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ACTION MEMORANDUM FOR THE Acting Deputy ADMINISTRATOR

THRU : ES

THRU : AA/PPC, Alexander Shakow

FROM : AA/AFR. Goler T. Butcher

SUBJECT: Somalia Comprehensive Groundwater Development Project (649-0104)

I. Problem: Your approval is required to execute a grant of $1,000,000 from FAA Section 104(c) funds (Population and Health) to the Government of Somalia (GSDR) for the Comprehensive Groundwater Project and to authorize a life of project funding of $13,000,000 from both FAA Section 104(c) funds and FAA Section 103 funds.

II. Discussion:

A. Project Description: The goal of the project is to strengthen the capability of the Water Development Agency of the Government of Somalia to design and implement a national water resource development program. The project will assist in the collection of adequate national hydrogeologic, economic and social data and will provide technical assistance and commodities for a production drilling program. Data collected under the project will enable the National Water Committee (NWC) to establish criteria and set priorities for a rational approach to national water resource development.

The Water Development Agency (WDA) of the Ministry of Minerals and Water Resources (MMWR) will be responsible for drilling approximately one hundred and fifty wells for domestic and livestock use under the production drilling component of the project.

This project is closely linked to two other AID projects -- Central Rangelands Development, approved by the A/AID on August 14, 1979, and the Bay Region Project scheduled for early FY 80 approval. The Groundwater Project will install the wells needed for these projects in addition to providing thirty five to fifty rural wells in the Central region of the country.

The Government of Somalia has expressed its commitment to the project by vesting the National Water Committee with the authority to make decisions concerning water resource development in Somalia.

To provide an integrated, rational approach to water resource development, the project contains the following components:

1. Initial data gathering studies

This component of the project is designed to define more precisely the availability of groundwater, both nationally and regionally, to ensure efficient use of the resource. Existing data will be analyzed and hydrogeologic maps will be prepared. Additional data will be collected and geophysical tests will be performed. An estimated forty exploratory wells will be drilled to provide information on location, yield and quality of the acquifers.

2. Institutional support for the WDA and the MMWR

Systems will be established for data collection and analysis, logistical supply, equipment management and improved financial management. AID will cooperate closely with the Federal Republic of Germany under their project with WDA to strengthen the logistical supply capability and the equipment and financial management of the institutions. Training will be provided through a combination of on-the-job training, intensive technical seminars and limited participant training.

3. Exploitation Program

This phase of the project will concentrate on implementing the decisions of the NWC based on the initial data collected on the location, yield and quality of the acquifers. It is estimated that the program will provide the required 32 livestock wells for the Central Rangelands Project; 10 livestock wells for the Northern Rangelands Project; 24 livestock wells and 36 rural wells for the Bay Region Development Project; and 35-50 additional rural wells resulting in approximately 200,000 people having access to more and better quality water. In certain areas of the country where well drilling is not feasible, dug wells or surface water development will be undertaken.

4. Ongoing data collection

To further refine the hydrogeologic data base, the drilling teams will be given the capability and the responsibility to collect geophysical data from the wells they drill. Water samples will be continuously collected and sent for analysis at regional and central water quality labs.

B. Financial Summary

	(in thousands)	
	1st Project Year	Life of Project
Capital	100	506
Technical Assistance	650	5,421
Training	100	607
Commodities	150	3,999
Other	-	2,467
Total	$1,000	$13,000

The GSDR will contribute $4,965,000 (approximately 26% of total project costs) to the project to help finance the costs of salaries, operating expenses and local costs.

Of the total amount to be authorized for the project, $6.6 million will be allotted from the functional account for Population and Health (FAA Section 104(c) and $6.4 million will be allotted from the functional account for Agriculture, Rural Development and Nutrition (FAA Section 103).

C. Socio-Economic, Technical and Environmental Description:

1. Social Soundness: The project has been judged to be socially sound. It is designed to have a positive impact on the nomadic population by increasing the availability of potable water in areas of most urgent need. Women will directly benefit from the project due to the reduced time and labor that will be needed to fetch and carry water. As major beneficiaries, women will be encouraged to participate in discussions with the representatives of the regional Water Development Agency to determine the location of wells.

2. Economic Feasibility: Cost effectiveness is the best indicator of the economic feasibility of the project. If the Comprehensive Groundwater Project were not undertaken, water resource development would be the responsibility of individual water development units in each of the AID financed projects. Over $1.5 million is saved by providing the 102 wells required under the Bay Region and Central Rangelands Project through this project. Increased livestock production will also result from the range management programs based on groundwater use as a critical mechanism for controlling and optimizing range utilization. There are significant non quantifiable benefits including improved health from a reduction in water borne diseases, protection against drought related livestock losses, a reduction in time and effort spent fetching water, and the improved delivery of social services resulting from the aggregation of people within a ten mile radius of the water points.

3. Technical Analysis: The REDSO/EA engineer has advised that the project is technically sound and the requirements of 611(a) and 611(b) have been met.

4. Environmental Analysis: The environmental profile of Somalia, undertaken during October, November and December 1978, identified environmental issues in water resource development. The Project Review Meeting held on July 31, 1979 confirmed the positive determination of the Initial Environmental Examination that an Environmental Assessment (EA) was necessary. In accordance with the requirements of AID Regulation 16, copies of the PID and the IEE were circulated to interested government

agencies on July 13, 1979 with a request for comments to be received within thirty days. No comments have been received. An Environmental Assessment was prepared and considered in the final design stage of the project.

D. Implementation: The Project Paper proposes to use host country contracting procedures as the appropriate mode for contracting U.S. technical assistance. The primary GSDR agency responsible for implementing all aspects of the project will be the Water Development Agency. The WDA has demonstrated a capability to undertake host country contracting by managing numerous contracts with both local and foreign suppliers. Successful implementation of the project will also depend on the activities of the National Water Committee, supported by the information and technical assistance provided under the project.

E. Committee Action and Congressional Apprisement: The Africa Bureau Executive Committee for Project Review (ECPR) met on August 9, 1979 and was chaired by the Deputy Assistant Administrator for Africa. The ECPR recommended that the project proceed to authorization.

This project was not included in the annual Congressional Presentation for FY 1979, thus, an Advice to Congress of $1,000,000 in FY 1979 was forwarded on August 31, 1979. The fifteen day waiting period notifying for intended obligation will expire on September 15, 1979. The Project Paper recommends, and the authorization contains, a proprietary procurement waiver to permit purchase of light passenger motor vehicles from a single U.S. manufacturer for standardization purposes. Your authority to approve such a waiver is set forth in AID Handbook 15, Chapter 3.

This project has received Human Rights clearance.

III. Recommendation: That you sign the attached PAF II, thereby authorizing the proposed project, and approving the requested waiver.

Attachments: A - PAF II
B - Environmental Assessment
C - Project Paper

Clearances:

AFR/DR/EAP, MMcDaniel _____
AFR/DR, JWKoehring _____
AFR/DR, NCohen _____
AFR/EA, RHynes _____
AFR/DR/ENG, MJMorgan _____
AFR/DR/SDP, EBoyd _____
AFR/DR/ARD, WJohnson _____
AFR/DR/ARD, DGates _____
GC/AFR, EDragon _____
GC, MBall _____
PPC/PDPR, MZak _____
PPC/PDPR, BSidman _____
DAA/AFR, WHNorth _____
D/AA, RHNooter _____

AFR/DR/EAP:MFoster:hph:9/5/79:x28286

PROJECT AUTHORIZATION AND REQUEST FOR ALLOTMENT OF FUNDS

PART II

COUNTRY: Somalia

PROJECT: Comprehensive Groundwater Development

PROJECT NO.: 649-0104

Pursuant to Part I, Chapter 1, Sections 103 and 104(c) of the Foreign Assistance Act of 1961, (the "Act"), as amended, I hereby authorize a grant to the Somali Democratic Republic (the "Cooperating Country") of not to exceed One Million United States Dollars ($1,000,000), to assist in financing certain foreign exchange and local currency costs of goods and services required for the Project as described in the following paragraph.

The Project will consist of four components designed to assist the Cooperating Country to strengthen and support a national comprehensive water development program. These components are: (1) Hydrogeologic data collection - to define the availability of groundwater on both a national and regional level to permit efficient utilization of the resource; (2) Institutional support for the Somali Water Development Agency and the hydrological section of the Ministry of Minerals and Water Resources - to provide these agencies with a capacity for implementing a national water program; (3) The Exploitation Program - to provide for drilling wells, dug wells and surface water development; and (4) On-going data generation program - to provide for continuing hydrogeologic and socio-economic data collection, analyses of data, updating of maps and information. To carry out the objectives of the Project, A.I.D. will provide financing for technical assistance, commodities, participant training, and construction and other services (the "Project").

I approve the total level of A.I.D. appropriated funding planned for the Project of not to exceed Thirteen Million United States Dollars ($13,000,000), grant, including the funding authorized above, during the period FY 1979 through FY 1983, subject to the availability of funds and

in accordance with A.I.D. allotment procedures. Of the total amount authorized for the Project, $6,400,000 will be allotted from the functional account for Agriculture, Rural Development, and Nutrition (FAA Section 103), and $6,600,000 will be alloted from the functional account for Population and Health (FAA Section 104(c)).

I hereby authorize the initiation of negotiations and execution of the Project Agreement by the officer to whom such authority has been delegated in accordance with A.I.D. Regulations and Delegations of Authority, subject to the following essential terms, covenants and conditions, together with such other terms and conditions as A.I.D. may deem appropriate.

a. Source, Origin and Nationality of Goods and Services.

Goods and services, except for ocean shipping, financed by A.I.D. under the Project, shall have their source, origin and nationality in the Cooperating Country, the United States or in the countries included in A.I.D. Geographic Code 941, except as A.I.D. may otherwise agree in writing. Ocean shipping financed under the Project shall be procured in the United States or the Cooperating Country.

b. Condition Precedent to Initial Disbursement.

Prior to any disbursement, or the issuance of any commitment documents under the Project Agreement, the Cooperating Country, except as A.I.D. may otherwise agree in writing, will furnish in form and substance satisfactory to A.I.D., two copies of 1:100,000 topographic and vegetation maps for the Project priority and peripheral areas.

c. Additional Disbursement.

Prior to any disbursement, or the issuance of any commitment documents under the Project Agreement to finance the Exploitation component of the Project, the Cooperating Country, except as A.I.D. may otherwise agree in writing, will furnish in form and substance satisfactory to A.I.D., evidence that the existing water user associations possess the capability to manage the wells established under the Project for livestock and domestic use.

d. Covenants.

The Project Agreement will contain covenants providing, in substance, as follows:

1. The Water Development Agency will establish technical socio-economic and environmental criteria to serve as guidelines for the National Water Committee.

2. The Water Development Agency will review their fee collection procedures and schedules with a view toward maximizing efficiency.

3. The Water Development Agency and the Ministry of Minerals and Water Resources will provide, on a timely basis, qualified counterpart staff for the technical assistance staff.

4. The Cooperating Country will provide, or cause to be provided, on a timely basis, all financial, logistical, personnel and other resources required for the effective implementation of the Project.

5. The Cooperating Country will covenant that it will identify and select qualified candidates for participant training on a timely basis. The Cooperating Country will ensure that persons who receive long-term training financed under the Project, will, upon successful completion of such training, be employed by the Ministry of Minerals and Water Resources and the Water Development Agency in positions related to this Project for which they have received training, unless otherwise mutually agreed by both parties.

e. Waiver.

The following waiver to A.I.D. regulations is hereby approved:

For the reasons set forth in Annex 14, pages 8 and 9, of the Project Paper, and for purposes of standardization in accordance with A.I.D. Handbook 15, Chapter 3, formal procurement procedures are hereby

waived to permit the procurement of utility vehicles and passenger vehicles of United States manufacture from the supplier of vehicles for which a standardization plan is approved by the Office of Commodity Management.

Date: 4/21/74

Alexander Shakow
Acting Deputy Administrator

Environmental Assessment

Somalia - Comprehensive Groundwater Development Project
649-0104

The attached Somalia Environmental Profile (Profile) should be considered the Environmental Assessment (EA) for the Comphrensive Groundwater Development Project. The Profile was prepared in December 1978 as an EA for several AID financed Somalia projects, including Agriculture Delivery Systems, and Central Rangelands Development, approved, for FY 79, and Bay Region Development planned for FY 80, and the Comprehensive Grouhdwater Development Project planned for FY 79 authorization.

Only the Groundwater Project, however, received a positive environmental determination and recommendation for an environmental assessment.

This annex to the Environmental Assessment provides a brief description of the Groundwater Project and its relationship to the AID program in Somalia, outlines the environmental implications of the project, and discusses the alternatives considered during design of the Project.

I. Description of the Project

This Comprehensive Groundwater Development Project is designed to assist the Water Development Agency (WDA) of the Ministry of Minerals and Water Resources (MMWR) of the Government of Somalia in establishing and implementing a national water resource development program. The project will assist in the collection of adequate national hydrogeologic, economic and social data and will provide technical assistance and commodities for a production drilling program. Data collected under the project will enable the National Water Committee (NWC) to establish criteria and set priorities for a rational approach to national water resource development.

The Water Development Agency will be responsible for drilling approximately one hundred and fifty wells for domestic and livestock use, under the production drilling component of the project. The Groundwater Project is closely linked to two other AID projects in Somalia, Central Rangelands Development and Bay Region, and will install the wells needed for the successful implementation of these projects, in addition to providing thirty five to fifty rural wells in the Central region of the country.

To develop an integrated, rational approach to water resource development the project contains the following components.

--Initial data gathering studies

This phase of the project is designed to define more precisely the availability of groundwater, both nationally and regionally, to ensure efficient use of the resource. Existing data will be analyzed and hydrogeologic maps will be prepared. Additional data will be collected

and geophysical tests will be performed. An estimated forty exploratory wells will be drilled to provide information on location, yield and quality of the acquifers.

--Institutional support for the WDA and the MMWR

Systems will be established for data collection and analysis, logistical supply, equipment management and improved financial management. AID will cooperate closely with the Federal Republic of Germany under their project with WDA to strengthen the logistical supply capability and the equipment and financial management of the institutions. Training will be provided through a combination of on the job training, intensive technical seminars and limited participant training.

--Exploitation Program

This phase of the project will concentrate on implementing the decisions of the NWC based on the initial data collected on the location, yield and quality of the acquifers. It is estimated that the program will provide the required 32 livestock wells for the Central Rangelands Project, 10 livestock wells for the Northern Rangelands Project; 24 livestock wells and 36 rural wells for the Bay Region Development Project; and 35-50 additional rural wells resulting in some 200,000 people having access to more, better quality water. In certain areas of the country where well drilling is not feasible, dug wells or surface water development will be undertaken.

--Ongoing data collection

To further refine the hydrogeologic data base the drilling teams will be given the capability and the responsibility to collect geophysical data from the wells they drill. Water samples will be continuously collected and sent for analysis at regional and central water quality labs.

In addition to the technical data collection program, a program will be instituted to collect socio-economic data through the WDA pump operators regarding usage of the wells. This data will include items such as number of humans and livestock served, resident or nomadic (in transit), water charges collected, etc. These data will be analyzed by the water resource planner as part of the impact analysis and planning programs.

II. Impact of Project

The Comprehensive Groundwater Project will have an impact in the following key areas, human health, environment, economic development, agriculture, and social organization. For a discussion of the potential benefits and costs in these areas, see page 76-79 of the Profile.

--Health

The project is designed to optimize health benefits from the wells. First, pollution of acquifers will be minimized. Hydrogeological data collected and analyzed during the initial phase of the project, and on an ongoing basis, will provide information on location, yield quality of aquifers. Low quality aquifers will be sealed off. Secondly, the project utilizes two approaches to address the need for environmental health/sanitation education for the water users. In those regions where the AID Rural Health Delivery project is active (Bay, Mudug and Toghere), the health education activity will be provided by the village health workers trained under the project. In the remaining regions, WDA staff operating the wells will be trained by the Ministry of Health to provide environmental health education for the users of the wells.

--Environment

The Profile mentions the need for regulatory agencies to assure management of water resources and to minimize the potential adverse impact on the environment.

The National Range Agency (NRA) has been given responsibility as the environmental watchdog in rural areas. The new Range Law (No. 3, February 4, 1979) requires that they approve the installation of rural wells (both government and private) after investigating the environmental effects. The AID financed Central Rangelands project will support the NRA's department of Range and Environment with technical assistance and training to permit them to better exercise their regulatory authority as stated in the range laws. The NRA is one of the core members of the National Water Committee (NWC) and it is through the NWC that it has its influence.

The NWC, a Ministerial level committee, is chaired by the Minister of Minerals and Water Resources and includes representatives of the Water Development Agency, the Ministry of Finance, the Ministry of Local Government, the Ministry of Agriculture, the National Range Agency, the State Planning Commission plus any other Ministries and agencies requiring water development. The committee will meet regularly to plan the water development program. It will be their function to allocate the capabilities of the WDA to various activities including rural water supply, support of projects, urban water supply, etc.

