a fairly extensive, although incomplete water system made up of asbestos cement, galvanized steel and polybutylene pipe. The distribution network is estimated to have 44,745 meters of 50 mm diameter polybutylene pipe, 18,440 meters of 100 mm diameter pipe, 14,070 meters of 150 mm diameter pipe and a total of 83,825 meters. The distribution system is equipped with valves to isolate segments of the system for repair.

In general, the distribution system appears to be in good serviceable condition with little evidence of external corrosion or internal tuberculation.

The main reservoir for Gedaref is a reinforced concrete structure with a total capacity of 9090 m^3. It is divided into two chambers to facilitate cleaning and maintenance. The reservoir is located on a military base about 25 meters above the average elevation of the city. The reservoir was constructed in 1969 and appears to be in good physical condition.

The reservoir served as a mixing reservoir for the water coming from Es Showak and Abu Naga. Both transmission pipelines terminate at the reservoir, however, the Abu Naga pipeline has been tapped so frequently, it currently functions more as a distribution pipe. Chlorination facilities are located adjacent to the reservoir in Gedaref and when in operation, injected chlorine into the 50 mm diameter Es Showak-Gedaref pipeline approximately 50 meters upstream of the reservoir. An electrical fire in 1982 partly destroyed the controls and chlorinator and caused a chlorine gas leak that destroyed all equipment housed in the building. Replacement equipment was reported as having been ordered. Since the fire, no chlorination, except at the treatment plant is taking place.

B. Tawawa Distribution

Tawawa is equipped with a basic water distribution system and a 25 m^3 elevated reservoir that if operational would deliver water to the consumer through public taps. The pipeline connecting Tawawa with Gedaref has been broken for some time and the distribution network and public taps are in complete disrepair. With the prevailing thinking of the residents of Gedaref, who feel that the reason for their shortage is due to the influx of refugees, the connecting pipe has not been fixed. The residents of the Tawawa refugee settlement receive their water via water haulers from a well located about 2 km southeast from Tawawa. The water from this well has poor quality characteristics and belongs to the Ministry of Agriculture. A new well was drilled in 1983 by UNHCR and will be equipped with a submersible pump, a ground level storage tank and auxiliary power generator.

III. PROJECTED WATER DEMANDS

A. Population Growth

The population of the Greater Gedaref Area is estimated to be 157,000 plus 7,000 in the Tawawa refugee settlement. During harvest season, these totals are estimated to increase by a total of 20,000 to 40,000 migrant workers. A summary of the current and near future estimated population are shown in Table F-1.

TABLE F-1

POPULATION PROJECTION

Town/ Village	Estimated Population		
	1982	1987	Peak 1982
Gedaref	157,000	211,000	231,000 to 251,000
Es Showak	10,000	16,000	19,000 to 21,000
Er Rawashda	8,000	11,000	11,000
Umm Shegara	10,000	14,000	14,000
Tawawa	7,000	10,000	12,000 to 15,000
Ghubeisha	10,000	14,000	14,000
TOTALS	202,000	278,000	301,000 to 326,000

B. Water Consumption

It is estimated that the population served by the Es Showak-Gedaref system receives only 25 lpcd. The residents in the outlying and some refugee settlements areas who do not receive water from the Es Showak-Gedaref system are purchasing water in amounts less than 10 liters per person per day. The small amount consumed by the refugees and low income poeple is due to the high cost ranging from LS 11 to 29 per m^3 versus LS 0.26 for metered connections in Gedaref.

The minimum requirement to meet drinking, cooking and personal hygiene standards was established at 20 to 25 lpcd by A.I.D. Policy Paper entitled: "Domestic Water and Sanitation" dated May 1982. Due to the nature of the urban area, its economics and the presence of a significant affluent element within the community, a high of 50 lpcd is not considered to be excessive for consumers connected directly to the water supply system. For those consumers living at least 30 meters from a public tap an average consumption of 35 lpcd is considered a reasonable amount. Commercial, institutional and industrial users are estimated to use 10% of the total domestic consumption and water losses or unaccounted-for-water are not expected to exceed 20% of total domestic

consumption. Fire demands are small and are included in the commercial, institutional and industrial demand. Table F-2 contains the projected water demands based on the population projections and expected per capita demand.

TABLE F-2

PROJECTED WATER DEMANDS

1987

Demand Source		
Residential users with service connections within 30 meters of supply source	177,500	8,875
Residential users living more than 30 meters from supply source	118,300	4,140
SUBTOTALS	295,800	13,015
Commercial, Institutional and Industrial	--	1,302
TOTAL ACCOUNTABLE WATER		14,317
Unaccounted-for-water		2,863
TOTAL WATER DEMAND (December 1987)		17,180

The projected water demands listed in Table F-2 include a service population of 278,000 permanent residents and 50 percent of the average migrant worker population in 1987, or an additional 17,800 equivalent permanent residents.

IV. AVAILABLE WATER RESOURCES

A. Introduction

The maximum projected daily demand for the Gedaref system, the Tawawa refugee settlement, Umm Shegara, Er Raswashda and Es Showak is 17,180 m^3. This water must come from three separate sources, the Atbara River, Abu Naga well field and Tawawa. A well has been developed for the Tawawa refugee settlement by the UNHCR which based on the initial pump tests will not be adequate to supply its water need. It appears

that another well will be required. Many of the refugees that have settled in and around the Gedaref area will be obligated to receive their water from standpipes to be installed by the project. Therefore, the number and density of standpipes will be sharply increased in these areas so that the access distances will not exceed 50 meters. The water demands for the remaining locations, with the largest demand, will be from the Atbara River and the Abu Naga well field.

B. Atbara River

The original water supply scheme for which the first phase was constructed in the early 1970's, provided water treatment and transmission facilities with a daily capacity of 12,500 m^3/day. (The river intake was piped for the ultimate capacity of 12,500 m^3/day whereas, the other facilities, namely the first phase of the treatment plant, high lift pump station and transmission pipeline were sized for a maximum capacity of 12,500 m^3/day.)

The amount of available water at the Atbara River exceeds the demand for the project area. The limiting factor is the Es Showak-Gedaref pipeline with a capacity of 540 m^3/hour if the internal pressure does not exceed approximately 420 meters (42.0 kg/cm^2). At 540 m^3/hour, the pipeline will provide 12,960 m^3/day, leaving 4,220 m^3/day to be supplied by the Abu Naga well field and Tawawa well.

C. Abu Naga Well Field

The Abu Naga well field receives all of its water from the Nubian Sandstone. When in full operation, prior to the completion of the Es Showak-Gedaref transmission pipeline, eleven wells were operated that reportedly produced a total of 1,900 m^3/day, or the equivalent of 172 m^3/day per well. Records show that when originally tested, each of the wells were pumped at 545 m^3/day, therefore, it appears that the well field was never utilized to its full extent. Based on this information, eleven wells would produce a daily capacity of 5,995 m^3/day. However, after evaluating the available data, the consultant concluded that there was insufficient data to develop a safe yield for the Abu Naga well field. The consultants did feel confident in estimating a safe yield for the Abu Naga well field from the Nubian sandstone aquifer somewhere in the range of 3,500 to 4,500 m^3/day with no adverse impacts on the groundwater.

D. Tawawa Refugee Settlement Area

The Tawawa refugee settlement has been totally reliant on water vendors bringing water from a single well located about 2 km southwest of the settlement. The original well was located on land owned

by the Ministry of Agriculture and produced water with a high hydrogen sulphide content. UNHCR recently drilled and equipped a well about 1.2 km from the settlement. It was drilled after the consultant completed his feasibility study. The quality of the water is unknown, but purported to be of good quality and the well has been tested at 300 m^3pd. No pipeline has yet been provided to transport the water to the refugee settlement. All water is still being hauled to the settlement on donkey carts by water vendors or residents.