Land Use and Agriculture

The primary environmental benefits of the water project relate to the use of wells to open previously undergrazed lands to optimum grazing and to the use of the well as a lever to encourage herder participation in range management programs.

Severe overgrazing sometimes occurs due to congregation of livestock around limited water sources in the dry season. Provision of wells

in presently underutilized areas will decrease the density of animals around existing waterpoints. Overgrazing in these new areas will be prevented by the range management program, which is linked to the establishment of wells in the rangelands area.

There is some concern that the water development program may encourage the spread of crop agriculture into more fragile ecological areas resulting in a "dust bowl" type of situation. The groundwater program is not designed to provide wells for irrigation and thus will not contibute to the spread of croping. The NRA responsibility for land use planning includes the authority to ban agriculture under such conditions.

--Social Organization

The greatest positive impact is a decrease in the amount of time spent in water gathering activities. It is estimated that in the nomadic societies over half of the women's time is spent in water gathering and transport. With the installation of wells this time saved can be channeled into other social and economic endeavors.

The water development program will also lead to increased geographic stability, although not sedentarization. This permits more permanent social relationships and enchances access to social services such as health, education, etc.

As with any program which causes social change; the disruption of social structures may lead to some stress. The project includes financing for social investigation to help define the likely magnitude of this problem. The Central Rangelands Project incorporates additional social investigations and non formal education to address this problem in the rangelands area.

Given the fact that water is a valuable resource there is a possibility for conflict over the location and control of wells. The activities of the NRA and the criteria established by the NWC should ensure rational siting of wells and thereby reduce the potential for conflict. For further discussion of the social organization and implications of the project see pp 82-86 of the Profile.

III. Alternatives to the proposed Project

The alternatives considered in preparation of the Groundwater project included variations in timing, variations in organizational structure and other technical approaches.

1. Timing

In terms of timing the primary alternative was to initiate the program with studies only with the production program to be defined after completion of all studies. This alternative would have the benefit of giving a more complete data base upon which to base the production program. However, two factors mitigated against selection

of this option. First, the staff and equipment required for this portion of the project would be approximately the same as for the entire project. Therefore, the incremental funds to include the production phase was minimal. Other donors, primarily UNDP, had undertaken such studies programs in the past with no follow up thus leading to resistance from the government to yet another studies project.

Secondly the success of other projects depend on the development of water resources. Delaying design of the production portion of the subject would delay the start up of drilling for nearly five years. The other projects would not be able to wait that long for water development and therefore would have gone forward on their own. The implications of fragmenting water resource development are discussed under organizational alternatives.

The other alternative which was proposed and rejected was to begin the drilling program immediately. This alternative was considered to represent minimal improvement over the presently inefficient program. Furthermore, the other projects will not be ready for their drilling programs for 2-3 years so the initiation of the drilling program is not critical. Time spent gathering technical, social, economic and environmental data and information will make the program much more effective in the long run.

2. Organization

Prior to AID's involvement in the water resource sector the approach taken by other donors was to create a water resource development capability in each of their projects thus fragmenting the sector. This was done because no one had funds available to provide truly comprehensive assistance to the MMWR and WDA to develop their overall capability in water resource development.

When AID became involved in developing a program in Somalia, the fragmentation of water development raised major issues. In terms of the environment, it eliminated the possibility of national regulation of the drilling program since each agency would be functioning independently. It also did not permit a national program of data collection and analysis which would fully define the hydrogeology of the country. Further, it eliminated national water resource planning. The Comprehensive Groundwater Project is a direct result of these concerns and is the mission's endeavor to address these issues.

3. Technical

The primary technical alternative which was considered was the increased utilization of surface water rather than emphasis on groundwater. This was investigated in detail during project design and a determination was made to rely on surface water only where groundwater was not available. The rationale for this was overwhelming. On the technical side there is the problem of low and

extremely variable rainfall which makes surface water more unreliable than groundwater. Also, the NRA anticipates utilizing water as part of a management scheme and it is more difficult to control the use of water from surface reservoirs. It was also shown that surface reservoirs when properly designed are more expensive than drilled wells.

Even more critical were the environmental problems associated with surface storage. In the gypsoferrous soils of Somalia the quality of surface water is often very poor. Surface storage areas provide good breeding areas for both the anopholes mosquito and the schistosomiasis carrying snail. Even well designed surface structures are subject to pollution due to the number of animals around the wells and in the water collection ditches. Past experience has shown that surface collection structures are subject to both sedimentation and erosion of the banks. Measures to alleviate these problems further increased the costs mentioned above.

Following these analyses a determination was made to focus primarily on groundwater in the project.

The second technical option explored dealt with the use of alternative energy sources instead of fossil fuels for pumping. Both wind and solar energy were explored. In terms of wind powered pumping both wind generators and traditional lift pumps were investigated. The first alternative was rejected due to the sophistication of the technology and the need for large battery banks with their associated costs. The second alternative had been introduced for use on shallow (30 meter) wells in some areas of the country. The problems experienced there in terms of operation, and maintenance raised some questions but it was felt that they could be addressed through a training program. Of greater concern was the depth of the static water level and thus the need to provide for a lift of over 100 meters. Although it is technically possible to lift from this depth using a windmill, the volume of water lifted is small. Since the wells in Somalia normally serve a large livestock population substantial quantities of water are required which cannot be supplied by a windmill.

Somalia has been undertaking some trials with solar pumping. Preliminary data indicates that it is effective but very expensive. Until solar cells become more efficient and price competitive, solar generation is not a viable alternative.

The approach which was ultimately selected was one of an electric submersible pump run by a diesel generator, If in the future alternative energy technology improves to the point where it is cost effective to utilize wind generation or solar generation of electricity, the diesel generators can be replaced with other types.

Clearances:
AFR/DR/EAP, M. McDaniel _____
AFR/DR/SDP, B. Boyd _____
AFR/DR/ENG, D. Davies _____

AFR/DR/EAP:MFoster:hph:9/12/79:x28286

2 X

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT PAPER FACESHEET

1. TRANSACTION CODE: A (A = ADD, C = CHANGE, D = DELETE)

PP

2. DOCUMENT CODE: 3

3. COUNTRY/ENTITY: SOMALIA

4. DOCUMENT REVISION NUMBER: 1

5. PROJECT NUMBER (7 digits): 649-0104

6. BUREAU/OFFICE: A. SYMBOL: AFR; B. CODE: 06

7. PROJECT TITLE (Maximum 40 characters): Comprehensive Groundwater Development.

8. ESTIMATED FY OF PROJECT COMPLETION: FY 86

9. ESTIMATED DATE OF OBLIGATION: A. INITIAL FY 79; B. QUARTER 4 (Enter 1, 2, 3, or 4); C. FINAL FY 83

10. ESTIMATED COSTS ($000 OR EQUIVALENT $1 –)

A. FUNDING SOURCE	FIRST FY B. FX	FIRST FY C. L/C	FIRST FY D. TOTAL	LIFE OF PROJECT E. FX	LIFE OF PROJECT F. L/C	LIFE OF PROJECT G. TOTAL
AID APPROPRIATED TOTAL	3,191		3,191	12,936		12,936
(GRANT)	(3,191)	( )	(3,191)	(12,936)	( )	(12,936)
(LOAN)	( )	( )	( )	( )	( )	( )
OTHER U.S. 1.						
OTHER U.S. 2.						
HOST COUNTRY		688	688		4,965	4,965
OTHER DONOR(S)						
TOTALS	3,191	688	3,879	12,936	4,965	17,901

11. PROPOSED BUDGET APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	PRIMARY TECH. CODE D. LOAN	E. 1ST FY 79 F. GRANT	E. 1ST FY 79 G. LOAN	H. 2ND FY 80 I. GRANT	H. 2ND FY 80 J. LOAN	K. 3RD FY 81 L. GRANT	K. 3RD FY 81 M. LOAN
(1) FN	113	091		1,570		1,610		1,400	
(2) Health				1,621		1,611		954	
(3)									
(4)									
TOTALS				3,191		3,221		2,354	

A. APPROPRIATION	N. 4TH FY ___ O. GRANT	N. 4TH FY ___ P. LOAN	Q. 5TH FY ___ R. GRANT	Q. 5TH FY ___ S. LOAN	LIFE OF PROJECT T. GRANT	LIFE OF PROJECT U. LOAN
(1)	1,400		200		6,380	
(2)	922		748		6,556	
(3)						
(4)						
TOTALS	2,322		948		12,936	

12. IN-DEPTH EVALUATION SCHEDULED: MM 05 YY 81

13. DATA CHANGE INDICATOR. WERE CHANGES MADE IN THE PID FACESHEET DATA, BLOCKS 12, 13, 14, OR 15 OR IN PRP FACESHEET DATA, BLOCK 12? IF YES, ATTACH CHANGED PID FACESHEET.

1 (1 = NO, 2 = YES)

14. ORIGINATING OFFICE CLEARANCE

SIGNATURE: P. Pakowski

TITLE: Acting Mission Director, USAID/Somalia

DATE SIGNED: MM 06 DD 16 YY 79

15. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION: MM DD YY

AID 1330-4 (3-76)

Project Development Team

Project Officer	G. Nelson	USAID/Somalia
Team Leader/Hydrologist	R. Moresco	CH2M Hill
Surface Water	G. Dearth	CH2M Hill
Water Quality	D. Wisegarver	CH2M Hill
Economist/Financial Analyst	J. Romm	CH2M Hill
Sociologist	S. Sukkary	CH2M Hill
Environmentalist	E. McGowan	Contract

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16. PID Review cable

I. PROJECT DESCRIPTION.

A. Background.

In arid Somalia the provision of adequate, good quality water to the population is one of the highest priorities. The population of 3.5 million is spread over 637,000 square kilometers, an area the size of the eastern United States from Florida to upstate New York to Central Michigan. Due to the low productive capacity, the 80 percent of the population who are rural inhabitants are widely dispersed resulting in low population densities. Providing services to this scattered population is a difficult, but essential task, for development in Somalia.

Geographically, Somalia forms part of two plateaus sloping from the Ethiopian highlands, toward the Indian Ocean in the East, and the Gulf of Aden in the North. Climatically, the country divides into: (1) a Northwest zone with a Mediterranean climate and an annual precipitation of above 400mm in certain areas: (2) a Northern and a Central zone with an arid and hot climate and annual precipitation between 50 and 200 mm; and (3) a Southern zone with a more humid climate and an annual precipitation of up to 600 mm. Two rainy seasons prevail over much of the country, the long or "Gu" rains (March-April to June) and the short or "Der" rains (September-October to December). Rains are highly variable in total amount, intensity and aerial distribution. Storms tend to be concentrated over small areas, consequently some areas may not receive any rain during some years. The rainy seasons are separated by the dry monsoons. The southern monsoon occurs from July through August and the northern monsoon occurs December through February.

The temperature is fairly uniform throughout the year varying from 25°C to 30°C. In this country of mostly low, erratic precipitation and high evapotranspiration, water supply is critical. There are only two relatively small rivers, the Juba and the Shebelli, crossing the southern portion of the country, with the rest of the country deprived of perennial surface water. Thus ground water is the only dependable water source in most of the country.

The scarcity of dependable water supplies for the rural population and their livestock is a serious constraint to bringing into production the potentially productive lands of Somalia and to making efficient use of the country's livestock resources. Only a small percentage of the land suitable for agricultural production is cultivated due to the lack of water for domestic use. The rational development of ground water resources for the national range lands will strengthen the all important livestock sector as the principal earner of foreign exchange.

Other donors have recognized the need for development of groundwater resources as a critical component of agriculture and livestock

projects, as a compliment to health projects, and as a development program of its own. However, due to the magnitude of the problem on a nationwide basis, most past efforts have been of a "stop-gap" nature. Past projects have primarily focussed on turn key jobs to provide water for urban or semi-urban centers. The early AID program to provide the water system for Mogadiscio, the Chinese program to provide a water system for Hargeisa and Baidoa, the Federal Republic of Germany program to provide water for the regional capitals of Burao, Afgoi, Balad, Merka and Johar and the IBRD program to undertake Phase II of the Mogadishu Water Supply are examples of this approach.

Another approach taken by other donors has been to create a water resource development capability in each of their projects rather than strengthening the existing, albeit weak, Water Development Agency (WDA) capability to undertake the water development required. This approach was originally planned for the Central Rangelands Project and the Bay Region project.

The result of the turn-key approach has been a steady decline in the capabilities of the WDA and a lack of long-term multiplier effects of the turn-key projects. The creation of numerous agencies with water development capabilities would lead to duplication of skills, fragmentation of water development policy, erosion of the authorities of the Ministry of Mining and Natural Resources to plan and manage the water resource, and eliminate the primary source of additional geophysical and hydrogeological data collection.

The AID project will address the water resources development program on a national basis emphasizing the need for a unified water development policy and provide the assistance to implement both data collection and production activities to serve the needs of projects and for rural water supply.

B. The Project Concept.

The Ministry of Minerals and Water Resources (MMWR) and the Water Development Agency (WDA) must be made competent to design and effectively implement a water resource development program.

The first pre-requisite for a rational program is an adequate groundwater data base defining the occurrence, movement, storage, recharge, discharge, quantity and quality of the groundwater in various aquifers throughout the country. Initially, existing data from prior FAO general hydrogeological studies must be collected and data gaps identified. Then these data gaps must be filled during the exploration phase. In addition to this initial data collection activity, a system must be established for continuous data collection from the drilling program so that each well drilled adds to the store of information regarding the geophysical and hydrological characteristics of the country.

The information gathered in the data collection program is useful as one input into decision-making process for rational use of water resource. Given the immense need for water resource development, presently over 1,000 rural villages lack an adequate water supply and several hundred wells are needed in rangeland areas, a system must be developed to allocate the resources of the WDA so that needs are met in a rational manner according to firm priorities. The National Water Committee (NWC), which has existed for many years and is presently being revitalized, must be given a good data base upon which to formulate its decisions. In addition to the technical data provided by the geophysical and hydrogeological studies, socio-economic data on villages needing water must be collected and presented and criteria to set priorities must be established.

Once the data has been collected, criteria established, priorities set and decisions made by the NWC, the WDA must be capable of implementing the drilling program. Presently, due to their limited technical capability and limited hydrogeological data base, the approach has been to install a standard well of 200 meters, loose packed around the casing with gravel to allow infiltration of water from any aquifer they cut to be pumped from the bottom of the well. This has resulted in a very low success rate (40 percent) on wells and also a high incidence of mixing of aquifers resulting in low quality water from surface aquifers infiltrating higher quality deeper aquifers. It is also inefficient as often a good aquifer might be found at 100 meters or less and the extra casing in the hole leads to excessive cost. Conversely, they might stop at 200 meters and abandon the well as a dry hole when there is a good aquifer at 225 meters. Without the technical capability to define location of aquifers, the standard well is probably the most efficient method of cutting losses, but in the long term, a better solution must be implemented.

In addition to improved drilling techniques to permit a higher success rate and more efficient drilling operations, the drilling program must incorporate geophysical logging to feed back into the geophysical/hydrogeological data base to permit further refinement of the surveys by the MMWR to, in turn, permit more efficient drilling activities. Until the drilling program is put on a more scientific basis both drawing from and contributing to the data base, it will be little more than a "wildcatting" operation.

In order to reverse the stagnation of 10 years of neglect and turn the MMWR/WDA into an organization capable of both developing and implementing a rational water development program, a massive contribution of assistance is required. Infusions of capital alone will not overcome the inefficiencies of operation and could not be effectively utilized. Minor infusions of technical assistance could not address the multitude of needs which have been identified. Therefore, a program has been developed to address the needs at all levels both for exploration and exploitation of the resource.

C. The Project.

In order to adequately address the needs in the water development sector, the project contains the following components:

1. Initial data-gathering studies;
2. Institutional support for the SDA;
3. Production drilling program; and
4. On-going data generation program.

Because of the large size of the country and the long distances between points it is not possible to address all areas of the country in this project. In defining what regions would be priority regions for the AID participation, one primary criterion was to cover areas where other non-water projects were planned that require water development for their success. These were Bay, Hiran, Galgadud and Mudug regions. Starting from this base peripheral regions that indicate a need for significant water development which are adjacent to the priority areas were identified. The total scope of the project is shown on Map 1.