V. WATER METER CONNECTIONS AND SERVICE

There are approximately 6,500 metered water service connections on the Es Showak-Gedaref water system. Approximately 700 meters are serving commercial, institutional and industrial purposes with the remaining 5,800 serving residential or domestic users. Relatively few meters are installed in Es Showak or the other villages between Es Showak and Gedaref.

Of the 5,800 residential meters, approximately 2,500 are serving permanent (concrete) single family structures and the remaining 3,300 are generally serving a hydrant within private compounds consisting of an average of five thatch huts. It is estimated that an average of 5.2 persons reside in each permanent structure and 3.5 persons in each thatch hut. This combination translates into 64,000 people with direct connections or direct access to the water system.

The population in Gedaref, the immediate surrounding towns, and Tawawa refugee settlement totalled 164,000 in 1982. In other words, about 100,000 people do not have direct access to the water system and most are buying water indirectly from one of 46 contract vendors and directly from the water vendors. During the preparation of this project paper, further investigation determined that currently water delivered in this fashion was costing the consumer LS 0.20 for one 4 gal tin or the equivalent of LS 11.00/m^3. It was also reported that this price increases by twofold or more during the dry period or when the water system has been out of order for a couple of days.

VI. RECOMMENDED FACILITIES AND IMPROVEMENTS

Improved water supply facilities recommended by the Consultant took into full account the status and extent of the existing facilities, the needs of the consumer, consisting of the refugees in the Tawawa and the Greater Gedaref area, as well as the permanent residents, and the available water resources to meet the demand through 1987. The consultant also took into consideration the emergency improvements made by national and international relief agencies.

Emphasis was placed on adequate water supplies available to all consumers in reasonable quantities. A total of 35 liters per capita per day (lpcd) is projected as the quantity available to all persons required to carry water more than 30 meters from a standpipe and 50 lpcd for those persons either directly connected to the distribution system or required to carry water a distance less than 30 meters. The minimum requirements to meet drinking, cooking, and personal hygiene standards was established at 20 to 25 lpcd by A.I.D. Policy Paper entitled: "Domestic Water and Sanitation" dated May 1982. For design purposes, the Consultant assumed a factor of 10 percent of all domestic water consumption as a reasonable amount for commercial, institutional and industrial uses. Water for fires is stored in designated tanks and was not included as an additional water requirement. A factor of 20 percent was used to allow for unaccounted for water.

The total permanent population including the refugees was estimated to be 202,000 in 1982. This total is projected to increase to 278,000 in 1987 plus anywhere from 23,000 to 48,000 migrant agriculture workers during certain times of the year. The total projected water need to meet the demands of this population is estimated to be 17,180 m^3 per day at the end of 1987.

The projected improvements provide the above water requirements from the following sources:

Source	m^3 per day
1. Atbara River infiltration wells:	
For Es Showak-Gedaref transmission	12,500
For Es Showak Village Supply	700
2. Abu Naga Well Field (minimum supply)	3,800
3. Tawawa Well	600
Total Water Supply	17,600

A description of the improvements follows. The location of facilities are shown on the following map of the existing water supply system with proposed improvement locations.

1. Tawawa Refugee Settlement

A new well has been drilled and developed by the NAW through relief funds provided by UNHCR. This new well is about 1.2 km southwest of the refugee settlement and replaces a well loaned to UNHCR by the Ministry of Agriculture. The Agriculture Department owns two wells in the vicinity, one of which has a high hydrogen sulphide gas content. The well has been on loan for a two year period that has now expired. The UNHCR intends to equip the newly drilled well with a submersible pump. It will also construct a ground level storage tank with approximately 25 m^3 capacity and a chlorinator utilizing hypo chloride rather than chlorine gas. The refugees are still required to either haul the water themselves or buy it from vendors.

Recommended project improvements include installing a 100 mm diameter pipeline directly from the well to the existing 25 m^3 reservoir in Tawawa, increase tht total storage capacity at Tawawa to 70 m^3, repair, replace and expand the water distribution network throughout the developed area and install safe sanitary standpipes. The pipeline connecting Tawawa to Gedaref should also be repaired to water to provide a secondary source.

2. Abu Naga Well Field

Because of the shortage of water in Gedaref, NAW, with emergency relief funds from the UNHCR rehabilitated four of the original eleven wells and drilled four new wells. The remainder of the existing wells were not recoverable. One of the new wells is capable of pumping water. In addition, a 200 mm diameter PVC pipe was installed from the Abu Naga pump station to the booster station on the edge of town. Water is delivered to the Gedaref reservoir via this transmission pipeline when there is electric power and sold to water vendors at the booster pump station. The pipe was provided by UNHCR, and,was placed in a shallow trench, approximately 150 mm (4 inches) deep and covered with 100 to 150 mm (13 to 14 inches) of loose soil. It has been and is subject to failure from vehicles and erosion.

The recommended improvements to the Abu Naga System are summarized below.

a. Install new submersible pumps in two new and four rehabilitated wells.

b. Install new 150 mm and 200 mm diameter pipes connecting the new and rehabilitated wells to the Abu Naga pump station. This pipe will be equipped with check and isolation valves and buried to avoid damage from vehicular traffic and vandalism.

c. Install electric control panels on the new well pumps and those installed by UNHCR.

d. Rehabilitate the Abu Naga pump station and install a new 200 m^3/hour pump and electric motor including motor control equipment and a step-up transformer and chlorination facilities to chlorinate the water in the pipeline.

e. Install 5,500 meters of new 300 mm diameter pipe and reinstall the existing pipeline provided by UNHCR in a deep trench. Isolation valves will be added to the pipeline.

3. Atbara River Source System

The existing system of treating Atbara River water at Es Showak will be abandoned in favor of installing infiltration wells adjacent to the Atbara River and pumping the water directly to Gedaref through the existing water transmission pipeline. This process will eliminate the intake structure, pumping from the river and the problems associated with the silt deposits and the change of the river channel. The improvements to the Atbara River source system and Es Showak-Gedaref water transmission pipeline are listed below.

a. Drill infiltration wells adjacent to the Atbara River.

b. Equip the infiltration wells with submersible pumps, electric power lines, electric control panels, and a single auxiliary electric power unit.

c. Install collection piping from the infiltration piping to the clear well reservoir at the existing water treatment plant. The piping will have check valves and isolation valves at the discharge of each well.

d. Modify the existing chlorinator and piping at the old water treatment plant to chlorinate the water coming from the infiltration wells.

e. Replace the pump motor units in the Es Showak pump station with three new 360 m^3/hour units at 180 total dynamic head. Provide electric control panels for new pump motor units, provide check and isolation valves on the discharge and isolation valves on the inlet side of each pump.

f. Replace the pressure differential unit on the venturi flow meter at the discharge of the pump station to measure and record the flow.

g. Install a new 40 m^3/hour pump in the Es Showak pump station to serve the village of Es Showak and improve the piping at the new elevated reservoir installed by UNHCR.

h. Construct a new booster pump station at the midpoint of the Es Showak-Gedaref transmission pipe line. The booster station will be equipped with three pump motor units, motor control panels, transformers, valving, auxiliary power, a 400 m^3 reservoir and electric power lines to the booster pump station will be installed.

4. Gedaref Reservoir

At the 9090 m^3 reservoir in Gedaref, new chlorination equipment will be installed to replace the equipment destroyed by the fire in 1982 plus some miscellaneous piping.

5. Water Meters

Over 50 percent of the existing and installed water meters do not work and the accuracy of the remaining meters is questionable. This project included the purchase and installation of 10,000 domestic and 400 commercial sized water meters. The effect of replacing the existing domestic meters will increase the total number of service connections to about 10,700, a net increase of 4,200 meters. A majority of the increased meters will be installed in the outskirts of Gedaref, serving the thatch housing compounds. At roughly 17 persons per new service connection, a total of 70,000 additional persons will be connected to the water system, increasing the total from 65,000 to 134,000 by the end of the rehabilitation and construction program. These meters and their installation are essential to control water losses and generate revenues.

The replaced meters will be stored for eventual repair and testing once the repair facilities have been equipped and stocked with replacement parts. These meters can then be reinstalled in new services after the completion of the construction portion of the project to increase the number of service connections and the revenue base.

6. Telephone and Radio Communication

Reestablish telephone communications between the Es Showak pump station and Gedaref and tie into the new booster station on the Es Showak-Gedaref transmission pipeline. Also purchase and provide a radio communications system consisting of two base stations and three remote units to facilitate improved operations and maintenance.

7. Operating Equipment and Materials

Purchase and provide for vehicles for operation and maintenance of pumps, tools and construction equipment, plus supplies and replacement and spare parts for existing and new equipment.

VII. SYSTEM IMPROVEMENT COSTS

The following is a detailed break-down of the costs to provide and install all the physical improvements to the water supply system. The costs of each element is quoted in dollars only, with the Sudanese pound portion, consisting of labor and locally provided vehicles and equipment quoted only in the subtotals. The exchange rate is 1.3 Sudanese pounds to 1.0 dollars.

Item	Dollar Costs	Sudanese Pound Costs
Tawawa Refugee Settlement Water Supply and other improvements.		
1. Install a 100 mm diameter pipeline from the new Tawawa well to the elevated storage tank. 1200 meters at $35 per meter.	42,000	
2. Install chlorination equipment at Tawawa well.	3,500	
3. Construct housing for control panel auxiliary power.	5,000	
4. Provide and install additional elevated water storage capacity-Tawawa refugee settlement.	25,000	

5. Expand and improve existing water distribution network in the refugee settlement.	91,700	
6. Rehabilitate existing and install additional public standpipes and meters.	11,800	
7. Miscellaneous appurtances, valves, etc.	7,700	
SUBTOTAL	186,700	113,000
Abu Naga Well Field and Transmission System Improvements.		
1. Install new submersible pumps in new and rehabilitated wells not already equipped by UNHCR.	144,000	
2. Install electric control panels for all new and rehabilitated wells.	24,000	
3. Install 1500 m of 150 mm diameter and 3,500 m of 200 mm diameter pipe from wells to Abu Naga pump station.	295,000	
4. Rehabilitate existing Abu Naga pump station and install a new booster pump motor unit, 200 m^3/hr at 100 total dynamic head, step-up transformer, and piping.	60,000	
5. Install new chlorination equipment at pump station.	5,000	
6. Install 5,500 m of 300 mm diameter pipeline and reinstall 4,000 m of the existing 200 mm diameter PVC pipeline from pump station to the booster pump station at the edge of Gedaref.	585,000	
7. Miscellaneous appurtances, valves, etc.	23,000	
SUBTOTAL	1,136,000	452,200
Gedaref Reservoir		
1. Install new chlorination equipment and piping at the existing 9090 m^3 reservoir in Gedaref.	13,000	
SUBTOTAL	13,000	3,400

Atbara River Source and Es Showak-Gedaref Transmission Pipeline Improvements

1.	Construct infiltration wells parallel to Atbara River and equip with submersible pumps.	561,000
2.	Install electric power lines and control panels for well field.	30,000
3.	Install auxiliary electric power generator for well field.	55,000
4.	Install collection piping to reservoir at existing water treatment plant.	180,000
5.	Modify existing chlorination equipment and piping at the existing water treatment plant.	2,000
6.	Replace existing pump motor units in Es Showak pump station with three new 360 m^3 per hour units and electric control panels.	105,000
7.	Construct new booster pump station at midpoint of Es Showak Gedaref water transmission pipeline.	25,000
8.	Three pump motor units at midpoint booster station. 360 m^3/hr capacity each.	105,000
9.	Construct 400 m^3 reservoir at midpoint booster station and install piping and valving.	100,000
10.	Install electric power to midpoint booster station.	20,000
11.	Auxiliary electric power at midpoint booster station.	65,000
12.	Replace nonfunctioning measuring and recording equipment on venturi flow meter in Es Showak pump station and provide other flow metering and control equipment.	15,500

13. Miscellaneous appurtances, valve, etc.	17,000	
SUBTOTAL	1,280,500	355,000
Es Showak Village Water Supply Improvements		
1. Replace service pump in Es Showak pump station to supply water to the village.	10,000	
2. Miscellaneous piping and materials at new elevated reservoir and for transmission pipeline.	10,000	
SUBTOTAL	20,000	34,300
Water Meters		
1. Provide and install 10,000 new domestic water meters (1/2 to 5/8 inch multi-jet) including couplings.	500,000	
2. Provide and install 400 new one inch and larger water meters for commercial and industrial users complete with couplings.	40,000	
SUBTOTAL	540,000	54,100
Other Improvements		
1. Re-establish telephone communications between Es Showak and Gedaref.	7,000	
2. Provide radio communication equipment: two base units and three remote units.	43,000	
SUBTOTAL	50,000	9,100
Operating Materials and Equipment		
1. Provide four operations and maintenance vehicles.	40,000	
2. Provide tools and construction equipment.	20,000	
3. A supply of replacement and spare parts.	30,000	
SUBTOTAL	90,000	2,100

TOTAL COST TO IMPROVE WATER SUPPLY FACILITIES	3,316,200	1,023,200

The above cost estimate is based on 1982 values and does not include a factor for inflation.

INSTITUTIONAL DEVELOPMENT/TECHNICAL ASSISTANCE

This component of the project will address the institutional needs of the Gedaref Water Utility and includes, administrative procedures, service regulations, supplies, storekeeping, support equipment, internal systems-records-reports and procedures, operations and maintenance, and the development of human resources through comprehensive training. The activities financed under this component will enable the Gedaref water utility to operate as a self sustaining agency by the completion of the project and to administer and operate a potable water system with increased supply on a 24 hour/day basis.

In an effort to maximize the benefits of the consultant's training efforts, NAW will arrange for employees of other water utilities to participate in the training at Gedaref. The consultant's training plans will be reviewed by NAW and wherever possible, employees, from other areas in Sudan and from NAW's staff, will be scheduled to be present in Gedaref and attend the particular training sessions. The consultant will also be asked to review what courses are being offered at various technical schools, colleges and universities in Sudan to determine if any courses are pertinent to water utility operations and attempt to arrange either an exchange of instructors or students. To the extent possible, the consultant will attempt to institutionalize the training of water utility management and operators.

A. Technical Assistance

Approximately 47 person months of technical assistance and training will be provided over an 18 month period for development of the Gedaref water utility's institutional skills. (Additional assistance will also be provided under construction management activity.) Three long-term specialists will assist the utility's administrative, commercial, and operations staff in the development of effective procedures and hands-on training in the use of these procedures. The four principal areas of technical assistance are described as follows:

1. Organization and Management

Technical advisors will provide assistance with a wide array of organization and management procedures. The advisors will assist water utility management in developing a workable and practical organization plan for the utility. Technical advisors will evaluate the sufficiency of all internal systems, procedures and controls. Areas of assistance will include general administrative activities, filing and records, personnel administration, procurement procedures, storekeeping, general accounting (systems), billing and collecting, customer relations and records.