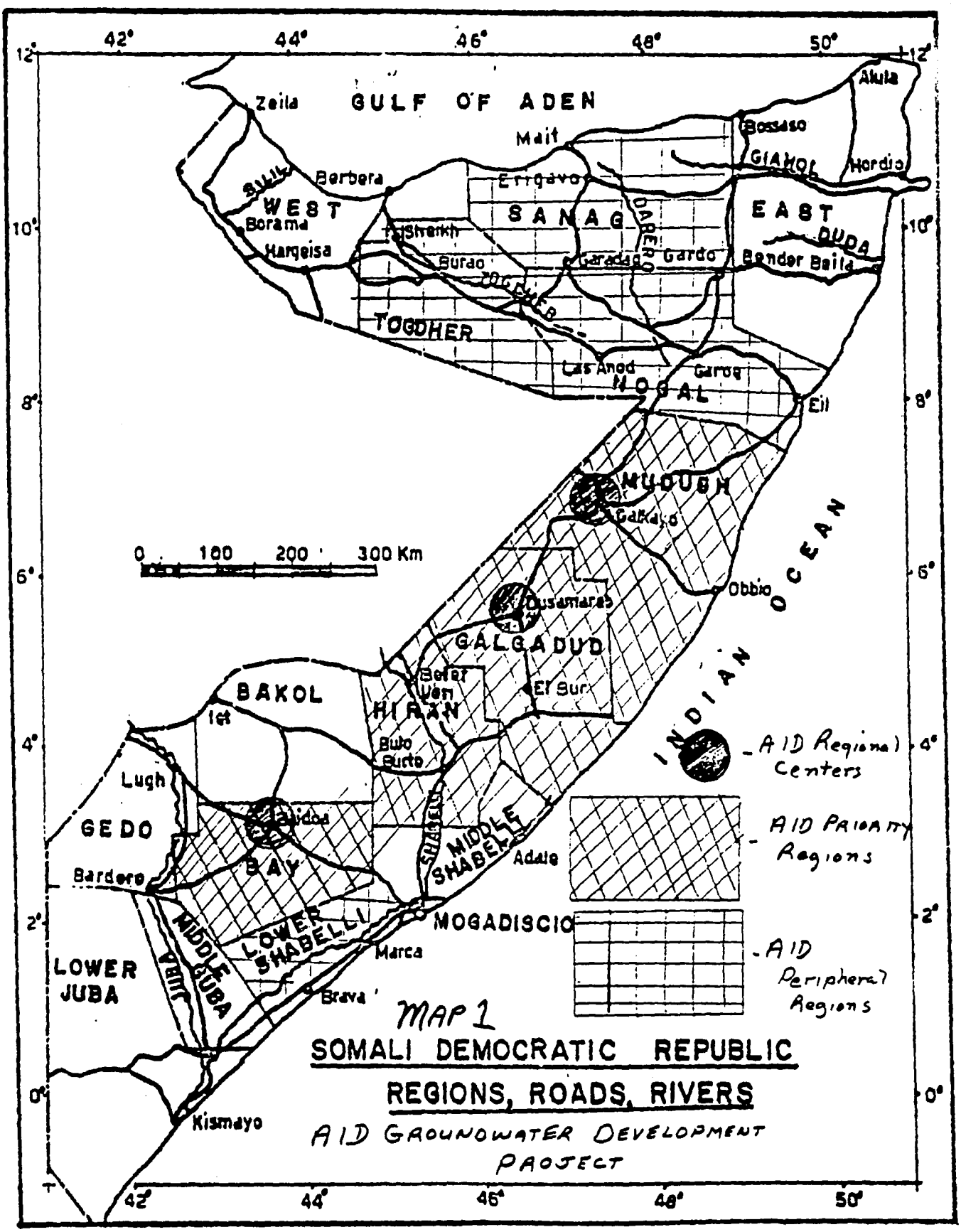
Once the regions were defined, regional headquarters were identified which would be used as the base of operation. In the south, this center is at Baidoa which will serve the Bay and Lower Shabelli region. In the central area, the center is at Dusa Mareb which will serve Hiran, Galgadud and southeastern Mudug Regions. In the more northern region, the center at Galcaio will serve most of Mudug, Nogal, Sanag and Togdher regions. This results in each regional unit serving a population of just over 400,000 persons.

1. Preliminary Hydrogeologic Data Collection.

This component will more precisely define the availability of groundwater both nationally and regionally to permit efficient utilization of the resource. It will contain two phases, a general nationwide groundwater resource survey and a more detailed survey of project priority regions.

Phase I, the general water resource survey, will be based on the UNDP/FAO Mineral and Groundwater Survey in Somalia done in 1967 to 1975 and other existing reports. It will collate all materials and data presently existing on the geophysical and hydrogeological characteristics of the country and plot it on maps in a useable form.

Phase II will begin detailed investigations of the project priority areas as indicated on Map 1. This will begin with an inventory of existing watering points in the area, gathering data such as present depth of well, original depth of well, static water level, water quality,


GULF OF ADEN
Zeila
Alula
Bossaso
Mait
GIAMOL
Hordio
Berbera
Erigavo
WEST
SANAG
EAST
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Hargeisa
Burao
Garadag
Gardo
Bender Beila
TOGDHER
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HIRAN
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Baidoa
BAY
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MIDDLE SHABELLE
Adale
LOWER SHABELLE
MOGADISCIO
Marca
LOWER JUBA
MIDDLE JUBA
Brava
Kismayo
AID Regional Centers
AID Priority Regions
AID Peripheral Regions
MAP 1
SOMALI DEMOCRATIC REPUBLIC
REGIONS, ROADS, RIVERS
AID GROUNDWATER DEVELOPMENT PROJECT

water temperature, method of water extraction, condition of the well, yield of the well, usage of the well, etc. This information will be utilized to prepare hydrogeoligic maps, show depth to water contours, water elevation contours, flow of water within geographic areas, etc.

This existing data will permit precise identification of areas indicated on Map 2 requiring additional original data collection and will determine location and depths for boring exploratory wells. Test borings will be made according to the plan above and geophysical borehole surveying can begin. An estimated 40 holes are required for the exploratory program. In addition to the test borings, the geophysical tests, including down hole camera inspection, will be done on as many uncased wells as possible, particularly those over 30 meters in depth. Simultaneously, specific capacity tests will be performed on all wells having mechanical pumps to estimate premeability of the aquifers.

Data from all the above operations will be collated and seasonal water contour maps will be prepared showing location, yield and quality of aquifers and seasonal variations in the aquifers due to rainfall and use variations. See Annex 6 for additional details on the exploration program.

In order to accomplish the aims of this component the following inputs are required.

a) 3 Geophysical trucks with downhole video equipment

b) Establishment of regional water quality laboratories capable of undertaking basic chemical and biological quality tests.

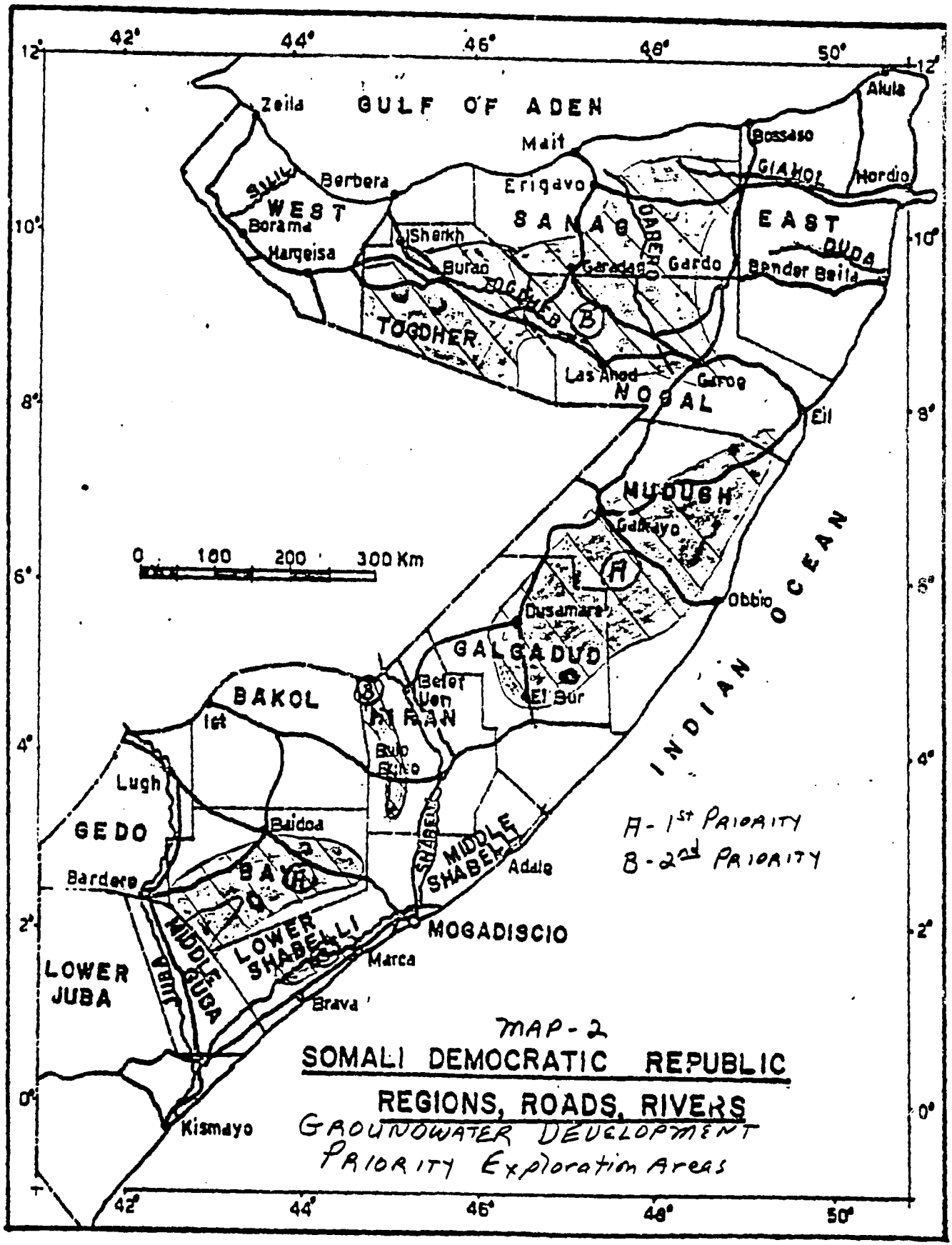
c) 4 four-wheel drive vehicles.

d) 22.2 person years of technical assistance including a hydrologist and a hydrology technician, water quality experts and various consultants for Phase I and supplementary hydrologists, geophysical technicians and drilling views for Phase II. See Annex 13 for additional details on the technical assistance needs.

2. Institutional Support for the SDA and MMWR.

In order to adequately utilize the contribution of the project, the institutional structures of the SDA and the MMWR will be strengthened. This will permit them to incorporate the needed skills and systems within their own structures so that the momentum generated under project funding will continue after the project is completed. In this component the AID project will be cooperating closely with the FRG project team to strengthen the institutions.

MAP 2



MAP-2

SOMALI DEMOCRATIC REPUBLIC

REGIONS, ROADS, RIVERS

GROUNDWATER DEVELOPMENT

PRIORITY Exploration Areas

The most critical needs of the institutions are systematic. Systems must be established for data collection and analysis, logistical supply, equipment management, improved financial management and for allocation of WDA capabilities.

The data collection system is discussed in detail under the data collection component of the project.

Logistical supply systems must be established which will assure a steady supply of essential materials to the drilling and maintenance crews. Present operators find crews often waiting for extended periods for spare parts, casings, screens, drilling mud, etc. with the result that rigs capable of drilling 10-12 wells per year can only do 4 or 5. This coupled with the low success rate results in a very low output at excessive cost.

The FRG under their project with the WDA will provide one person year of assistance particularly to reorganize and streamline the supply system to assure that critical logistics needs are met. In addition, the FRG will provide an advisor to the Director General of the WDA who will, among other tasks, assist in maintaining the supply system.

The area of equipment management will be strengthened at regional levels by the drillers assigned to each region. They will spend a portion of their time working with the regional WDA directors, organizing and planning equipment use. Training courses will be held by the TA team in Mogadishu during the rainy seasons to further support the management expertise. The resource planner will also be tasked with assisting the SDA in following up on logistics supply. He will initiate a more detailed annual work planning process including supply lead time and materials delivery planning. Five 7-ton trucks are included in the project to aid the supply function.

Financial management is another area that needs strengthening if the WDA is to be capable of recovering a major portion of their ongoing operation and maintenance costs. Preliminary analysis done for this project paper indicates that there is a good potential for recovering a major portion of O and M costs. In order to fully refine the analysis and make firm recommendations to the SDA, further investigation is needed. Funds are provided in the project for both initial and ongoing data collection and analysis to devise an improved fee collection system. The consultant will assist the WDA to restructure their accounting system to make it more useful in the decision-making process. The FRG will be providing an accountant for one year to assist in operationally training the accounting office at WDA to maintain their accounts.

In the critical area of allocation of WDA capabilities, the General Manager wishes to revitalize the National Water Committee (NWC) as a central decision-making board to review total national needs for water development and balance the needs against WDA's available resources to provide wells or surface catchments. The data collected by the hydrological studies will assist in defining the resource while the social, economic and environmental analysis done by consultants (24 person months) under the project will help to define the criteria for judging the relative merits of proposed wells. The annual planning done by the resource planner and his SDA counterpart will define SDA capabilities to permit a more solid definition of what commitments can be made by SDA to install wells or surface catchments. With adequate data and the new commitment shown by the Central Manager of the SDA, the NWC can become an important tool in managing water resource development.

In order to assure a solid, ongoing institution, training of local staff is a critical function. The training in the project will be given utilizing three methods -- on-the-job training, intensive seminars at the WDA, and limited participant training. Each member of the technical assistance staff will be training Somalis on the job to strengthen their overall capabilities. The water quality team at the MMWR will set up the water quality laboratories and train Somalies to operate the lab to assure a constant stream of water quality data. The hydro-geologist and geophysical technicians will train their counterparts to operate the geophysical equipment and report the data; the drilling crews will train their counterparts to effectively utilize the drilling equipment and to collect needed data. The mechanics provided will train staff in maintaining the drilling equipment and the well, while the FRG-provided mechanics train staff for the repair and maintenance of pumps and engines.

This on-the-job training will assure a continual availability of skilled staff. Since the TA team is a long-term team, they will be capable of training several Somali counterparts allowing spread of the technical expertise into areas not considered a priority under the project. It is estimated that each technical assistant will be able to train four counterparts thus a minimum of 68 staff will receive on-the-job training.

The on-the-job training will be supplemented by a series of intensive seminars of approximately 3 weeks each in well-defined technical subjects. These seminars will cover such areas as groundwater geology, geophysical techniques, data collection, well construction, well design, data analysis, well rehabilitation and groundwater mapping. The courses will be open to employees of the MMWR, the WDA, the NRA, the Mogadishu Water Authority and other ministries up to a maximum of 30 students per class.

The seminars will provide a basic conceptual background on the subject and move quickly to teaching the actual skills. Emphasis will be placed on the essential need for the particular skill in the overall water development program so that all students understand the rationale for the course.

The courses will be taught during the rainy seasons, permitting the use of the technical assistance team as instructors and their counterparts as students. Additional consultants will be brought in under the technical assistance contract to assist with developing the courses and getting the program started. The in-country on-the-job and seminar training will be supplemented by 6 participant training courses to prepare hydrogeolgists for senior analytical or management positions. The returned participants will form the core of the MMWR geophysical/hydrogeological department and the WDA technical staff.

3. The Exploitation Program.

The exploitation program will have three parts -- the drilling program, dug wells and surface water development. The drilling program will concentrate on implementing the decisions of the NWC in the Bay, Hiran, Galgadud and Mudug regions with peripheral activities in Lower Shebelli, Nogal, Togdher and Sanag regions. It is estimated that the program will provide 66 livestock wells and 75 to 85 rural wells. It will provide the required 32 livestock wells for the Central Rangelands Project, 10 livestock wells for the Northern Rangelands project, 24 livestock wells and 36 rural wells for the Bay Region Development Project; and 35-50 additional rural wells in Lower Shebelli, Mudug, Galgadud, Hiran regions.

The drilling program will consist of 3 mobile teams; each with a driller, a hydrogeologist, a geophysical technician and a mechanic. The teams will be based in Baidoa, Dusa Mareb and Galcaio. The Galcaio and Baidoa teams will each have one rotary rig and one percussion rig or two combination rigs; the Dusa Mareb team will have one rotary rig. Each team will have support trucks and vehicles.

The drilling program is responsible for installing the wells and for collecting geophysical data for the ongoing data collection program.

The maintenance service for maintaining the pumps, etc., is being supported by the FRG with a workshop supervisor and a training officer to upgrade maintenance skills.

In some areas, shallow aquifers exist which can be exploited utilizing shallow dug wells less than 15 meters deep. In these areas, well digging is a traditional trade usually performed by a village crew at village expense. There is some scope for improving the dug wells through partially casing the wells or installing hand pumps.

due The project will not be placing major emphasis on the well digging program/to the massive resource requirements for large areas where dug wells are not possible. The civil engineer on the technical assistance team will be tasked with assisting with development of improved dug well designs and procedures.

In certain areas of the country, neither drilled wells nor dug wells may be possible. In these areas, surface water development will be undertaken. Surface water development is based on the construction of a rectangular, cement or polyethelene lined, below ground reservoir of some 20,000 - 70,000 cubic meter capacity depending upon water needs in the area.

The civil engineer provided on the technical assistance team, and his counterpart, will have primary responsibility for surface water development. Excavation and construction equipment including a bulldozer, a motorgrader, a roller, cement mixer, etc. to implement the program are provided for in the project.

4. On-going Data Collection.

To further refine the hydrogeologic data base, an on-going hydrogeologic data collection program will be installed to in effect, transform each new well into an exploratory hole by doing detailed geophysical logs on each. To accomplish this, the drilling teams will be given the capability and responsibility for collection of data from the wells they drill. The data they will collect are geophysical and water chemistry. In addition, they will collect water samples for analysis at regional and central water quality labs.

The data collected will be forwarded to the MMWR for analysis and summary. Within the MMWR two offices will contribute to the analytical process. The geophysical/hydrological division will collate all data in an operational system and analyze the data systematically to permit regular updating of hydrogeological maps and information. The hydrology technician and his counterparts will be primarily responsible for this operation.

The water samples and water quality data from drilling teams and from the regional laboratories will be processed by the water quality section. This section will do more sophisticated analysis, check field analysis for accuracy and collect all data and report summaries to the hydrology division for incorporation into their reports.

This system will allow refinement of survey conducted under the exploration component as well as expand the knowledge on areas which were not covered by the exploratory program.

In addition to the technical data collection program, a program will be instituted to collect socio-economic data through the WDA pump operators regarding usage of the wells. This data will include items such as number of humans and livestock served, resident or nomadic (in transit), water charges collected, etc. These data will be analyzed by the water resource planner as part of the impact analysis and planning programs. (See Table 1.)

The inputs required to establish this data collection system include the hydrology technician to assist in processing the geophysical and hydrological data and to train his counterparts, the chemist, lab technician, and equipment maintenance specialist to get the water quality lab functional and to establish regional labs and the water resource planner to coordinate all activities and undertake the socio-economic analysis. Numerous consultants are included in the project to assist the water resource planner in this critical task.

II. Analyses:

A. Hydrogeological.

Several reconnaisance level national surveys have been undertaken of which the latest are the 1973 UNDP/FAO "Hydrogeoligic Investigation of Somalia," and the UNEC "Hydrogeologic Review of Somalia" by W. F. Grimmehman done in 1975. These surveys define the stratigraphy of the underlying structures but do not contain an adequate inventory of water points to define the entire hydrogeology of the area.

The need at this point in time is for detailed regional surveys to precisely define the hydrogeology of specific areas. The UN/FAO hydrogeologic maps at 1:2 million are suitable to permit developing a detailed survey although not sufficient to site individual wells.

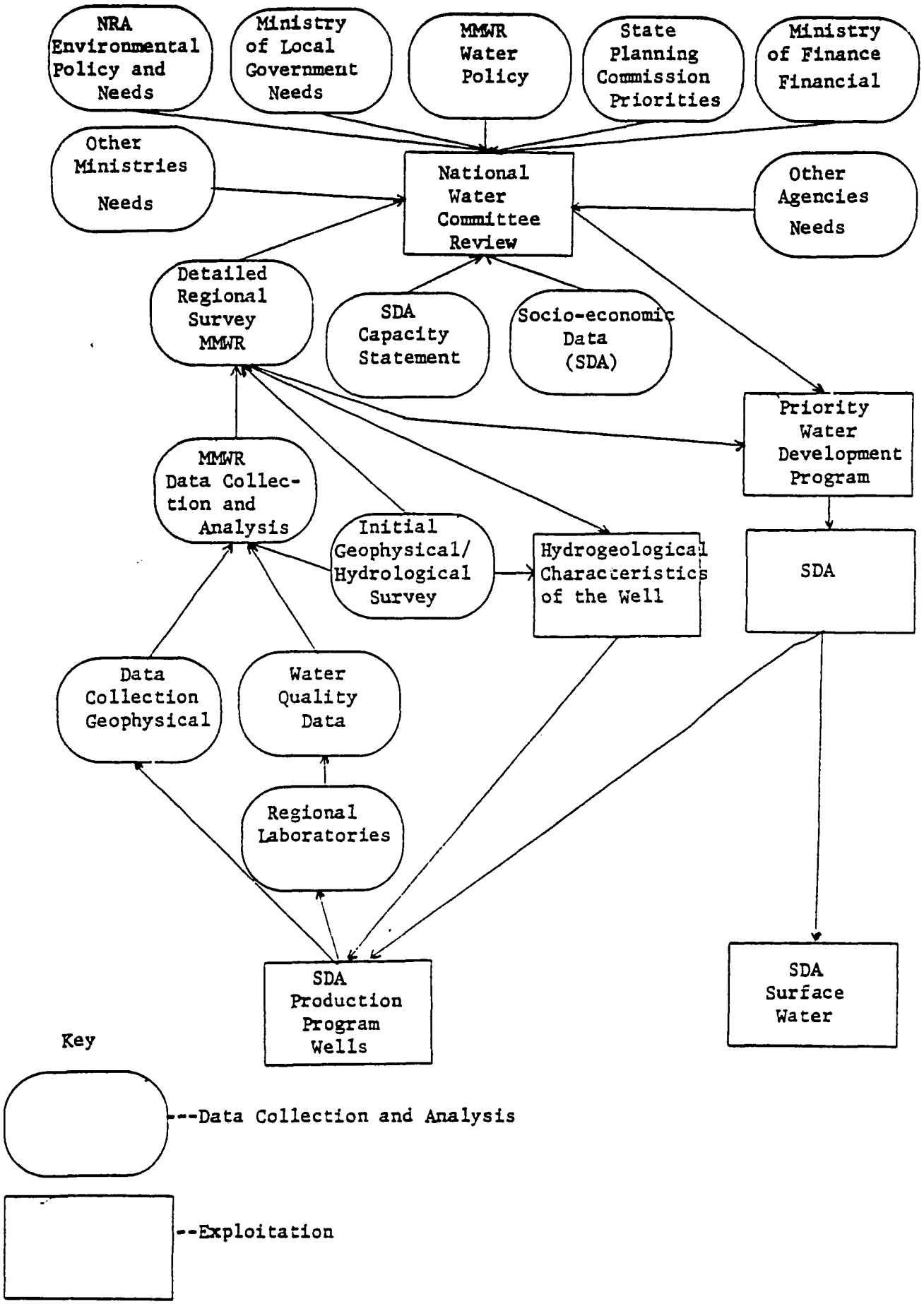
The general hydrogeological characteristics of the project areas are as follows:

Bay Region

The Upper Juba hydrogeolgic province in the Hiran and Bay Regions is made up of Jurassic limestone, marl, clayey sandstone, and gypsum. Groundwater is found at between 2-18 meters and springs occur along the basement (Bur) complex contact. Large volumes (up to 1,000 liters per minutes have been produced). The quality is a TDS of between 1500-3000 mg/1.

TABLE 1

WATER DEVELOPMENT INFORMATION FLOWS



The Lower Juba groundwater province occurs in the southern Bay Region. Alluvial sands, silt and gravels are found in this province. The water up to 80 meters or so in depth has been found to be extremely saline with TDS up to 35,000 mg/1. There is a second water horizon at greater than 120 meters depth that is less salty. Geophysical exploration and deeper drilling is required to determine if good quality water exists.

The Bur hydrogeological province occurs through the center of the Bay Region. This province is a precambian gneiss and granite complex. Exploration is required to find a potable water supply in sufficient quantities for domestic use.

Hiran Region.

The Hiran groundwater province is made up of Jurassic marls, clays, limestone and gypsum. Water quality is a TDS concentration of 3,500-5,000 mg/1. Cattle are generally watered from dug wells with water in the 1-18 meter depth zone. The deeper horizon up to 400 meters have not as yet been explored for better quality water.

The Upper Juba groundwater province described above is also found in the Hiran Region.

The Benadir groundwater province is a wide belt in Hiran and the southern part of the Galgadud Regions. Water is found at 40-70 meters depth in the miocene Merca formations. The TDS ranges from 2,500 to 4,500 mg/1. Boreholes are required to reach water in this province.

Galgadud.

Dusa Mareb in Galgadud region is underlain by limestone, sandstone, gypsifirous marl and gypsum formations. Two water bearing horizons occur in the upper levels. Dug wells find water at 5-9 meters with TDS of 2500-17000 mg/1. A second water horizon at 60 meters is associated with sandstone interbedded with clay. The TDS is 3000 mg/1.

Geophysical borehole invesitgations are recommended to delineate the freshwater horizons in the 200-300 meter zone.

The Benadir groundwater province discussed above is also found in the southern portion of the region.

The Indian Ocean Coastal Zone province, found along the Indian Ocean in both Galgadud and Mudug regions, is a thin band of sand dunal formations. Water is generally found at depts of 1-6 meters and is of good quality with TDS ranging from 1500-3000 mg/1. Dug wells are all that exist in most of this area.

Mudug Region

The High Pleateau groundwater province is located in the north and covers the western Mudug Region and much of Nugal Region. Groundwater is found between 50-200 meters. Water quality ranges from 1500-2500 mg/1. The Jisomma sandstone in the southwest of this province could have some potential for development in the 150-200 meter range or deeper.

The Mudug Plateau groundwater province is in the central part of Somalia and is made up of extensive inland miocene sedimentary formations termed the Merca limestone, sandstone, clay marl and surface gypsum. Groundwater is generally found between 1-30 meters, with a TDS of about 2500 mg/1; and between 40-60 meters with TDS of 2000 to 4000 mg/1. A detailed groundwater survey of the deeper horizon is needed to determine potential yields and quality Galcaio is underlain by gypsiferous marl and gypsum with sandy clay intercalations. One well is 350 meters deep with water at 150 meters. Goundwater of better quality may be obtainable in 400-500 meter range. Individual aquifers need be examined for quality.

Nugal and Togdher and Sanag Regions

The mountainous zone province in Nugal and Togdher Regions has groundwater occurring as underflow in loose valley sediments and in outcrops in the form of springs. Groundwater generally occurs at depths from 1-3 or 5-10 meters. The water is usually fresh but TDS can reach as high as 2000 mg/1. Groundwater can be found at depth in tectonic fracture zones, with a 25-30 liter per hour yield potential.

The Nugal Depression and Taleh Plateau province of the Togdher is a large area within the central part of the Somalia High Pleateau. Groundwater has been found at 2-3 meters and 20-30 meter depths without the presence of any identifiable persistant horizons. The water is highly mineralized (3500 - 5500 mg/1), but is still adequate for watering livestock. Dug wells are the normal development in this province, however, exploratory drilling could produce improved water quality.

Burao, the capital of the Togdher, overlies deposits of recent to Eocene allurium, dunesands, sandy clay anhydrite and gypsum. Deep wells 100 to 177 meters deep provide the main supply. The water from 100 to 130 meters is good quality with a TDS concentration of 1000 to 1200 mg/1. However, water quality at 177 meters is TDY 4700 mg/1. Exploratory holes are desirable to determine the horizons of good quality water.

The high plateau groundwater province discussed above covers a large portion of Nugal region.

Lower Shabelli Region

This Region contains two primary groundwater provinces. The Benadir province was discussed under the Bay Region above. The second province, the river valley province, is recent stream alluvium. The primary aquifer is a stream-fed aquifer at 3-8 meters in depth having a TDS of 1,500-4,000 mg/l. Additional better quality aquifers are likely in the 100-200 meter range. Annex 1 contains a summary mapping of groundwater provinces.

A cursory analysis of water needs versus potential recharge indicates that the total rural water program will draw less than 20,000 acre feet of water while national precipitation exceeds 2,000,000 acre feet. Thus less than 1 percent of the precipitation must percolate into the aquifers for adequate recharge of the aquifers. Since it is likely that there is also significant recharge of deeper aquifers from the Ethiopian Highlands and definite recharge of the river basin aquifers from the rivers which rise in Ethiopia there is clearly adequate recharge of the aquifers. Chemical analysis of existing water supplies does not indicate that fossil waters are being tapped.

B. Surface Water

Surface water development should be utilized only in situations where adequate groundwater is not available. Due to the high permeability of the soils over most of the country, catchments must be lined if they are to carry over to the dry season. This leads to a cost exceeding an equal capacity groundwater source.

Due to the variability of rainfall and occurrence of periodic low rainfall years, surface catchments would not be filled in those dry years when water supply is most needed.

Maintenance of surface water catchments has proven to be relatively expensive due to erosion problems. Minor design modifications will ameliorate this situation but with lined tanks maintenance will always be costly.

In order to maintain control of water use, sanitation, etc., it is recommended that a pump system be continued rather than shifting to a gravity flow system.

The WDA has experience in establishing both large and small surface water collection and storage structures. With the technical assistance provided under this project and by the FRG they will be capable of meeting the needs for surface water development.

C. Water Quality

Water quality is a serious problem in Somalia with high concentration of sulfates, chlorides and other salts as well as bacteriological problems. See Annex 7 for details.

At present, the capabilities of the MMWR to undertake water quality analysis is severely limited by a lack of operational equipment and staff. The contribution of the project to upgrade their capabilities will enable them to analyze samples and collate the data.

Given the large geographical area and the rough terrain in the country, it is important to install the capability for basic titration and incubation analysis in each of the project's regional centers. In addition, the drilling teams themselves will have colormetric analysis capabilities as well as conductivity test apparatus.

D. Institutional and Manpower

The primary institutions responsible for undertaking water development are the Ministry of Mineral and Water Resources (MMWR) and the Water Development Agency.

Ministry of Mineral and Water Resources

The MMWR is primarily responsible for geophysical and hydrological analysis and policy decisions regarding utilization of the water resources. Its geophysical/hydrological division will process data gathered under the initial survey and the ongoing data collection program. It will develop regional groundwater maps showing water contours, yields of aquifers, water quality, etc. These maps and surveys will be updated regularly as additional data is collected.

The MMWR will be responsible for operation of the central water quality laboratory and will process data from all laboratories for incorporation into the regional surveys.

In his policymaking role, the Minister sits as Chairman of the National Water Committee (NWC), which allocates resources for water resources development.

At present, the geophysical/hydrological division is staffed by one graduate hydrogeologist and several assistants. The one hydrogeologist is not able to undertake analysis on his own and, therefore, functions primarily as a problem solver in the drilling program. The division has two drill rigs for exploratory purposes, one of which is operational.

The water quality section of the Ministry has a laboratory, albeit in poor shape. A great deal of non-operable equipment is in place and a good maintenance program would go a long way toward making the lab operational. Few adequate records have been kept in the past and a good record system must be installed.

Water Development Agency (WDA)

The WDA is the implementation arm of the MMWR for the development of water resources. The WDA is responsible for installing the wells allocated by the NWC and for operating and maintaining the wells.

At the present time, their capability to meet the demand is limited both by the availability of adequate equipment and by a lack of professional staff.

The WDA has a total of 22 drilling rigs of which only one-third are operational. Many of their operational rigs are 10-15 years old and thus excessive time is spent in maintaining them as operational units. They lack any geophysical equipment and support vehicles are in short supply. Their maintenance shops are in disrepair and the lack of spare parts have deadlined many units. See Annex 6 for details. At the present time, they install only approximately 40 wells per year.

The WDA staff is large but weak. Only two trained hydrogeologists are on the staff and these are both stationed in Mogadishu. The drilling crews and mechanics seem capable of managing to keep old rigs running at least part of the time despite the lack of spare parts. However, the drilling crews are not capable of performing any systematic analysis of materials encountered in order to judge when to stop drilling or where to insert screens. The result has been an inefficient standard well approach.

The WDA staffing pattern calls for 896 field positions of which only 236 are filled. Partially this is due to the lack of equipment to utilize the full staff and partly it is due to the overall stagnation of the agency over the past few years.

If the WDA is to become capable of undertaking a proper drilling program, it will need at least 10 trained hydrogeologists to oversee drilling operations, numerous new drillers, geophysical technicians, mechanics and support personnel. This project will provide training to upgrade staff into most of those positions while the FRG project will focus on mechanical workshop training.

National Water Committee

The NWC is the key to rational utilization of the water resources. Up to the present, they have been minimally effective because demands for development of water resources have been overwhelming; data concerning the water resources has been too scanty to permit any firm definition of supply, and the WDA has not been capable of implementing the development program which has been programmed.

The project will address each of these constraints by
1) collecting technical data to define resource availability;
2) assisting SDA to establish social and economic criteria to judge the relative value of individual wells and to establish priorities; and
3) give SDA the capability to implement a program of some 50 additional wells per year.