Technical advisors will review and assist in the development of detailed job descriptions for each job classification involved in water utility activities showing specific functions and duties within the organization structure. The advisors will assist in analyzing salary range programs in order to develop salary structures that are compatible with resp sibilities, technical skills and the competitive labor market. The proposed program includes various training components designed to provide the broadest possible training exposure throughout the entire water utility organization. During the 18 month institutional assistance program, the advisors will continually provide on-the-job training of counterpart utility personnel plus individuals that may be assigned by NAW, or the University for the long-term benefit of similar future country-wide training programs.

Advisors will assist in the planning and design of information systems geared toward providing timely and essential data for management review, decision-making and planning purposes. Information systems should include, but not necessarily be limited to, classification of customer water service, production and loss calculations, unit water costs, financial statements and budget comparisons, leak repairs and maintenance reports, staffing reports, construction progress, billing and aged account data, and cash flow reports.

(2) Revenue Collection

The full realization of water service revenue due the water utility is essential to the implementation of institutional improvements and to assure financial viability and true semi-autonomous operation.

Advisors will assist in the development of a workable enforcement program that will achieve the desired results within an acceptable time frame. It is considered desirable that all water accounts be brought to a current basis within the 18 month advisory service program.

It is estimated that over 50% of the installed water meters are inoperative or are estimated due to meter-location and reading problems. The advisors will assist in a thorough analysis of the problem and will develop a planned program to correct the deficiencies within a reasonable time frame.

Advisors will assist in developing priority schedules for meter replacement and the installation of new service connections coordinating with the meter service installation construction contract. Of high priority will be an institutional change in the status of the existing contract public hydrant vendors. The project will provide system extensions and metered hydrants to as many residential compounds as can be accomplished with the new meters not required for replacement. To the extent that present distribution system is inadequate and extension is impractical, public hydrant stations should be established and manned by water utility employees to assure that all consumers can obtain water at regular utility rates.

The advisors will develop a controlled monitoring program to monitor collection enforcement, meter maintenance, and public hydrant distribution to:

- assure that disconnect orders are fully implemented and that disconnected customers do not illegally reconnect; and

- assure that all inoperative meters are included in the corrective program, and operating meters are recording accurately; and

- assure that the public water system is not being improperly used for private profit.

Other acceptable sources of revenue, including reconnect charges, connection charges, or "buy in" fees, for new service connections will also be evaluated.

(3) Engineering Records

The advisors will assist utility staff in the development of a basic, uniformly-scaled mapping system of the underground and above-ground water facilities. Transfers should be made of all data available to "as-built" drawings and from information developed through field investigations and discussions with present and past water utility staff.

A coded work order system will be developed for all water utility plant construction activity as well as systems to provide complete information on project construction progress. Advisors will also develop procedures to process and properly record all new service applications. Records will be maintained on all installed water connections and replacement meters for statistical reasons, maintenance and relocation works, and as controls for water billing procedures.

(4) Operations and Maintenance

The technical advisors will provide assistance in all areas of water system operations, including well stations, booster pumping stations, storage facilities, meter maintenance, communication systems, controls and special operating devices.

Recording and reporting systems essential to operational management will be developed and utilized for analyzing costs, operating efficiency, and management decisions. Hands-on preventive maintenance and repair techniques will be demonstrated in the field for the benefit of utility O&M staff assigned to the maintenance of the various water system components. Logistic support requirements for continuing maintenance will be developed and identified.

B. Training Programs

The proposed institutional and technical assistance program is scheduled to span 18 full months overlapping most of the construction schedule and beyond. During this period, construction supervisors and technical assistance advisors will work with Gedaref water utility counterparts and their respective staffs in developing and implementing improved systems and procedures.

As indicated above training programs are proposed for all levels of operation, maintenance, and management. The type of training will be both formal and informal.

1. Informal on-the-job training will principally consist of the day-to-day discussions in development of systems, procedures and implementation effort between advisors and counterpart staff. Field demonstrations of proper operating and maintenance techniques would also fall in this category.

2. Formal training will generally occur in a classroom setting involving the use of visual aids and water system components for demonstration purposes. Teaching the use of and reason for commercial practice procedures is a typical subject for the classroom.

3. Outside of country observation-type tours for the manager of the Gedaref utility and the chief operating superintendant are included in the construction budget. These tours are intended to include visits to modern and efficient overseas water utilities of similar size and complexity.

In recognition of the language difficulties which could complicate the in-country training program, the technical advisory committee will be asked to assist in providing English speaking training assistants for all formal training sessions. NAW and the University Engineering Department would both be invited to participate in as much of the training program as possible.

PROJECT COSTS AND FINANCIAL FEASIBILITY

A. Project Costs

The current detailed outline of project components and associated costs is presented at the end of the Technical Analysis (Annex D-1). It has been prepared in close coordination with the PP team, and as such reflects their current analysis of the situation as it exists today based on a $7.5 million project. Four major changes are to be found that differ from earlier presentations.

1. Total funding for the project has been increased from $7,200,000 to a rounded total of $7,500,000.

2. Since the Feasibility Study was completed, the UNHCR has sponsored the construction of civil works related to water supply in Gedaref which, have a value as estimated in the Feasibility Study of $624,250. To that extent, the construction requirements of the project have been reduced.

3. There have been some changes in design, in the cost of the test well program, the metering program, and in other preliminary expenses.

4. Finally, given the financial constraints indicated in the Feasibility Study, the time and cost required to conduct a truly effective Technical Advisory program has been increased. Such a program is absolutely essential to the success of the entire project, since without it there is no assurance that the system would be properly operated and maintained. There is also no assurance that the water utility would develop the commercial management skills to administer the utility on a financially viable basis. Technical advisory funds within the project have been increased to reflect technical assistance of about $900,000 over the project period.

Before escalation, Project improvement costs total $3,664,320, and LS 1,126,950, respectively. These costs have been escalated at 8% per year for the dollar component, pro-rated to the point in the project when they are forecast to occur. The LS costs have been escalated at 15% per year in a similar fashion. The two rates of escalation were chosen after examination of recent United States and Sudanese experience with inflation, plus examination of economic forecasts for the next few years.

The LS component was estimated by the Consultant for each of the major project components, and includes such factors as local labor and materials which can be used in the construction of that component (see Feasibility Study, 11.1.1-a).

There are three components furnished by the GOS without which the project cannot succeed. The first is the current utility facilities in place and operating. This project does not begin from scratch, but rather adds improvements of various types to a water system that is already in place. The consultants estimated that on July 1, 1983, the Gedaref Water Utility would have utility plant assets worth a minimum of LS 2,997,400, which were useable, in place, and net of depreciation (Feasibility Study, Table 12.4). Because the project is strictly described as the rehabilitation and expansion of the utility and the existing plant is already in place, and not an addition, its value was not considered as a GOS contribution to this project.

The second element is the operation of the water system iteself. Table 12.8 of the Feasibility Study presents a detailed picture of operating costs. In the fiscal year 1983-84, those costs are estimated to be LS 751,900, of which wages and salaries are approximately LS 355,000. These costs exist with or without the project and are not a result of the project. Therefore, they are not considered as a GOS contribution to the project. As the project is implemented these costs become intermingled with the incremental costs of operating the new facilities, as well as older plant and equipment. In the economic evaluation the incremental costs are estimated in uninflated terms to average approximately LS 115,000 per year over the period 1984-85 to 1991-92, not including the site location supplement, which will become a GOS (Gedaref utility) responsibility beginning July 1, 1986.

The third element, a GOS contribution, is the funds provided from the CIP to finance monitoring, evaluation and training for a total contribution of LS 290,000 and the site supplement of LS 830,000. These funds are provided outside of the utility and are a GOS contribution to the project.

B. Financial Feasibility

With the projected improvement in managerial and operational capability developed by the time the project has been constructed and becomes operational, the project is financially feasible. The project is feasible from both an accounting (Income Statement) and a cash flow point of view. However, the development of enhanced management and operational capabilities is essential.

Most of the financial data and analysis used have been taken from the Consultant's Feasibility Study (Tables 12.8 and 12.9), and modified to fit current circumstances and additional information developed since the study was completed. The consultants did a careful study of the Gedaref financial operating situation and though they were unable to develop some data, their Study probably has more complete data, and a more thorough analysis of the situation, than exists anywhere else.

Of the three documents normally used in the financial feasibility analysis, only two are available in this case. The balance sheet is missing. It portrays assets and liabilities at any selected point in time, and is normally prepared once a year at the same time as the Income and Expense Statement. While the consultant was able to prepare an estimate of the assets represented by current utility plant in service, it was impossible for them to determine other forms of assets and liabilities that are essential in preparing a balance sheet, such as accounts receiveable and accounts payable. Normally, one is particularly interested in a utility balance sheet to determine two things: 1) The extent money is owed the utility, and 2) The degree of the utility's debts.

To the extent that considerable funds are owed the utility, especially by customers, it indicates the utility has been less than efficient in collection, and that steps will have to be taken to strengthen the process. Secondly, the amount of money owed the utility can sometimes be used as a critical bridge, if it can be collected to some degree in a short period of time, to cover cash short-falls very early in the project period. However, Gedaref does not show a critical need for a cash bridge from the information developed. So, if and when overdue accounts receiveable are collected, they will form more of a pleasant cushion than a critical necessity.

On the debt side, the analyst is generally concerned that a utility may be sitting on externally owed debt, and especially short-term debt. This would lay first claim on any additional revenues generated by project and/or institutional improvements. In such a situation, the project could be an outstanding economic success, and a financial disaster. Such is not the case in Gedaref, which appears to have no external debt, and which has apparently had all capital improvements financed over time by monies in the form of grants to the utility, or its parent body. Operating expenses appear to be met, and the utility appears to have been operating on the basis of buy what you can with what you have, rather than buy now and hope you can pay later.

Therefore, it has been concluded that the lack of a Balance Sheet does not raise questions, or present problems, that are significant in the determination of the financial feasibility of the Project.

1. The Income and Expense Statement.

Table D3-2 presents a condensed and modified version of the Income and Expense Statement prepared by the consultants, and set forth in the Feasibility Study in Table 12.8. The first item to note is that Gedaref only becomes profitable after depreciation in the fiscal year 1985-86, when new facilities are in place and the new rates have been implemented.

Depreciation is the accounting method for taking into account the economic obsolesence (wearing out) of capital assets. Regardless of how well facilities are maintained, eventually they will be retired and replaced. Therefore, the transaction is shown on the Income and Expense Statement. Even though a paper transaction it is an accounting test of whether or not the utility is generating revenue so that with prudent management and the building of reserves, financial resources will be available for major overhaul and at least partial replacement of facilities, when the time comes. Beginning in fiscal year 1985-86, Gedaref water utility does begin to generate sufficient income to cover depreciation, and to begin the accumulation of some surplus as well.

2. Revenues and Rates

The Feasibility Study included a revenue projection resulting in a 6% return on utility plant and equipment investment. This requirement has been eliminated as not appropriate for a publically owned, grant funded, utility in the Sudan. While an argument can be made for such a requirement in an investor owned utility, or for a utility which must finance its capital expenditures with external debt, such is not the case with the Gedaref water utility. At the time of the Feasibility Report, it was not clear whether project funds could come in the form of a grant, and provision was made to cover possible debt repayment-both principal and interest.

Since neither GOS or AID is interested in seeing the utility reap unneeded profits at the expense of the consumers, this assumption has been eliminated.

However, it is believed that when the time arrives that Gedaref can shoulder the burden of the site location supplement; it should do so. Those costs have been added to the operating expense estimates, beginning July 1, 1986. With the proposed water rates the utility continues to generate a surplus in that year, and in years following through 1989-90.

Even with the inclusion of the site location supplement, the utility does begin to generate a level of surplus after depreciation which raises the question as to whether or not the proposed rate increase is too high- After considerable discussion, it has been concluded that the proposed rates should be retained in this analysis, and that a final decision on its implementation, or downward revision, should be made in early 1986, by competent authorities, in consultation with the technical advisors - who will be present at that time and will have had considerable on-site experience to guide their recommendations. The reasoning is as follows.

First, the rate structure as proposed is within the ability of even the poorest consumers to pay. They are not being asked to carry an intolerable burden, and in fact, many consumers will be paying far less for more water than they are today. The suggested water rate schedule proposed for adoption July 1, 1985, is shown on Table D3-3.

Second, the financial success of the project depends upon the accomplishment of certain institutional, management, and operational goals by the utility with the help of Technical Advisors. These goals may or may not be realized as rapidly and as completely as the Feasibility Study indicates. Factors that are included in the financial analysis and statement are:

a. Water production and sales will begin to increase in 1985-86.

b. Unaccounted for water will be reduced from approximately 32% currently, to 20% and less over just a few years.

c. A massive new metering program will be completed and operational at the same time as other construction is completed.

d. Billing will be made efficient and the collection rate will reach 97% within two years.

e. Operations and maintenance will improve to the point that water is available in the system 24 hours a day.

None of these goals is impossible, and all should be reached. However, experience in other developing nations suggests that when an opportunity exists to take out a small insurance policy against delay in any of those accomplishments, that policy should be adopted. The rate structure recommended by the consultants provides such a policy, and it should be retained until events show that in fact, it need not be fully implemented.

3. The Cash Flow Statement

The Cash Flow Statement serves as the focus for analysis on the actual ability of the utility to meet its obligations by paying its bills. Cash flows often differ markedly from income and expense statements, since they will include any principal repayments on debt falling due, and will also include any capital expenditures made by the utility on its own behalf.

In the case of Gedaref water utility the cash flow is quite similar to the Income and Expense Statement, since there is no external debt to service, and the projected capital expenditures by the utility tend to parallel depreciation as taken in the Income and Expense Statement.

The most important conclusion to be reached from examination of Table D3-4, is that annual cash flow becomes positive during the fiscal year 1985-86, and remains positive through most of the analysis period or until 1989-90, when the need for a new rate increase is indicated. Since the financing will be in the form of a grant, no debt service is required. Accumulated cash reserves are projected to become somewhat large towards the end of the analysis period, and this is a function again of the proposed rates. If events go very well, and the rates need not be fully implemented, cash generation will be correspondingly less.

TABLE D3-3

PROPOSED WATER RATE SCHEDULE
(Fiscal Year 1985-86)

1. Minimum Charges — LS 4.00 — 8 m^3

2. Quantity Rates (above minimum)

A. Class "A" Customers

Connections to single family residance, Commercial, Institutional/Government, Industrial:

1) From 9 m^3 thru 25 m^3 = LS 0.50/m^3
2) From 26 m^3 thru 100 m^3 = LS 0.70/m^3
3) Over 100 m^3 = LS 0.90/m^3

B. Class "B" Customers

Residential connections to family housing compounds:

1) From 9 m^3 thru 35 m^3 = LS 0.50/m^3
2) Over 35 m^3 = LS 0.70/m^3

C. Class "C" Customers

Metered public standpipes serving residential areas.

1) All water at LS 0.50/m^3 or proportional fraction thereof for small containers. (Example-LS 0.010 per 4 gal tin).

Based on the estimated consumption of 35 lpcd, the cost per family (5.2 persons) is less than LS 5.50 per month.