Thus, with the added capabilities the NWC becomes of increasing importance as they will have a real contribution to make.

The NWC, a Ministerial level committee, is chaired by the Minister of Minerals and Water Resources and includes representatives of the Water Development Agency, the Ministry of Finance, the Ministry of Local Government, the Ministry of Agriculture, the National Range Agency, the State Planning Commission plus any other Ministries and agencies requiring water development.

These members each have specific roles to play in the decision making process. The MMWR has overall responsibility for water resource development and is also the repository for geophysical and hydrological data showing the availability of water for exploitation. The WDA, as the implementing agency for the water development program is responsible for defining its capabilities to undertake the program as well as advising the NWC on priorities for individual wells.

The Ministry of Local Government is responsible for collecting requests from villages for water supplies and listing them by priority. The Ministry of Finance controls funding for implementation of the program and is responsible for keeping the program within its financial parameters.

The National Range Agency is the watchdog for the environment and according to the Range Law (No.3, Feb. 4, 1979) must give its consent prior to drilling of rural wells. The State Planning Commission is responsible for assuring that the water program supports the GSDR 5-year plan in priority areas.

Other Ministries and agencies such as the Ministry of Health, the Settlement Development Agency, the Livestock Development Agency, etc. will sit on the committee as non-voting members when their needs are considered.

The committee will meet regularly to plan the water development program. It will be their function to allocate the capabilities of the WDA to various activities including rural water supply, support of projects, urban water supply, etc. It is evident that even with the additional capabilities given to the WDA under this project, it will not be capable of meeting the total need in the short or medium term. Therefore the NWC will also direct some request to private sector drillers for implementation.

Manpower Availability

At the professional level, new graduates of the Faculty of Engineering at the University of Somalia will be selected for post graduate training in the U.S. The project anticipates training six persons in post graduate programs. With the annual output of the faculty of 15 graduates per year, assurances have been given that minimum of four from the class in year one would be made available for the participant program. The project will continue to draw 4 engineers per year for on-the-job and in-country training as hydrologists and geophysics. This will result in 6 professionals and 20 technicians in hydrology and geophysics by the end of the project. This would permit a 50 percent attrition rate for the technicians and still have a sufficient core staff.

The first two years of the drilling program will have technical assistance drillers working directly in each region training newly recruited drillers on nearly a one-on-one basis. The requirements for new drillers will include literacy and at least a minimum level of English language capability. Each technical assistant can train one driller every six months so 12 additional drillers will be trained. This again allows for a 50 percent attrition rate. Follow-up supervision and retraining is provided for in the project.

The provisions in the project for manpower development appear adequate to address the manpower constraint.

E. Social Analysis

Travelling through Somalia, one realizes that the issue of water availability, water quality, and water delivery system are among the main concerns of the Somalis. In this arid country where rainfall is erratic, and droughts constitute on eminent threat every four or five years, the availability of a steady water supply is one of the most critical perceived needs of a majority of the population.

The main beneficiaries of the project are the agro-nomadic population of Somalia. The project will achieve the following.

1. Make water available in the areas of the greatest need where, frequently, people and their livestock have to travel for many miles to find a water source.

2. Improve the quality of water used for human consumption. In Somalia, the high salinity of the water causes many health problems among humans and livestock.

3. Reduce women's workload; some 70 percent of the women's daily labor is spent on solving water-related problems (see Annex 9). The Comprehensive Groundwater Project is designed to ensure the availability of a potable water supply for humans and animals in certain selected areas where the need is most urgent. The project will include an intensive sociological

study to be conducted in order to determine (a) local criteria for the selection for well sites; (b) details on water utilization practices, and (c) identify local community leaders and encourage their participation in the different phases of the project.

In some rural areas of Somalia, people form communities that vary in size depending on the amount of water available for human and animal consumption. Agriculture is practiced on small plots where sorghum, millet, corn, edible oils, and tomatoes, and sometimes beans, are grown. Pastoralists graze their animals in adjacent areas. Some of the rural population keep large herds, and practice herding and farming alternately on a seasonal basis. In parts of Somalia, one cannot always draw a sharp line between nomadic and agricultural populations. It is common for a family to have the male clear a land lot for agriculture, and leave with the herds to seek better pasturage while a wife weeds and harvests the crops. In some areas, this flexibility is not possible because of environmental constraints. In Mudug and Galgadud districts, agriculture is extremely limited because of the scarcity of water. In these areas, the development of groundwater will permit a more stable migratory pattern as the nomads move to graze but have less of a requirement to move for water.

It should be noted that in Somalia, local water utilization practices are not wasteful. People are aware of the precious value of water. Throughout the whole country, one sees women and children carefully hauling water for miles to their homes. Plastic containers, water baskets, and clay-made jars are filled from wells, reservoirs (uars), rivers, water ponds or government tanks and then carried home for consumption. Payment for water for livestock and in many cases for humans is a long-accepted practice in the country.

People prefer rain water (sweet water) over well water because some wells have a high magnisium sulfate content which is harmful to humans as well as livestock. However, "sweet water" is seasonal, limited, and has its own health problems too, e.g., shistosomiosis, tryponsomiasis, dysentery and other gastro intestinal diseases.

With poor planning, problems of over-population and over-stocking can occur around water points. Ironically, these problems are worsened by the very technological aid that is aimed to rectify them. The drilling of wells can attract nomads who would originally have been dispersed during the dry seasons. They bring the animals to wells in large numbers, and overgraze the surrounding land. The inclusion of the NRA in the National Water Committee to exercise their authority to regulate rural water as given in the Range Law provides environmental safeguards. Community input will be sought in determining criteria for well-drilling. Local needs will be assured on the basis of discussions between community members and representatives of the regional Water Development Agency. Women form a large number of the beneficiaries hence they will be encouraged to participate in these discussions.

Local water needs vary from one location to another according to population density, size of herds, herd composition, number of nomads visiting the area, and water utilization patterns. Establishing "a priori" criteria to be applied in all different regions of the country is a useless procedure because it ignores local complexities. However, the following can serve as general guidelines for prioritizing well locations:

a. Needs of over-crowded areas have to be met first before drilling in upopulated areas.

b. Wells should be drilled where people live or on migratory routes most frequented.

c. Social and health services have to be extended to the areas where wells will be drilled.

d. Somalis have a well-established tradition of paying for water to be used by their livestock. This tradition should be encouraged but the cost of water from the newly-dug wells should not be prohibitive, or beyond people's economic means.

The AID health program will assist the Somali Ministry of Health in explaining water-related diseases. Health programs will be implemented in Bay, Togdher and Mudug regions and will emphasize preventive health education. This will effectively compliment the water development program by providing information regarding water borne diseases and sanitation to villagers.

A social science consultant is provided for in the project to both help establish social criteria to assist in setting priorities for new wells and to measure social impacts around wells.

F. Economic

The development of water resources is an essential component of nearly all development projects in Somalia. Without water resource development, agriculture development and range development are stymied. The need for water is central to any developmental activity and therefore the benefits from water development rely on the benefits accruing to other projects. For the purpose of economic analysis of this project, benefits have been divided into three groups, quantifiable benefits which can be assigned on economic value, measurable benefits and non-quantifiable benefits.

The primary quantifiable benefit is increased livestock production due to range management programs which are based on groundwater use as a critical mechanism for controlling and optimizing range utilization.

It is not possible to separate out the contribution of groundwater to the overall production because each component is necessary to realize the benefits. However, the cost efficiencies of doing a national groundwater project as discussed in the financial analysis section of this paper, raised the ERR of the central rangelands project from 12% to 14%.

The measurable benefits are based on the number of people previously without reasonable access to a permanent, safe water supply. Assuming a total of 74 wells primarily for human consumption, some 200,000 people would have access to more, better quality water due to the project. The impacts of this improved supply fall under non-quantifiable benefits.

The nonquantifiable benefits are by far the most important. First of all, there is a positive benefit from reducing the magnitude of drought relief efforts required in times of low rainfall. Since a major problem during the drought was the concentration of people around the limited number of permanent water sources with subsequent over grazing and starvation of animals, it is reasonable to assume that the existence of additional water points dispersed over the area would decreas the losses due to drought. The total magnitude of the drought loss is staggering. An indication of the massive diversion of resources to deal with the drought can be drawn from the following summary of the 1974-75 drought.

	So. Shs.
Relief Operations	250,000,000
Food Aid	250,000,000
Other Financial Assistance	375,000,000
Loss of 20 - 30% of GDP	400,000,000

A second nonquantifiable benefit is improved health due to a reduction in water borne diseases. This reduction in turn leads to increased productivity for the people.

A third nonquantifiable benefit is a reduction in the amount of time and effort spent fetching water. It is estimated that in many rural areas of East Africa over 25 percent of a persons daily energy requirement is utilized in fetching water. In nomadic families this figure may approach 80 - 90 percent. Women in particular are likely to spend well over half their time hauling water thus have little time left for other pursuits. The water development program will have major impacts on this situation.

A fourth nonquantifiable benefit is the fact that water points, particularly in the range lands, will become periodic gathering points

for groups of people. For many years, the Government has been faced with the problem of how to deliver social services: education, health, etc., to the nomadic population which has been widely dispersed. The development of range reserves based around water points may aggregate sufficient numbers of people within a 10-mile radius to permit delivery of social services.

The economic feasibility of this project is best indicated by cost effectiveness analysis. If this project was not undertaken, water resource development would be undertaken by individual water development units in each of several other projects, for example, Central Rangelands, Bay Region, etc. From a purely financial sense, over $1.5 million is saved by doing the 102 wells required by Bay Region and Central Rangelands through the present project rather than through individual projects. In addition to this financial savings, which arises from utilizing the same staff for other functions and for additional wells, doing the water development through the groundwater project allows the building of a data base and an ongoing institutional capacity. It also permits development of national groundwater development policy and provides control of exploitation.

In summary, the project as designed is much more cost effective than other alternatives and allows numerous nonquantifiable benefits which would not be possible if water development were fragmented between other minor projects. If the project is to have both the production and institutional benefits, it must be conducted at the magnitude designed. Costs would be cut by eliminating studies and institution building and doing a turn key program for 140 wells. However, this approach would eliminate long-term benefits and should not be encouraged.

G. Environmental

An IEE for this project was submitted with the PID, and reviewed and the negative determination was approved. The project will work closely with the division of Range and Environment of the National Range Agency to assure that adequate ecological planning is done prior to installation of wells. By virture of the new Range Law, the NRA must consent to the installation of any rural wells. This gives the NRA the authority as well as the responsibility for protecting the environment. The AID contribution to the Central Rangelands Project includes support for the Division of Range and Environment.

The project presented in this PP also includes provision for an environmentalist to work with the WDA and the NRA to define the environmental considerations and criteria for the water development program.

With these additional safeguards the recommendation for a negative determination remains valid.

III. Financial Plan

A. Budgets

Following is a summary of the project funding:

	AID $000	GSDR $000
Technical Assistance	5,421	172
Training	607	50
Construction	506	672
Commodities	3,999	250
Operations	0	937
Salaries	0	1,216
Inflation	2,166	1,526
Contingencies	237	142
TOTAL	12,936	4,965

Derivation of GSDR Funding by Year
$000

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
Budget	18	159	310	387	454	512	1,840
PL 480 Proceeds	570	199	507	630	456	763	3,125
TOTAL	688	358	817	917	910	1,275	4,965

AID Contribution by Functional Account
$000

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
FN	1,570	1,610	1,400	1,400	200	200	6,380
Health	1,621	1,611	954	922	748	700	6,556
TOTAL	3,191	3,221	2,354	2,322	948	900	12,936

Detailed budgets may be found in Annex 10 Section B pages 16-18.

B. Financial Analysis

The $17,901,000 cost of the Project is borne by a $12,936,000 contribution by AID and a $4,965,000 contribution from the GSDR. The 27% of the Project cost attributed to the GSDR contribution includes a $1,840,000 budgetary contribution for salaries and a $3,125,000 contribution from the proceeds of the sales of PL 480 commodities for operating costs and various local costs. The Mission plans to initiate a PL 480 Title III program in FY 80 which will include support for this Project as one of its priority development activities.

The financial analysis of this project included a discounted Net Present Value (NPV) analysis of the cost per well of doing the project through the Groundwater Project as opposed to putting a water development component into both the Central Rangelands Project and the Bay Region Project. Using a 12% opportunity cost of capital wells under the Groundwater project cost $54,000 per well. Doing the same wells as individual components under the Bay Region and Central Rangelands projects gives a discounted NPV per well of $71,000 for a discounted savings of $17,000 per well. When aggregated by the factor of 92 wells for the two projects, the total savings amount to $1.5 million which provides funds for a sizeable additional rural well program.

The Bay Region and Central Rangelands Projects will pay SDA a portion of the costs of installation of the wells. $25,000 per well has been budgeted in the Central Rangelands Project to cover operating costs for installation of the wells. The Bay Region project will budget a similar amount. In addition, the casings, screens, pumps, engines, etc. for the wells under the Bay Region and Central Rangelands will be provided by those projects. These items are budgeted at $10,000 per well. In addition, some $2,500 is budgeted in the CRDP and Bay Region Project for the construction of pump houses, pipe installation, troughs, etc. It is planned that the only cash payment to WDA will be the $25,000 per well to defer the operation cost of installation.

After the end of the Project the WDA is projected to have sufficient cash flow generation from water fees to cover operations and maintenance of the domestic wells with a small residual to cover at least a portion of further well development costs. The equipment provided will be operational for at least 15 years during which time nearly 800 additional wells can be drilled. The installation costs for the additional wells will have to be borne either through the government budget or through village subscriptions. Water charges are based on stock watering rather than human consumption as is the present practice. There is some indication that a domestic fee of 1 to 3 shillings per 1,000 liters can be charged. Further details of the question of fees is found in Annex 10.

IV. Implementation.

The primary implementing agencies for the Project will be the WDA and its parent ministry, the MMWR. The WDA will be administratively responsible for implementing all aspects of the Project including the assistance provided to the MMWR.

The project components operating within the Ministry are the initial survey, the ongoing data processing and the central water quality investigations. All field operations, including data collection, well drilling, field laboratories, etc., are the responsibilities of the WDA.

As discussed in the organizational analysis, the activities of the National Water Committee are important to proper implementation of the Project. Project activities will supply much of the information and many of the guidelines needed for smooth operation of the NWC.

Support provided to the National Range Agency in the environmental field under the Central Rangelands Project will further strengthen the capabilities of the NWC to make rational decisions regarding water development. Table 2 presents a schematic of the organizational structure of the Project.

The WDA has demonstrated a capability to undertake host country contracting by managing numerous contracts with both local and foreign suppliers. The present General Manager was formerly General Manager of the Mogadishu Water Authority which had contracted with an American firm, Parsons, Inc., for installation of the Mogadishu water supply and with other international firms under the IBRD-financed expansion program. The WDA will be backstopped in contracting and procurement by the technical division of the State Planning Commission and its Project Implementation Unit which is being strengthened by the IBRD to serve as advisors in implementation actions.

On the Mission side, the Mission engineer will be Project Manager for this project. The SPAR for this position was submitted in January 1979 and we expect assignment in September 1979.

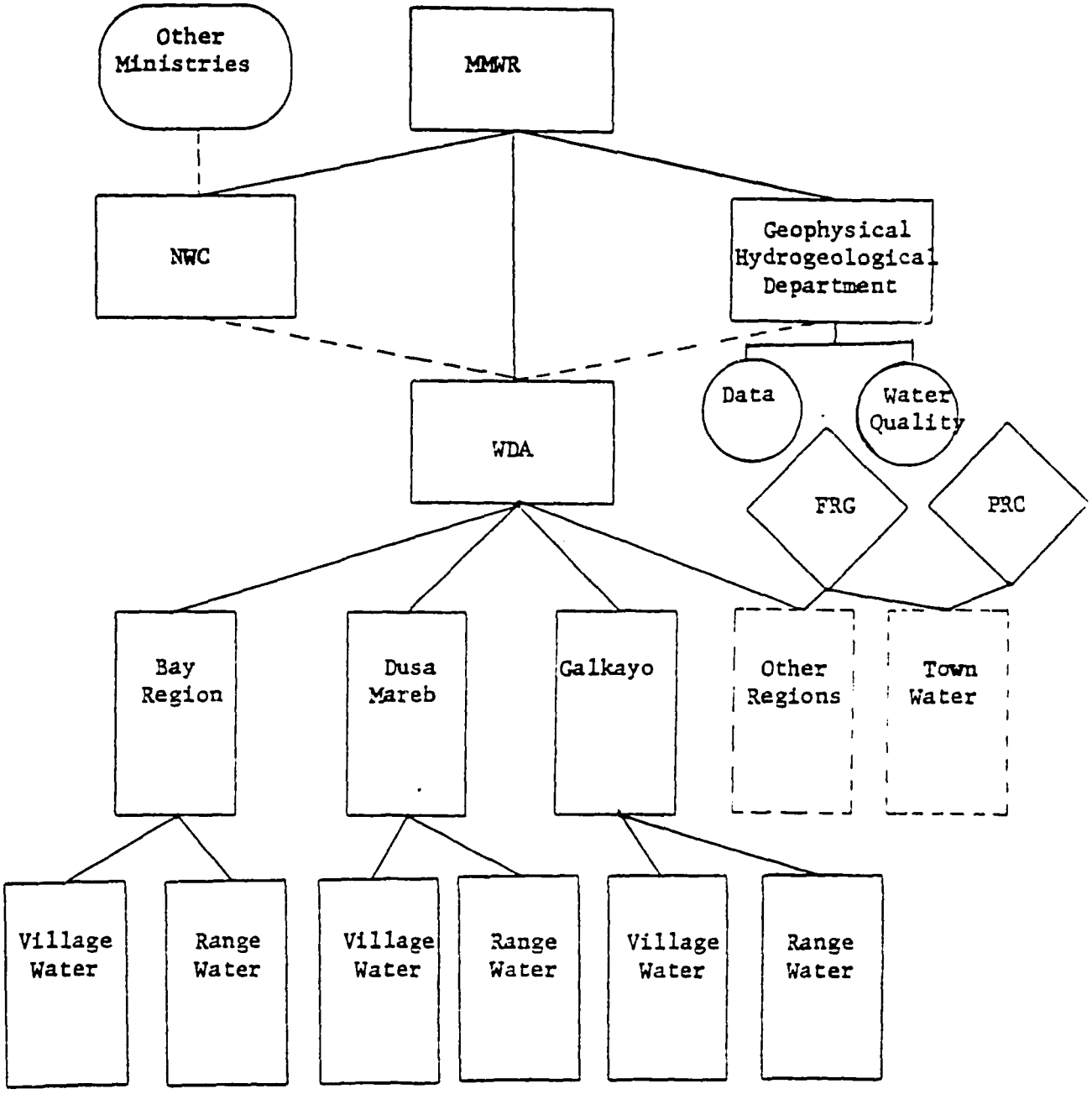
An implementation plan for the first three years of the Project is presented in Table 3. During these three years the program is just getting started. Actions to get staff on board, equipment ordered, housing begun and participants off for training receive high priority. These three years find the initial surveys being completed in each of the regions and the drilling program beginning. See Annex 14 for additional details.

Table 4 shows the progress of the drilling program with evaluation points and benchmarks identified. The rangelands drilling program is left somewhat flexible between June 1981 and December 1984 because the drilling of range wells is dependent upon the progress in establishing range associations and grazing reserves before installing water. If the range program is delayed, the WDA will begin with the domestic water supply program or in the northern regions where the range program is more advanced and move to the rangelands when needed.

TABLE 2

GROUNDWATER DEVELOPMENT

PROJECT ORGANIZATIONAL STRUCTURE



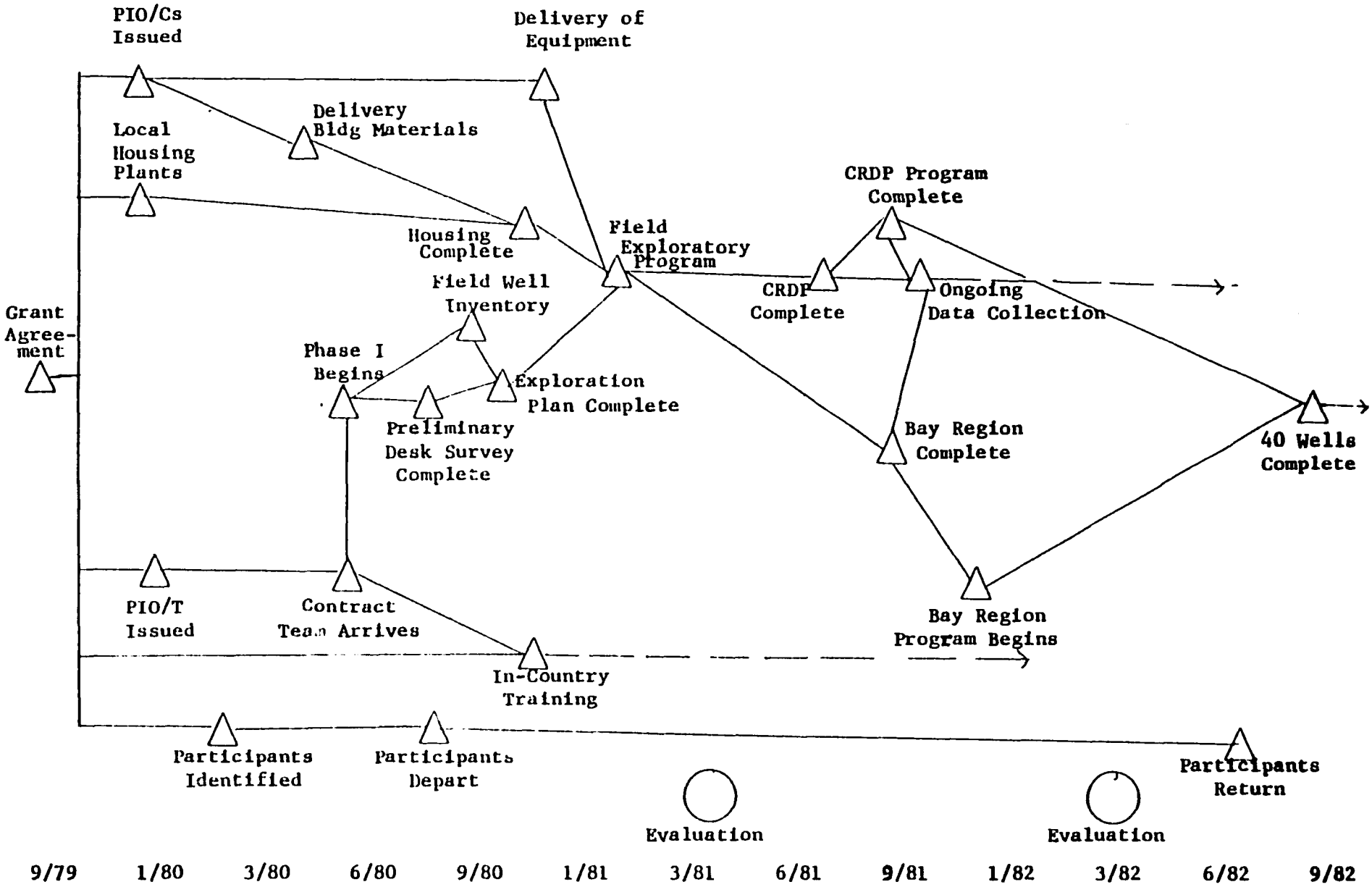


TABLE 3
IMPLEMENTATION SCHEDULE PROJECT START UP

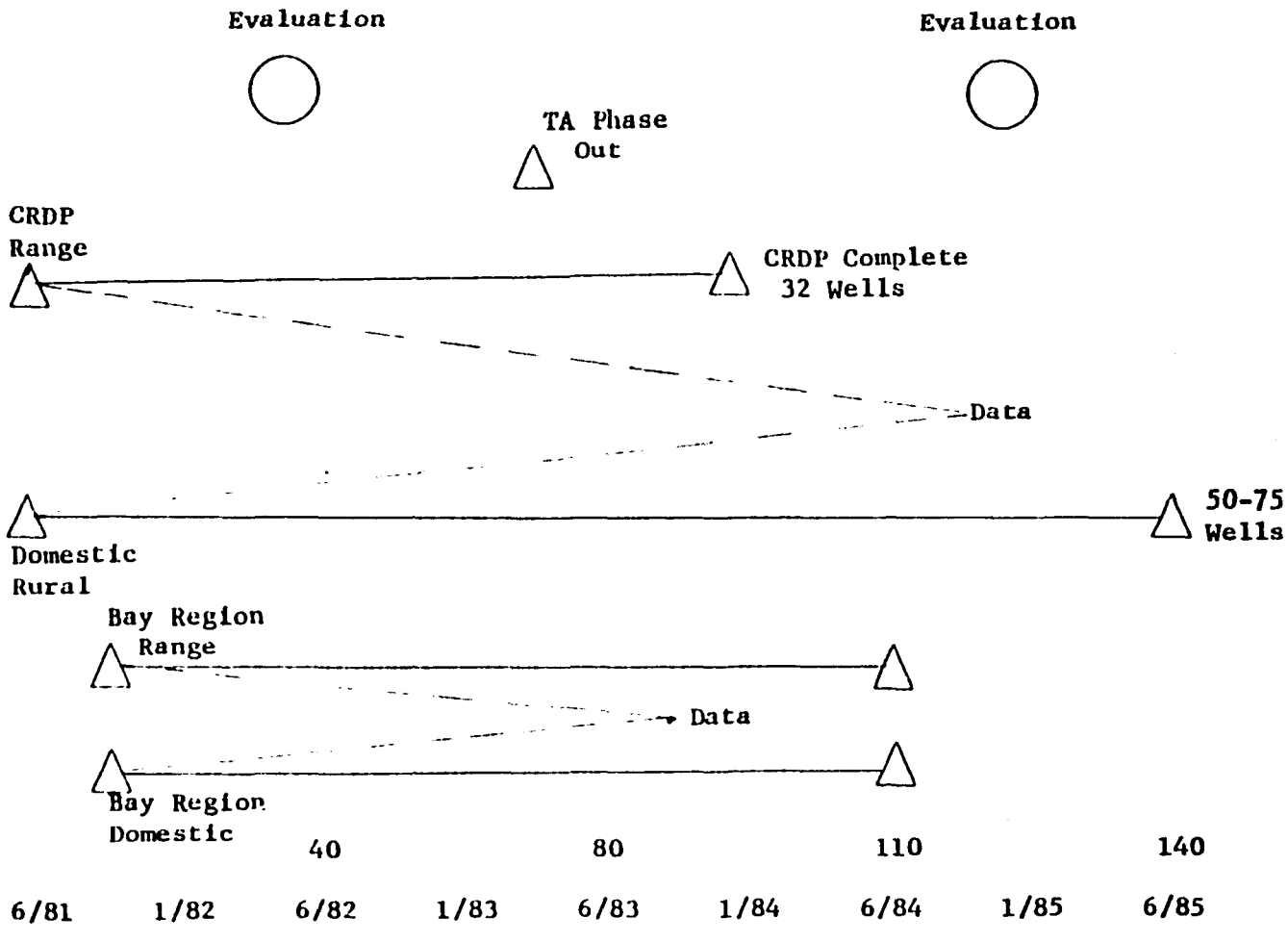


TABLE 4

DRILLING PROGRAM

Technical assistance phase out will begin in 1983, initially scaling down TA involvement but maintaining some supervisory staff. By the final year of the project all full-time TA, except the team leader, will have departed, leaving their trained counterparts to their tasks.

V. Evaluation.

Four external evaluations are built into the Project and funded under other services. Their role will be to evaluate both methods and progress in the Project and to review the work done by the contract team in impact definition.

The Project's initial survey phase will collect socio-economic baseline data concerning water usage as well as technical data. During the course of the production program, funds are provided under consultancies for follow-up impact evaluation where data can be checked against earlier projections.

The Project will be aided in evaluation by the extensive evaluation mechanisms built into the Central Rangelands and Bay Region Projects. The Central Rangelands Project incorporates an evaluation unit to undertake continual socio-economic monitoring as well as a range and environment unit to monitor ecological change due to construction of water points and installation of range management programs. The Bay Region Project will incorporate similar evaluative units.

It is expected that evaluation teams for the groundwater project will collaborate closely with these other resident groups to draw and analyze data.

In evaluating progress of the Project, the evaluation teams will also appraise WDA effectiveness in accomplishing its implementation tasks, the MMWR effectiveness in gathering and utilizing data and the NWC effectiveness in rationally allocating the capability to develop the water resource base.

VI. Conditions, Covenants and Negotiating Status.

A. Negotiating Status.

The project has been under discussion with the Government since April 1978, when the first PID was drafted. In November, 1978, a revision of the PID was done in which the USGS team collaborated closely with the WDA and MMWR. During the PP preparation, the team has worked with WDA in developing the program and the WDA is well aware of what the Project entails. The USAID Mission has carried on a continuous dialogue with the WDA, the Minister of Mineral and Water Resources and the State Planning Commission. The concept of utilizing the WDA as the unit having water development expertise has been agreed by the National Range Agency.

It is the opinion of the Mission, that final project negotiations will be brief as all concerned ministries are firmly on board.

B. Conditions.

The only condition recommended by the project development team is that AID requires that the GSDR provide to USAID 1:100,000 topographic and vegetation maps for the areas in which the Groundwater Project will be active. This has been discussed with the State Planning Commission and the WDA who feel that it poses no problem. A formal letter of request has been sent to the State Planning Commission requesting these maps.

C. Covenants.

In addition to the standard AID covenants, the Mission recommends the following:

1. The WDA agrees to establish technical, socio-economic and environmental criteria to serve as guidelines for the National Water Committee.

2. The WDA agrees to review their fee collection procedures and schedule with a view toward maximizing efficiency.

3. The WDA and MMWR agree to provide full counterpart staffing for the Technical Assistance staff.

ANNEX 1

LOGICAL FRAMEWORK

Narrative	Objectively Verifiable Indicators	Assumptions
Goal: To provide adequate water supply for the population and livestock of Somalia.	1. Availability of minimum 30 liters per capita per day for each period in Somalia. 2. No range areas left ungrazed due to lack of water.	The Water Resource development is critical to overall development efforts.
Purpose: To develop an on-going water development program to provide potable and livestock water.	1. WDA installing in excess of 50 wells per year at completion of Project. 2. Data system is maintained. 3. Five-year plan includes water development policy.	1. Financing provided for operations of rigs and crews to continue the program. 2. Range Development Program continue as planned.
Outputs: 1. Production wells. 2. Capable institution in WDA for implementing water program. 3. Adequate data base for defining the water resource.	1. 66 primarily livestock wells. 2. 74 primarily domestic wells. 3. WDA undertaking annual work plan. 4. Drilling rigs averaging 8 wells/year. 5. Hydrogeologic maps at 1:100,000 developed. 6. Data being processed with regular updates of hydrogeologic data by MMWR.	1. National Water Committee revitalized. 2. Trained staff remain on the job. 3. User charges adequate to cover operation and maintenance costs.
Inputs: 1. Technical Assistance. 2. Training. 3. Equipment.	See Budgets	1. German program to support WDA on management side is implemented. 2. Counterparts and trainees are available. 3. 1:100,000 base maps are made available. 4. Range Program moves forward as planned.

ANNEX 2
5C(2) - PROJECT CHECKLIST

Listed below are, first, statutory criteria applicable generally to projects with FAA funds, and then project criteria applicable to individual fund sources: Development Assistance (with a subcategory for criteria applicable only to loans): and Security Supporting Assistance funds.

CROSS REFERENCES: IS COUNTRY CHECKLIST UP TO DATE? IDENTIFY. HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PROJECT?

A. GENERAL CRITERIA FOR PROJECT.

1 App. Unnumbered; FAA Sec. 653(b); Sec. 671

(a) Describe how Committees on Appropriations of Senate and House have been or will be notified concerning the project; (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more than $1 million over that figure

a) Congressional Notification will be submitted to Congress.

b) No.

2. FAA Sec. 611(a)(1). Prior to obligation in excess of $100,000, will there be (a) engineering, financial, and other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?

Yes, see Annex 5.

3. FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?

Not required.

4. FAA Sec. 611(b); App. Sec. 101. If for water or water-related land resource construction, has project met the standards and criteria as per *the Principles and Standards for Planning Water and Related Land Resources dated October 25, 1973?*

Yes, see 611 b Certification - Annex 5.

5. FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified the country's capability effectively to maintain and utilize the project?

Yes - see Annex 4.

6. FAA Sec. 209, 619. Is project susceptible of execution as part of regional or multilateral project? If so why is project not so executed? Information and conclusion whether assistance will encourage regional development programs. If assistance is for newly independent country, is it furnished through multilateral organizations or plans to the maximum extent appropriate?

Project is part of a multilateral program with geographic areas being parallel financed by various donors.

A

7. FAA Sec. 601(a); (and Sec. 201(f) for development loans). Information and conclusions whether project will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; (c) encourage development and use of cooperatives, credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions.

N/A

8. FAA Sec. 601(b). Information and conclusion on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).

The U.S. private sector will be invited to provide technical assistance equipment and commodities.

9. FAA Sec. 612(b); Sec. 636(h). Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized to meet the cost of contractual and other services.

All local costs are to be financed by GSDR.

10. FAA Sec. 612(d). Does the U.S. own excess foreign currency and, if so, what arrangements have been made for its release?

No.