TABLE D3-1: AID FINANCED PROJECT COST SUMMARY

I.	CAPITAL IMPROVEMENTS	$ 3,664,320	LS	1,126,950
II.	PROJECTED COST ESCALATION(2)	549,648		425,987
			LS	1,552,937
III.	OTHER IMPROVEMENTS PROGRAM COSTS:			
	A. FEASIBILITY STUDIES & RELATED	137,000		
	B. DESIGN, TENDER & TEST WELL	791,000		
	C. CONSTRUCTION SUPERVISION	256,600		
IV.	TECHNICAL ASSISTANCE	901,000		
V.	CONVERSION OF LOCAL COST AT LS 1.3 = $	1,194,567		
	PROJECTED TOTAL	$7,494,135		
	ROUNDED TO:	$7,500,000		

(1) Does not include $624,250 of improvements already constructed under the auspices of UNHCR.

(2) Escalation based on 8%/yr. for dollars and 15%/yr. for LS, allocated according to the staging of project construction, and based on analysis of recent U.S. and Sudanese experience, plus economic forecasts for future years.

TABLE D3-2

PROJECTED FINANCIAL STATEMENT FOR THE GEDAREF WATER UTILITY
(FISCAL YEARS 1983-90), LS

	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90
Population	217,000	232,800	248,600	264,400	278,000	293,800	309,680
Meters Installed	6,500	6,850	8,900	10,400	12,500	13,900	14,500
Water Production 1,000 m^3	3,100	3,300	5,500	5,900	6,100	6,500	6,500
Water Sales 1,000 m^3	2,200	2,950	4,400	4,800	5,100	5,400	5,650
Revenues							
Water Sales	595,000	798,000	2,870,000(1)	3,000,000	3,270,000	3,460,000	3,620,000
Others	-	-	50,000	100,000	100,000	100,000	100,000
Total Revenues	595,000	798,000	2,870,000	3,100,000	3,370,000	3,560,000	3,720,000
Expenses							
Source, Treatment & Pumping	504,100(2)	843,500	1,003,200	1,319,100(3)	1,525,900	1,752,600	2,009,400
Distribution	153,300	183,900	211,600	422,000	464,200	511,000	563,200
Commercial	52,600	73,600	106,800	247,800	279,800	338,600	408,000
Administrative & General	41,900	50,400	62,200	146,600	161,200	177,800	195,200
Total Operating Expense	751,900	1,151,400	1,383,800	2,135,500	2,431,100	2,780,000	3,175,600
Net Operating Income	(156,900)	(353,400)	1,486,200	964,500	938,900	780,000	544,400
Depreciation	120,000	120,000	416,100	416,100	420,000	423,000	426,000
Net Income (Loss)	(276,900)	(473,400)	1,070,100	548,400	518,900	357,000	118,400

NOTES:

(1) Reflects proposed rate increase effective July 1, 1985, and 3% uncollectable factor.

(2) Assigns annual escalation according to Consultant's Schedule, Table 12.8, Feasibility Study.

(3) Modified to reflect the assumption of the cost of the Site Location Supplement by the Water Utility in July 1, 1986.

TABLE D3-4. SIMPLIFIED CASH FLOW PROJECTIONS GEDAREF WATER UTILITY
(Fiscal Years 1983-90) LS

Beginning Balance	11,700[1]	(205,300)	(628,300)	407,700	822,200	1,186,000	1,366,000
Add Receipts	595,000	798,000	2,87[illegible],000	5,100,000	3,370,000	3,560,000	3,720,000
Funds Available	606,700	593,700	2,241,700	5,507,700	4,192,200	4,746,000	5,086,000
Expenditures							
Operating Expenses	752,000	1,151,000	[illegible]	2,155,500	2,431,[illegible]	2,73[illegible]	3,175,600
Internally Funded Improvements	60,000	70,000	[illegible]	330,000	[illegible]	[illegible]	60,000
Total Expenditures	812,000	1,221,000	[illegible]	2,485,[illegible]	[illegible]	[illegible]	3,235,[illegible]
Ending Balance	(205,300)	(628,300)	[illegible]	822,200	[illegible]	[illegible]	[illegible],250,400
Year's Cash Generated	(217,000)	(423,000)	[illegible]	414,5[illegible]	365,[illegible]	[illegible]	(115,600)

(1) From Feasibility Report

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ECONOMIC ANALYSIS

Rigorous economic analysis of the Gedaref water supply project produces very favorable results, even when strict limits are placed on benefits to be included. At a capital cost of $7.5 million and a 10% discount rate, the benefit-cost ratio is a favorable 1.90 to one, and at a discount rate of 15%, the ratio is still a favorable 1.69 to one. This is based on a ten year period which tends to understate actual benefits versus costs. An Internal Rate of Return was not calculated, but it is clearly well in excess of 15%. (See Table D4-1 for b-c ratio at higher capital cost.)

Economic analysis assigns benefits and costs to items which may not show up on the books of the utility (such as consumer surplus from water consumed, or loss of income to those displaced by a project.) It also deals with benefits and costs which cannot necessarily be quantified, but which are real, such as public health benefits from water supply. In general, water supply projects lend themselves to fairly rigorous analysis, since a relatively large portion of both the benefits and the costs can be quantified, though the benefits which are quantified often tend to be understated. In practically all cases, a water supply project with a favorable, quantified, benefit-cost ratio is economically very feasible, since non-quantifiable benefits are almost always concluded to be in excess of the non-quantifiable costs.

In performing the economic feasibility analysis, only the incremental benefits and costs associated with project implementation are included. This differs from the financial, where tool costs and revenues are analyzed. The project is made to stand solely on its own merits. Thus only the costs created by project implementation are included, and only the incremental benefits created by the project are used.

The time period for analysis selected has a direct effect upon the economic feasibility of the project. In general, with water supply projects, the shorter the time period selected, the greater the bias against economic feasibility, at least within the first thirty years and at a reasonable rate of discount. This is due to the fact that the vast majority of the economic costs, which are the capital expenditures, tend to occur in the first few years of the project, and are, therefore, discounted relatively little. Benefits from the project generally do not begin to flow in full measure until after the project has been completed, but continue to flow for many years to come. The economic analysis of the Gedaref project is treated conservatively, in that only a ten year analysis period is employed. Yet in the 11th year of the project, the net of benefits less costs is approximately LS 5,671,000 and if that net benefit is projected out to a 30th year, it still produces a positive discounted benefit of about

LS 85,600 at a 15% discount rate. However, there was no need to strain the analysis, and ten years was picked as being a reasonable period during which costs and benefits from the project can be identified with confidence.

The discount rate used in benefit-cost analysis is an estimate of the value of money over time to the sponsors of the project. The discount rate is then adjusted using experience and common sense to fit the particular attributes of the project (source and type of funding, for example). In the case of Gedaref two discount rates were employed, in order to test the Project for sensitivity. They were 10% and 15%. Both produced favorable results. 15% is probably at the upper end of discount rates used in the economic analysis of water supply projects, and is quite conservative.

No attempt is made to attach a hard economic value to benefits and costs which do not lend themselves to fairly strict quantification. They are analyzed and discussed outside the framework of the numerical benefit-cost ratio calculation.

There were two sets of costs included in the calculation: Project expenditures, and the incremental operating and maintenance costs of the Gedaref utility which are attributable to the addition of the Project facilities to the Gedaref utility. Project expenditures include all costs of the Project, including feasibility study, design, technical assistance, etc., and total $7.5 million. They were allocated to the analysis time period according to the best estimate of when they would be incurred (not obligated). Incremental operating and maintenance costs associated with the project were derived from the consultants' Feasibility Study, Table 12.8, plus the addition of the Site Location Supplement for the entire time period.