11. ISA 14. *Are any FAA funds for FY 78 being used in this Project to construct, operate, maintain, or supply fuel for, any nuclear powerplant under an agreement for cooperation between the United States and any other country?*

No

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

a. FAA Sec. 102(c); Sec. 111; Sec. 281a. Extent to which activity will (a) effectively involve the poor in development, by extending access to economy at local level, increasing labor-intensive production, spreading investment out from cities to small towns and rural areas; and (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions?

Is socially oriented rural program rather than economic, but is critical support element of cooperative rangeland management program.

B1

b. FAA Sec. 103, 103A, 104, 105, 106, 107. Is assistance being made available: [include only applicable paragraph -- e.g., a, b, etc. -- which corresponds to source of funds used. If more than one fund source is used for project, include relevant paragraph for each fund source.]

(1) [103] for agriculture, rural development or nutrition; if so, extent to which activity is specifically designed to increase productivity and income of rural poor; [103A] if for agricultural research, is full account taken of needs of small farmers;

Productivity in both Agricultural and Livestock subsectors are tied very closely to the development of potable and livestock water supplies.

(2) [104] for population planning or health; if so, extent to which activity extends low-cost, integrated delivery systems to provide health and family planning services, especially to rural areas and poor;

Good quality potable water is critical for improving rural sector sanitation.

(3) [105] for education, public administration, or human resources development; if so, extent to which activity strengthens nonformal education, makes formal education more relevant, especially for rural families and urban poor, or strengthens management capability of institutions enabling the poor to participate in development;

N/A

(4) [106] for technical assistance, energy, research, reconstruction, and selected development problems; if so, extent activity is:

(a) technical cooperation and development, especially with U.S. private and voluntary, or regional and international development, organizations;

N/A

(b) to help alleviate energy problem;

(c) research into, and evaluation of, economic development processes and techniques;

(d) reconstruction after natural or manmade disaster;

(e) for special development problem, and to enable proper utilization of earlier U.S. infrastructure, etc., assistance;

(f) for programs of urban development, especially small labor-intensive enterprises, marketing systems, and financial or other institutions to help urban poor participate in economic and social development.

B1b

(5) [107] by grants for coordinated private effort to develop and disseminate intermediate technologies appropriate for developing countries.	N/A
c. FAA Sec. 110(a); Sec. 208(e). Is the recipient country willing to contribute funds to the project, and in what manner has or will it provide assurances that it will provide at least 25% of the costs of the program, project, or activity with respect to which the assistance is to be furnished (or has the latter cost-sharing requirement been waived for a "relatively least-developed" country)?	Yes, the GSDR is making a major budgetary contribution and will utilize their Title I local currency generations to provide over 25 percent of project costs.
d. FAA Sec. 110(b). Will grant capital assistance be disbursed for project over more than 3 years? If so, has justification satisfactory to Congress been made, and efforts for other financing, *or is the recipient country "relatively least developed"?*	Country is relatively least developed.
e. FAA Sec. 207; Sec. 113. Extent to which assistance reflects appropriate emphasis on; (1) encouraging development of democratic, economic, political, and social institutions; (2) self-help in meeting the country's food needs; (3) improving availability of trained workerpower in the country; (4) programs designed to meet the country's health needs; (5) other important areas of economic, political, and social development, including industry; free labor unions, cooperatives, and Voluntary Agencies; transportation and communication; planning and public administration; urban development, and modernization of existing laws; or (6) integrating women into the recipient country's national economy.	Training is important part of the project. Potable water supplies are critical to improved health. Since women hold primary responsibility for drawing, carrying and using water the time they save by having a good water supply close at hand will permit them to increase their involvement in economic activities.
f. FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civic education and training in skills required for effective participation in governmental and political processes essential to self-government.	Water is one of the primary concerns in an arid country, and is one of the greatest perceived needs in rural areas. The project has an institutional bias and encourages full participation in allocation of water resources development capability through the National Water Committee.

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g. FAA Sec. 201(b)(2)-(4) and -(8); Sec. 201(e); Sec. 211(a)(1)-(3) and -(8). Does the activity give reasonable promise of contributing to the development: of economic resources, or to the increase of productive capacities and self-sustaining economic growth; or of educational or other institutions directed toward social progress? Is it related to and consistent with other development activities, and will it contribute to realizable long-range objectives? And does project paper provide information and conclusion on an activity's economic and technical soundness?

Yes, the development of water is central to any development activity and contributes to development in almost all sectors. (See details in Annex 10.)

h. FAA Sec. 201(b)(6); Sec. 211(a)(5), (6). Information and conclusion on possible effects of the assistance on U.S. economy, with special reference to areas of substantial labor surplus, and extent to which U.S. commodities and assistance are furnished in a manner consistent with improving or safeguarding the U.S. balance-of-payments position.

Nearly all A.I.D. funds will be expended in the U.S. for consultants and equipment.

Development Assistance Project Criteria (Loans only)

a. FAA Sec. 201(b)(1). Information and conclusion on availability of financing from other free-world sources, including private sources within U.S.

b. FAA Sec. 201(b)(2); 201(d). Information and conclusion on (1) capacity of the country to repay the loan, including reasonableness of repayment prospects, and (2) reasonableness and legality (under laws of country and U.S.) of lending and relending terms of the loan.

N/A

c. FAA Sec. 201(e). If loan is not made pursuant to a multilateral plan, and the amount of the loan exceeds $100,000, has country submitted to AID an application for such funds together with assurances to indicate that funds will be used in an economically and technically sound manner?

d. FAA Sec. 201(f). Does project paper describe how project will promote the country's economic development taking into account the country's human and material resources requirements and relationship between ultimate objectives of the project and overall economic development?

B2

e. FAA Sec. 202(a). Total amount of money under loan which is going directly to private enterprise, is going to intermediate credit institutions or other borrowers for use by private enterprise, is being used to finance imports from private sources, or is otherwise being used to finance procurements from private sources?

f. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete in the U.S. with U.S. enterprise, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan?

3. Project Criteria Solely for Security Supporting Assistance — N/A

a. FAA Sec. 531. How will this assistance support promote economic or political stability?

b. FAA Sec. 533(c)(1). *Will assistance under the Southern African Special Requirements Fund be used for military, guerrilla, or paramilitary activities?*

4. Additional Criteria for Alliance for Progress

[Note: Alliance for Progress projects should add the following two items to a project checklist.]

a. FAA Sec. 251(b)(1), -(8). Does assistance take into account principles of the Act of Bogota and the Charter of Punta del Este; and to what extent will the activity contribute to the economic or political integration of Latin America?

b. FAA Sec. 251(b)(8); 251(h). For loans, has there been taken into account the effort made by recipient nation to repatriate capital invested in other countries by their own citizens? Is loan consistent with the findings and recommendations of the Inter-American Committee for the Alliance for Progress (now "CEPCIES," the Permanent Executive Committee of the OAS) in its annual review of national development activities?

5C(3) - STANDARD ITEM CHECKLIST

Listed below are statutory items which normally will be covered routinely in those provisions of an assistance agreement dealing with its implementation, or covered in the agreement by exclusion (as where certain uses of funds are permitted, but other uses not).

These items are arranged under the general headings of (A) Procurement, (B) Construction, and (C) Other Restrictions.

A. Procurement

1. FAA Sec. 602. Are there arrangements to permit U.S. small business to participate equitably in the furnishing of goods and services financed?	Yes
2. FAA Sec. 604(a). Will all commodity procurement financed be from the U.S. except as otherwise determined by the President or under delegation from him?	Yes
3. FAA Sec. 604(d). If the cooperating country discriminates against U.S. marine insurance companies, will agreement require that marine insurance be placed in the U.S. on commodities financed?	N/A
4. FAA Sec. 604(e). If offshore procurement of agricultural commodity or product is to be financed, is there provision against such procurement when the domestic price of such commodity is less than parity?	N/A
5. FAA Sec. 608(a). Will U.S. Government excess personal property be utilized wherever practicable in lieu of the procurement of new items?	Yes
6. MMA Sec. 901(b). (a) Compliance with requirement that at least 50 per centum of the gross tonnage of commodities (computed separately for dry bulk carriers, dry cargo liners, and tankers) financed shall be transported on privately owned U.S.-flag commercial vessels to the extent that such vessels are available at fair and reasonable rates.	Yes
7. FAA Sec. 621. If technical assistance is financed, will such assistance be furnished to the fullest extent practicable as goods and professional and other services from private enterprise on a contract basis? If the facilities of other Federal agencies will be utilized,	Yes

A7

are they particularly suitable, not competitive with private enterprise, and made available without undue interference with domestic programs?

8. International Air Transport. Fair Competitive Practices Act, 1974

If air transportation of persons or property is financed on grant basis, will provision be made that U.S.-flag carriers will be utilized to the extent such service is available? — Yes

B. Construction

1. FAA Sec. 601(d). If a capital (e.g., construction) project, are engineering and professional services of U.S. firms and their affiliates to be used to the maximum extent consistent with the national interest? — Yes

2. FAA Sec. 611(c). If contracts for construction are to be financed, will they be let on a competitive basis to maximum extent practicable? — N/A

3. FAA Sec. 620(k). If for construction of productive enterprise, will aggregate value of assistance to be furnished by the U.S. not exceed $100 million? — N/A

C. Other Restrictions

1. FAA Sec. 201(d). If development loan, is interest rate at least 2% per annum during grace period and at least 3% per annum thereafter? — N/A

2. FAA Sec. 301(d). If fund is established solely by U.S. contributions and administered by an international organization, does Comptroller General have audit rights? — N/A

3. FAA Sec. 620(h). Do arrangements preclude promoting or assisting the foreign aid projects or activities of Communist-Bloc countries, contrary to the best interests of the U.S.? — Yes

4. FAA Sec. 636(i). Is financing not permitted to be used, without waiver, for purchase, long-term lease, or exchange of motor vehicle manufactured outside the U.S. or guaranty of such transaction? — Yes

5. Will arrangements preclude use of financing:

a. FAA Sec. 114. to pay for performance of abortions or to motivate or coerce persons to practice abortions, *to pay for performance of involuntary sterilization, or to coerce or provide financial incentive to any person to practice sterilization?*	Yes
b. FAA Sec. 620(g). to compensate owners for expropriated nationalized property?	Yes
c. FAA Sec. 660. to finance police training or other law enforcement assistance, except for narcotics programs?	Yes
d. FAA Sec. 662. for CIA activities?	Yes
e. App. Sec. 103. to pay pensions, etc., for military personnel?	Yes
f. App. Sec. *105*. to pay U.N. assessments?	Yes
g. App. Sec. *106*. to carry out provisions of FAA Sections 209(d) and 251(h)? (transfer to multilateral organization for lending).	Yes
h. App. Sec. *112*. *to finance the export of nuclear equipment, fuel, or technology or to train foreign nationals in nuclear fields?*	Yes
i. App. Sec. 501. to be used for publicity or propaganda purposes within U.S. not authorized by Congress?	Yes

DRAFT

ANNEX 3

PROJECT AUTHORIZATION AND REQUEST FOR ALLOTMENT OF FUNDS

PART II

Name of Country/Entity: Somalia

Name of Project: Comprehensive Groundwater Development

Number of Project: 649-0101

Pursuant to Part____, Chapter____, Section____ of the Foreign Assistance Act of 1961, as amended, I hereby authorize a Grant to Somalia the "Cooperating Country" of not to exceed three million two hundred thousand United States dollars ($3,200,000) the "Authorized Amount" to help in financing certain foreign exchange costs of goods and services required for the project as described in the following paragraph.

The project consists of an overall water development program beginning with hydrogeological and geophysical studies and then moving into a program to drill approximately 140 wells while continuing the data collection begun with the initial studies. Specific geographic areas encompassing 4 regions of the country have been identified as priority areas while 4 adjacent regions are regarded as peripheral areas which can be served from the same regional centers. The project includes a large institution building component to develop the Water Development Agency and the hydrological section of the Ministry of Minerals and Water Resources to give these agencies the the capability to continue the drilling and data analysis activities after the

end of the project. The project provides for 65 man years of technical assistance, 12 years of participant training, over 70 professionals and technicians to be trained in-country and the necessary equipment support for the exploration and drilling program.

I approve the total level of A.I.D. appropriated funding planned for this project of not to exceed twelve million nine hundred thirty six thousand United States dollars ($12,936,000), in Grant funds including the funding authorized above, during the period FY 1979 through FY 1983. I approve further increments during that period of Grant funding up to $9,736,000, subject to the availability of funds in accordance with A.I.D. allotment procedures.

I hereby authorize the initiation of negotiation and execution of the Project Agreement by the officer to whom such authority has been delegated in accordance with A.I.D. regulations and Delegations of Authority subject to the following essential terms and covenants and major conditions; together with such other terms and conditions as A.I.D. may deem appropriate:

a. Source and Origin of Goods and Services

Except for Ocean Shipping, Goods and Services financed by A.I.D. under the project shall have their source and origin in the Cooperating Country or in the United States, or in countries included in A.I.D. Geographic Code 941 except as A.I.D. may otherwise agree in writing.

b. Prior to any disbursement, or theissuance of any commitment documents under the Project Agreement, Grantee shall furnish in form and substance satisfactory to A.I.D., 2 copies of 1:100,000 topographic and vegetation maps for the project priority and peripheral areas.

c. Grantee shall covent_____

1) The WDA will establish technical socio-economic and environmental criteria to serve as guidelines for the National Water Committee.

2) The WDA will review their fee collection procedures and schedule with a view toward maximizing efficiency.

3) The WDA and MWR will provide full counterpart staffing for the Technical assistance staff.

d. The following waivers to A.I.D. regulations are hereby approved._____

1. Based on the project vehicle standardization plan for Somalia a proprietary procurement waiver for the purchase of _____manufactured light passenger vehicles is authorized.

Clearnaces:	Typed Name	Office Symbol	Data	Initials
	A.			
	B.			
	C.			
	D.			

Signature _____

_____
Typed Name of Authorizing Officer

_____
Office Symbol

ANNEX 4

611 E CERTIFICATION

COMPREHENSIVE GROUNDWATER DEVELOPMENT

649-0104

The purpose of this project is to develop a capability within the Government of Somalia's Ministry of Minerals and Water Resources and its implementing agency, the Water Development Agency, to plan and implement a water resource development program for the country. The A.I.D.-financed inputs include the technical assistance and training required to prepare the essential agencies for their tasks and the equipment and commodities required to begin a well-drilling program in 4 regions of the country. By the end of the project 140 deep wells will have been installed, hydrogeological maps for approximately half the country will have been prepared and some 70 professional and technical staff will have received intensive and on-the-job training.

Somalia's ability to maintain and utilize a program such as this is best indicated by the A.I.D.-financed Mogadishu Water Supply Program which was undertaken in the early 1960s and which they have maintained in operation since that time. Several drill rigs brought in at that time are still operating in rural areas despite the critical lack of spare parts. The financial analysis for the project demonstrates that the present water charge structure provides sufficient income to cover operation and maintenance costs of the wells.

I, Charles P. Campbell, A.I.D. Mission Director in Somalia, certify that the Government of Somalia will have, at the end of the project, the financial and human resources to operate and maintain the wells and equipment provided under the Comprehensive Groundwater Development Project. The GSDR has demonstrated in the past its capabilities in the Water Resource Sector and with the existing water charge structure the wells will be financially self-sustaining.

P. Campbell

Charles P. Campbell
Director
USAID/Somalia

Date

ANNEX 5

611a DETERMINATION

Reserved for REDSO action.

Department of State TELEGRAM

PAGE 01 MOGADI 02160 180936Z 0465
ACTION AID-31

INFO OCT-01 AF-10 EB-08 OES-09 /059 W
----------095189 180939Z /17

R 180618Z JUN 79
FM AMEMBASSY MOGADISCIO
TO SECSTATE WASHDC 8644

UNCLAS MOGADISCIO 2160

AIDAC

AFR/DR

E.O. 12065: N/A
TAGS: N/A
SUBJECT: YRO-0104 GROUNDWATER FAA 611 (A) AND (B)

FOLLOWING MESSAGE SENT MOGADISCIO PRIORITY ON 14 JUN FOR ACTION
REPEATED HERE FOR UR ACTION

QTE
UNCLAS NAIROBI 10495

AIDAC

E.O. 12065: N/A
SUBJ: PROJECT 694-0104 - GROUND WATER DEVELOPMENT FAA 611 (A)
AND 611 (B) DETERMINATION - DRAFT PP.