No shadow price was attached to the capital costs and no opportunity cost of capital was assigned. All dollar costs were converted to Sudanese pounds at an exchange rate of $1 = LS 1.90.

To understand the quantification of the benefits used in the analysis, it is necessary to give a short explanation of consumer surplus. When an individual pays a certain price for an item, we know it has at least that value to him, or he would not have bought it. We also suspect that in most cases that item actually has a higher value to the consumer than the price he paid. To the extent that consumers actually value a commodity such as water higher than the actual price they pay for it, they are said to gain consumer surplus. In the real world this is not possible to measure, and consumer surplus is often included in an economic analysis as a non-quantifiable benefit.

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However, in the case of the Gedaref Water Supply Project, there is an almost unique opportunity to measure one element of consumer surplus, and to assign a hard monetary value to it. That is the first 3.6 m^3 received by each of the estimated 70,000 people who are expected to be newly served by the expanded system. At the present time, these people purchase water from water vendors for prices ranging from LS 11.00 per m^3 when water is relatively abundant, to a high of LS 27.000 per m^3 during the dry months or during system breakdowns. The Feasibility Study estimated that these people were using an average of 10 lcpd, which totals 3.6 m^3 per year per person, and the best estimate available is that over the year the conservative average price they pay for vendor water is LS 19.000 per m^3. The price appears to put the consumers right on the margin as far as purchase is concerned, and it is fair to estimate that there is no consumer surplus left which is related to this consumption.

When the additional 70,000 people begin to receive water from the system, their monetary savings on their current consumption alone will total LS 4,662,000 on an annual basis. This figure has been calculated as a benefit, and included in the analysis.

Another benefit that can be measured is the minimum value placed on the incremental water produced and sold because of the project. The incremental amount of water sold because of the project has been estimated by the consultants as 750,000 m^3 beginning in FY 1984-85, rising to 3,600,000 m^3 in FY 1990-91. Feasibility Study, Table 12.8. For purposes of economic analysis, the benefit was equated to the lowest rate per m^3 to be charged by the utility (LS .50/m^3), and any consumer surplus was left in the non-quantifiable benefit category.

Therefore, the numbers used for benefits in the economic benefit-cost analysis are hard ones. They represent money which consumers are currently paying for water, or will pay in the future. We were simply fortunate in this case to be able to quantify the consumer surplus, where normally it cannot be done to any degree of accuracy.

Table D4-2 sets forth the incremental costs attributable to the Project and the incremental benefits in the upper two columns. The last set of columns represent the discounted present values (a cost or benefit back to the present from the time it occurs, using the discount rate). The sum of the discounted present benefits is divided by the sum of the discounted present costs, and the benefit-cost ratio is determined.

On the basis of the benefit-cost analysis, using the quantifiable, incremental benefits and costs, the project is clearly economically feasible.

Collective Economic Growth. There is little doubt that an abundant and safe water supply acts as a magnet for increased economic activity, especially in an environmental setting such as is found in the Gedaref area. There are obviously other factors involved, and, therefore, no attempt has been made to estimate the impact of improved water supply. However, Gedaref will almost certainly grow economically more rapidly than it would with inadequate water.

Improved Property Values. While improved water supply acts to fuel general economic growth, it also has a specific benefit for those whose properties are supplied with point source water for the first time. A landlord with a compound served by a standpipe can certainly command higher rents than one without, and since it is estimated that approximately 4,200 new services will ultimately be installed, the increase in property values should be substantial.

Consumer Surplus. Finally, a considerable consumer surplus will be created by the increased water supply. In the numerical analysis, the incremental water produced and sold was valued only at the minimum rate of the utility. There is no way of knowing what value the consumer will actually place on that water, since it is not subject to observation as it is in the case of water sold by the vendors. However, it is logical to suppose that the value of water to the consumer does not instantly decline from LS 19.00 per m^3 for the first 3.6 m^3 consumed per year, to LS .50 for the next m^3. To a degree that consumers value the incremental water at any price over LS .50 per m^3, consumer surplus is generated.

TABLE D4-1

BENEFIT-COST RATIOS USING ALTERNATIVE

PROJECT COSTS

CAPITAL COSTS OF $8,500,000

1. With a capital cost of $8,500,000, a ten year time period, an exchange rate of LS 1.9 per $, and a discount rate of 10%, the benefit-cost ratio of the project becomes 1.72 to one.

2. With a capital cost of $8,500,000, a ten year time period, an exchange rate of LS 1.9 per $, and a discount rate of 15%, the benefit-cost ratio of the project becomes 1.53 to one.

CAPITAL COSTS OF $9,000,000

1. With a capital cost of $9,000,000, a ten year time period, an exchange rate of LS 1.9 to $, and a discount rate of 10%, the benefit-cost ratio becomes 1.64 to one.

2. With a capital cost of $9,000,000, a ten year time period, an exchange rate of LS 1.9 to $, and a discount rate of 15%, the benefit-cost ratio becomes 1.46 to one.

TABLE D4-2 DISCOUNTED PRESENT VALUE OF INCREMENTAL COSTS AND BENEFITS. LS = 1.90, in LS.

	Capital Costs	Incremental O&M	Site Location Supplement	Total Costs
1982-83	260,300	-	-	260,300
1983-84	2,709,400	-	177,550	2,886,950
1984-85	10,412,000	124,700	436,000	10,972,700
1985-86	855,000	249,120	369,665	1,473,785
1986-87	-	56,690	489,500	546,190
1987-88	-	123,720	465,900	589,690
1988-89	-	78,510	612,100	690,610
1989-90	-	90,100	690,900	781,000
1990-91	-	99,900	690,900	790,800
1991-92	-	99,900	690,900	790,800

INCREMENTAL BENEFITS, LS

1982-83	00
1983-84	00
1984-85	5,037,000
1985-86	5,762,000
1986-87	6,012,000
1987-88	6,162,000
1988-89	6,312,000
1989-90	6,462,000
1990-91	6,462,000
1991-92	6,462,000

TABLE D4-2 Cont.

DISCOUNTED COSTS AND BENEFITS

1982-83	236,636	266,348	-	-
1983-84	2,385,909	2,182,949	-	-
1984-85	8,243,952	7,214,728	3,784,373	3,311,909
1985-86	1,006,615	846,641	3,935,524	3,294,442
1986-87	339,141	271,553	3,732,979	2,989,027
1987-88	332,865	254,939	3,478,288	2,664,003
1988-89	354,392	259,626	3,239,054	2,372,915
1989-90	364,342	255,310	3,014,571	2,112,439
1990-91	335,376	224,795	2,740,519	1,836,904
1991-92	304,888	195,474	2,491,381	1,597,308
	13,904,116	11,932,363	26,416,689	20,178,947

Benefit/Cost Ratio at 10% = 1.90

Benefit/Cost Ratio at 15% = 1.69

Exchange Rate - $1 = LS 1.90

Social Soundness Analysis

1. Background and Setting

The population served by the Gedaref municipal water system does not receive a reliable, adequate supply of potable water. Roughly 200,000 people do not have enough water to drink wash with or support normal living requirements. About 100,000 are purchasing an inadequate quantity of water at a very high price from water vendors. The total population of the service area of approximately 240,000 will be the beneficiaries of the project.

There are several factors which interact to produce this problem: unexpected population increase over the past decade, including the influx of 30,000 to 40,000 Ethiopian refugees, has pushed the system beyond its limits. At the same time, maintenance and repair of major systems components have not been sustained, leading to operational failures. Owing to drought and late rains in the Ethiopian watershed, the water level in the Atbara River, the sole supplier of the system's water, sometimes falls below required levels. Rate collection and maintenance of water meters have not been attended to, with the result that revenues needed to repair and maintain the system are inadequate. Of these factors, the demographic one is well outside the project's control and requires greater examination.

Designed in the late 1960's, the present system did not foresee the precipitous population expansion witnessed during the 1970's in the Gedaref area. Three factors are responsible for this increase and must be examined closely for their implications for the present project.

a. Expansion of Commercial Agriculture: During the 1970's mechanized agriculture was introduced to the Gedaref region. Millions of feddans (feddan = one acre) went under the plow. Today, the region is one of Sudan's major producers of dura (sorghum) which is both a dietary staple and a major export commodity. Gedaref was chosen as a site in the mid seventies for the construction of the largest grain elevator in the east

because of its location on the Khartoum-Port Sudan railroad. When the Khartoum-Port Sudan all-weather highway was completed in 1980, Gedaref's role as a transport hub was expanded. Thus Gedaref became during the late 1070's a major agricultural service center with transport, marketing and related light industries blooming.

b. Migrant Labor: The mechanized agricultural schemes around Gedaref require tens of thousands of seasonal laborers to weed and pick crops. Because of the urban amenities, including nonagricultural jobs, which Gedaref offers, many thousands of seasonal laborers and their families have settled in and around the town on a more or less permanent basis. Some of these laborers hold small numbers of livestock (camels, cattle, sheep or goats) either near their houses or along the Rahad or Atbara Rivers. Consequently, not only the human but also the animal population of the town and its environs has increased.

c. Ethiopian refugees: Traditionally, Gedaref has been a trading center for transfrontier commerce. Ethiopians and Sudanese come and go across the border and Gedaref has historically held a number of Ethiopian families. With the advent of commercial mechanized agriculture in the Gezira in the 1930s, Rahad in 1960s and Gedaref region in the 1970s, thousands of Ethiopians annually pass through Gedaref in search of seasonal labor. However, the upturn in civil strife in the region of Ethiopia adjacent to the Sudanese frontier during the 1970s has brought tens of thousands of refugees into the Gedaref area. Many simply cross and settle spontaneously in Gedaref. In 1978, partially to move the squatters out of Gedaref, the UNHCR and Sudanese Commissioner of Refugees (COR) agreed to build a refugee settlement at Tawawa, seven kilometers from Gedaref. It was planned that Tawawa residents would find jobs in twon or on the commercial schemes nearby. In 1982 and '83 several thousand drought victims arrived in Gedaref and placed an additional strain on the already overtaxed water system. Today, there are approximately 40,000 Ethiopian refugees and drought victims in the area served by the municipal water system with the rate of increase (during August '83) around 1,000 monthly.

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2. Feasibility of Project's Approach to the Problem

The bulk of the project's approach to increasing the supply of potable water to the service area is highly technical and based on construction: there is no reason, from a sociocultural point of view, to question the feasibility of drilling wells, improving pumping, etc. However, the use of water meters to provide financial incentives for conservation while raising revenues poses an interesting issue. There is no question that technicians can be taught to install and service meters. Whether customers can be motivated to use water rationally by being charged is not a given. People who are accustomed to drawing water from a river, as many of the residents of Gedaref formerly did, may not take kindly to being told that they must pay for it. Indeed, collecting from the thousands of subsistence households, both Sudanese and refugee, may present a considerable problem.

Nevertheless, it is necessary to charge and collect - especially from the refugees. Unless revenues are secured, no maintenance and expansion will be possible. The Tawawa camp is a prosperous center which requires no further subsidies, direct or hidden. Since the political issues which produced most of the refugees seem a long way from settlement, it is prudent to plan for the continued presence of refugees for the foreseeable future. This means that every effort must be made to make the refugee communities self-reliant. Part of self-reliance is paying for municipal services.

3. Features of the Social Environment

a. Population expansion: One cardinal feature of Gedaref's social map is the continued presence, indeed the likely increase in numbers of Ethiopians in the area. There are thousands of poor people in Ethiopia, and many are affected by war or drought - or both. The presence of relief supplies and services in eastern Sudan is well known in Ethiopia and acts as a magnet. Since the announcement of national military conscription by the Ethiopian Government, thousands of young men have crossed into Sudan. While the influx of draft evaders may decline over the coming months as it becomes increasingly clear that Ethiopia lacks the wherewithal to institute national conscription, its presence on the books will probably deter many families and single males from returning to their homes. The refugee-drought victim population will continue to increase, perhaps throughout the present decade.

Politicians, agriculturalists and other observers of the eastern region are increasingly questioning the continued

expansion, even the sustainability, of mechanized agriculture in the Gedaref area. Some note that yields are already declining as the soil is depleted of its nutrient reserves. Others see the past two years' low yields as resulting from inadequate rains, and wonder if the bumper crops of the late 1970s, which coincided with good rains, were not caused by exceptional rainfalls which may happen only rarely each decade. Many observers believe that commercial agriculture has expanded just about as far as rains and soil conditions will permit; others believe that it has already gone too far and must contract. In any event, there are few who believe that the requirement for seasonal labor will increase in the future and some argue that it will decline. The implication for Gedaref water is that the current Sudanese population may very well be a ceiling.

Taken together, the demographic trends suggest a slow expansion of the overall population during the 1980s. This should allow municipal authors, once the present project is completed, to sustain and expand as needed the municipal water system.

b. Water conservation: The point has already been made that many of Gedaref's residents are straight from the bush- former traditional farmers or seminomadic pastoralists. Previously these people practiced a severe system of water conservation: since water was often not available at all, or gotten by trekking miles to get it, drinking, bathing, watering of stock and other uses were kept to a minimum. However, once these same water conservers settled in town and found a "continuous" flow of "free" water, some blithely forgot their previous practices, often to the extent of simply leaving the water run without constraint. The most extreme example of squandering water occurs when pastoralists shoot holes in municipal pipelines in order to water their flocks.

Now it should be emphasized that wanton destruction of pipelines is rarely encountered, and the vast majority of residents turn off their standpipes. But conserving water in an urban setting is not well understood by some - perhaps many - and instruction coupled with carefully devised incentives (i.e., rate structure and collection) will be required.

c. Public health: The concept of potable water is foreign to people who are accustomed to drawing water from rivers or open wells. The high rate of water-borne diseases is mute testimony to the need for a comprehensive public health educational effort. The improved water system will improve the health status of the beneficiaries if coupled with an educational program to instruct the public in preventing contamination.

d. Principal beneficiaries: Expanding the system to provide adequate potable water will principally benefit the low income families who buy water at extremely high rates from commercial vendors. Residents of Tawawa who buy their water from vendors who cart it from town, and are charged as much as 32 times the municipal rate, will be especially benefitted.

Presently, the Tawawa refugee settlement is disconnected from the Gedaref water system. Water is obtained either from vendors (an economically onerous, even unattainable, purchase for many) or from water points two kilometers from the settlement. Because of the distance of these points, many male members of households remain in the camp to carry water rather than going off in search of employment. When safe water is provided in Tawawa, the available labor pool is expected to increase; with labor in short supply on nearby agricultural schemes, provision of water will lead to higher incomes for many refugee families.

Increased availability of potable water, combined with health education to protect safe water, will reduce the incidence of water borne diseases, thereby increasing both the numbers and productivity of the labor force served by the municipal water system. This will especially benefit many low income national and refugee families whose earnings are now curtailed due to chronic illness.

Non-agricultural employment opportunities will be increased when the water system is improved because the present inadequate system discourages the development or expansion of agricultural service industries and related enterprises. A reliable system of water thus will lead to conditions favorable to new off-farm income generating opportunities. This in turn will boost the growth of the region's private sector.

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