REF: (A) MOGADISCIO 1953 (B) MOGADISCIO 2008

1. REQUIREMENTS OF FAA 611 (A) AND (B) ARE CONSIDERED SATIFIED
SINCE (I) PROJECT AREAS HAVE BEEN IDENTIFIED, HOWEVER,
ACTUAL SITE SELCTION WILL DEPEND UPON ADEQUATE HYDROGEOLOGICAL
DATA, (II) KIND AND AMOUNT OF EQUIPMENT HAVE BEEN IDENTIFIED,
(III) HYDROLOGICAL MAPS FOR PROJECT AREA ARE AVAILABLE, (IV)
NUMBER AND TYPES OF WELLS HAVE BEEN ESTABLISHED, (V) ORGANIZATIONAL
[illegible]
PROJECT HAVE BEEN REVIEWED AND, AS A RESULT TECHNICAL
ASSISTANCE AND TRAINING HAS BEEN PROVIDED TO REMOVE PERCE-
IVED CONSTRAINTS TO PROJECT IMPLEMENTATION, (VI) MAINTENANCE
REQUIREMENTS HAVE BEEN IDENTIFIED AND RESONABLY FIRM COST
ESTIMATES HAVE BEEN COMPUTED, (VII) COMPUTATION OF TANGIBLE
AND INTANGIBLE BENEFITS AND COST HAVE BEEN IDENTIFIED.

2. RDSO BELIEVES PP TECHNICALLY SOUND AND WELL PRESENTED.
HOWEVER, SUCCESS OF PROJECT IMPLEMENTATION IS HINGED ON TIMELY
AVAILABILITY OF QUALFIED LOCAL MANPOWER TO WORK WITH USTA
AND FOR OVERSEAS TRAINING, HOUSING AVAILABILITY AND, LOCAL
LOGISTICS, MISSION SHOULD SUFFICIENTLY COVER THESE ISSUES
UNDER COVENANT. SIGNED BLANE
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ANNEX 6

GROUNDWATER

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ANNEX 6

GROUNDWATER

INTRODUCTION

Personnel interviewed for the groundwater portion of the project paper included the General Managers of the WDA and NRA plus administrative staff of both agencies and the MMWR. Additionally, experienced expatriate staff working in Somalia on groundwater supply projects were also interviewed as to their opinion and experiences with the ligistic and technical capabilities of the WDA, MMWR and NRA.

Existing projects in operation include the Trans-Juba water supply project, the water supply for the city of Baidoa by the Chinese, water supply for the cities of Burao, Merka, Dusa Mareb and Galcaio by the FRG.

Little is known of the Chinese-installed projects, however, the German plan has been to drill the wells themselves and then provide technical advisory training to the WDA for a period of time afterwards.

Literature review included the 1973 UNDP-FAO Hydrogeologic Investigation of Somalia; the UNEC Hydrogeologic Review of Somalia by W. F. Grimmelman, 1977; the Hydrogeologic Study of the Bur Region, Indotecneco, 1975; and "A Program for the Allocation of Deep Wells to Rural Areas", German Planning and Economic Advisory Group, 1976.

Field investigations included trips to and examination of well installations at Afgoi, Merka, Mogadiscio, Belat Wynn, Dusa Mareb, Galcaio, Baidoa, Burao and Sheikh.

SUMMARY

The installation of water wells to support the Central Rangelands, Northern Rangelands and Bay Regions is immediately required.

Groundwater resources are distributed unevenly throughout Somalia, they have been poorly studied and currently only a relative qualitative evaluation of the resource can be made. Water quality with some exceptions is generally poor, being high in TDS, particularly in the upper aquifers.

A groundwater data base is lacking for much of the country and to establish one requires investigation of the occurrence, movement, storage, recharge, discharge, quantity and quality. This can best be effected by field geologic studies, exploratory test wells, geophysical probing, pump tests, etc. On-going improvement of the data base can be accomplished by measurements of water levels and artesian pressure heads. A data base will greatly improve the success ratio of productive wells drilled over the estimated 40% success ratio that currently exists.

The Groundwater Development Project will strengthen the capability of the WDA and the Ministry of Minerals and Water to locate and provide potable water to the rural sector.

The project is multifaceted in that it includes institutional support, an integrated exploration and well drilling program, and a training program geared toward improving well location and drilling techniques with a strong maintenance capability development aspect.

The program will allow the WDA to support the water development components of the Central Rangelands and the Bay Regions projects as well as complimenting the Northern Rangelands, the Kurtunwaare Settlement, and the Rural Health Delivery Projects.

The critical linkages between the Groundwater Development Project and other projects (Bay, Kurtunwaare, Central Rangelands, Northern Rangelands) is the inter-agency cooperation in the National Water Committee (NWC) and through contractual arrangemants and agreements (especially in regard to the new Rangelands Law which strongly impacts the rural section) to assure that environmental concerns and technical concerns are equally addressed. The NWC as a mechanism to coordinate the programs is important for the project to be effective.

The Project is essentially one of improving the institutional capacities of the WDA and MMWR by filling in the gaps that exist currently and strengthening the ability to provide potable water to the rural sectors.

The Project will improve the supply of potable water in the rural regions for livestock and human consumption through the exploration effort and the drilling of 32 deep wells in the Central Rangelands, 60 deep wells and approximately 4 uars in the Bay Region, 10 wells in the Northern Regions and 50-75 wells for rural water supply around the periphery of the Project areas. Through the use of inert well casings the problem of well failure due to encrustation and corrosion will be greatly reduced. Maintenance will be simplified through the use of low maintenance submersible pumps. Sanitation will be improved by sounder well design practices and the elimination of access by buckets in the deep wells.

The Project would develop the capabilities of the WDA at the regional level, which is where the work for the rural sector is needed. It will require a strong commitment by the WDA to provide the best possible technical personnel for training throughout the life of the Project in a rugged environment. Housing in the field will be required for 13 expatriate personnel.

The Project provides 65 expatriate man-years of technical and management training on the job. Additionally formal training is included to provide approximately 14 Somali man-years of education through a series of eight short courses to be delivered by expatriate specialists and 12 man-years of training abroad.

Five drilling rigs (three rotary and two percussion) plus three completely outfitted bore hole geophysical trucks along with basic hydrogeology and water quality analysis equipment will be provided through the Project.

REVIEW OF LITERATURE AND DATA GAPS

There is extensive literature available on the rural hydrogeology in Somalia, which is best summarized in two documents of the UNDP-FAO, and by the German firm of F. M. Kochs.

The only source of the former document has been the personal copies of Marsolin Jones, U.N. hydrogeologist. Summaries of the documents are present in the UNDP-FAO library behind the National Planning Agency where other pertinent documents are also available. UNDP-FAO Rome, Italy, may be the only place where systematic well and water quality data, taken during the intense U.N. hydrogeologic reconnaisance survey, is available.

Rainfall data is also lacking at the NRA, MMWR and the WDA. Some rainfall data appears in agricultural reports and it is possible that the Ministry of Agriculture periodically collects such data.

Well data, specifically by location, geologic logs, water levels, quality, utilization, etc., is totally lacking at the MMWR, WDA and the NRA.

Hydrogeologic maps of a scale 1:2 million have been prepared by the U.N. FAO Report, Mineral and Groundwater Survey (Phase II), Somalia, 1972. The scale is sufficient for general reconnaisance surveys but unsuitable for individual well locations, and insufficient to show areal, deep bore-hole locations because of the relatively few numbers identified.

Russian topographic maps of scale 1:100,000 are in the possession of the MMWR, but have not been released due to military significance. These will be obtained as a condition precedent before Phase I planning. This will serve to reduce the costs involved in preparing maps for the Project. I have seen these maps for the Northern Rangelands area and they are very thorough and complete. The detail not only includes the location of wells but also notes the method of water removal.

WATER SUPPLY DEVELOPMENT ALTERNATIVES

The Groundwater Development Project as presented in the PID and modified in the Project Paper, is an alternative to allowing the continuation of the inefficient program of poking holes throughout Somalia in the hope of finding sufficient potable water to sustain the population.

Such a method is not only inefficient and expensive but contributes to the degradation of the groundwater aquifers through mixing of water from saline aquifers with fresh water lenses.

The alternative, heretofore practiced, of bringing in an expatriate drilling team to put in a series of wells and then departing does nothing to develop the institutions of Somalia in the field of water supply. Consequently the inability to service the country's water needs is perpetuated or at best improved only by a handful of wells. In a country where the perceived need is for an additional 3,000 wells in the rural sector, it is imperative that the well locating, drilling and maintenance capability be developed rapidly.

The WDA, in addition to having been given the responsibility for water supply in the rural sector, has the nucleus of an existing organization with capability to drill a few wildcat wells each year. It is most logical to attempt to build this institution rather than to initiate any others.

A centrally located, capable organization for the development of rural water supply wells can more efficiently and economically serve the needs of the rural sector than several fragmented efforts such as the Central Rangelands Project which, initially, focused on developing a well drilling capability within the NRA.

HYDROGEOLOGY

In 1973, the United Nations, as the executing agency for the U.N. Development Programme, completed an inventory of groundwater sources. This document, although it does not include any in-depth interpretation, provides a comprehensive and up-to-date record of general groundwater conditions and usage in Somalia.

In the UN document, 946 water points were studied and 881 water analyses completed. Of the 946 water points, 128 were boreholes with information, the remainder are water points without information, i.e. shallow wells and springs, located in streambed sands and gravels. Considering that some borehole logs are reported as being of doubtful origin, and that some are poorly constructed and provide doubtful data, it is probable that there are no more than 60-70 representative boreholes in the 640,000 Km^2 of Somalia. Thus, it is clear that the present state of knowledge is poor, and that future studies and investigations must be based initially on conceptual studies and professional opinions. This report is such a conceptual approach.

General Topography

The Horn of Africa is dominated by four main topographic units:

- a mountainous zone in the north,
- a broad limestone-sandstone basin covering all central and southern Somalia and the Ogaden region,
- a thin strip of coastal plains, and
- the broad swampland area of the Lower Shebelli and Lower Juba Region, in the south.

In northern Somalia, the topography is dominated by the northern mountain range where the relief is high and precipitous. The mountains have a thin overburden, rock outcrops are numerous and the soils stoney and of poor quality. Adjacent to the mountains, streams are deeply incised, the relief is high and erosion still active. Away from the mountains the relief decreases, erosion is minimal and the lesser inland streams eventually lose their identity in the desert sands. This lower country, i.e., surficial sands, clays, laterites and calcretes, has been eroded into the two characteristic erosion levels of the Old and the New African surface.

Several major drainages commence in the mountains, but only two, the Juba and the Shebelli, are destined to become rivers and reach the sea. Other drainages, clearly major ones in ancestral times, now flow only after heavy rains and then only for short distances. The underflow associated with these ancestral streams has long since become stagnant and gives rise to numerous gypsiferous "shoestring" deposits. From satellite imagery, these deposits produce a bizarre picture of "salt" lakes set in an otherwise featureless desert area.

To the south, in the Baidoa region, the topography is dominated by the Bur basement complex. This is an elevated area characterized by enormous granite inselbergs. To the west, the country is composed of limestone where surface streams are non-existant and there is much evidence of Karstic zones.

General Geology

On a regional scale the geology of Somalia is relatively simple, and in broad diagrammatic fashion it is attached. The Stratigraphic Column, taken directly from the main UNDP reference is attached.

In the north the western third of the mountains consists of metamorphics, crystalline rocks and basalt, the central third of sediments, and the eastern third of sediments with metamorphics and some basalt. There are numerous valleys and alluvial plains within the mountainous zone.

Table 1. Summary of Stratigraphy (Continued)

Era	Period	Epoch	Series or Suite	Symbol (in m 2)	Thickness (metres)	Character	Distribution
Mesozoic (contd.)	Cretaceous (contd.)	Lower	Elustabil Suite	Cr_1 es	120-180	Gypsiferous siltstone, mudstone, interbedded limestone	West of Scebeli River
			Mon Gypsum, Gabra Harre, Mao sub-suite	Cr_1 mg	350-450	Gypsum, anhydrite, interbedded gypsiferous clay, dolomite and limestone	West of Scebeli River and along Ethiopian border to Guiba River
		Undifferentiated	Marchan suite	Cr_{1-2} mr	300	Sandstone, occasional layers of clay	Border area near Kenya
	Jurassic	Upper	Gabra Harre Suite, Busol Sub-suite	J_3 bs	400	Bioclastic and oolitic limestone, dolomite, quartz sandstone, marl	Northern part of Scebeli-Giuba interfluve
			Degit Suite	J_3 dg	350	Coralline limestone, calcarenite, pisolitic marker band of algal limestone	Northern part of Scebeli-Giuba interfluve
			Anole Suite	J_3 an	300-450	Marly or clastic limestone, marl, limy clay	Northern part of Scebeli-Giuba interfluve
			Iscia Baidoa Suite	J_3 bd	250-870	Four members. 1) Deleh (base) quartz sandstone and conglomerate - 40m, 2) Uanei thin bedded limestone, limy clay and marl-120 m, 3) Baidoa clastic and lithographic limestone - 90m., capped by 4) Goloda detrital limestone in places 620 m.	Western and northern edges of the Bur massif, Southern provinces
		Upper Middle undifferentiated	Bihendyla Suite	J	830-950	Limestone, interbedded siltstone, mudstone, sandstone, marly shale, some gypsum and conglomerate	Central mountainous zone
		Lower	Adigrat Suite		40-1,000	Coarse-grained quartz sandstone, interbedded siltstone in lower part, limy sandstone and limestone in upper part	Western and central mountainous zone
			Unnamed unit	J_1	80	Limestone, mudstone, sandstone in lower part	North east edge of Bur area
Paleozoic	Lower	Undifferentiated	Post India Ad Series	δ_2	More than 1,000	Granite, pegmatite, aplite, quartz porphyry	Mountainous zone between latitudes 47° and 49° N.
			India Ad Series: Helvero Suite	Ya	200-300	Pelite, siltstone, sandstone, interbedded limestone	
			India Ad Series: Semat Suite		800	Tuffaceous sandstone and siltstone, interbedded conglomerate, mudstone, schist	
			India Ad Series: Haddit Suite		2500	Inequigranular sandstone, siltstone, conglomerate	
			India Ad Series: Magno Suite		2000	Sandstone, siltstone	
	Upper		India Ad Series: Arar Suite		3000	Sandstone, conglomerate, siltstone, mudstone, interbedded carbonate rock	
Proterozoic	Lower	"Basement Complex"	Acidic igneous rock	δ_1	More than 1000	Granite, granodiorite (commonly gneissoid), pegmatite, aplite, quartz porphyry	Western mountainous zone
			Basic igneous rock	γ	More than 1000	Gabbro, ultrabasite, syenite, monzonite	
			Abdel Cadir Hers Series	akh	More than 1000	Andesite, tuff, pelite, schist, gneiss	Western mountainous zone, northwest of Erigavo
			Bosaso Darbarruk Series	bd	More than 1000	Metamorphic carbonate psammite, pelite, schist, gneiss	Western mountainous zone
	Undifferentiated Precambrian		Bur igneous rock	δ	More than 1000	Granite, some gneissoid, minor syenite, diorite and gabbroid rock	
			Bur Acaba Series	Pcm	More than 1000	Gneiss, schist, amphibolite, quartzite, minor marble, carbonate and siliceous rocks	Bur area west of Mogadiscio

From Report of T. H. Johnson

Table 1. Summary of Stratigraphy

Era	Period	Epoch	Series or Suite	Symbol (map 2)	Thickness (metres)	Character	Distribution
Cenozoic	Neogene	Recent-Pleistocene	Surface cover	Not mapped	0-5	Breccia conglomerate, caliche over limestone, laterite over sandstone, gypsum crust	General throughout country
			Stream alluvium	Q al	100	Interbedded sand, sandy loam, loam and clay	Scebeli and Giuba river valleys, along intermittent streams
		Recent-Pliocene	Sand dunes and bars	N_2-Qplrdl	0-120	Fine grained wind deposited sand, friable sandstone, reef deposits	Coast of Indian Ocean and Gulf of Aden
			Proluvium and near-shore marine deposits	N_2 Qplrm	120-150	Gravel and boulder accumulations, coarse sands, coral and reef limestone	Coastal plain of North West Region, narrow strip along Gulf of Aden
			Proluvium, deluvium	N_2-Qeolrm	180-220	Gypsiferous clay, sand, gravel and loam	Northern provinces. Haud plateau and intermontane trenches
			Proluvium, alluvium	N_2-Qplral	100-120	Clay, sand, loam, lenses of gravel	Southern provinces, lower reaches of Guiba River
		Pleistocene-Pliocene	Aden volcanic Series	βN_2-Q_1ad	20-70	Basalt and tuff	Northern provinces. Northeast mountainous zone
		Pliocene-Miocene	Upper Daban Series	N_1-N_2ud	100-125	Sandstone and conglomerate	Northern provinces. Gulf of south of Bosaso
		Miocene	Mudugh-Merca Suite	N_1 md	40-500	Limestone, marl, sand, sandstone, gypsum	Southern provinces. Mudugh plateau and coast
		Miocene-Oligocene	Hafun and Dubar Series	Pg_3-N_1db	40-560	Conglomerate, coral and foraminiferal limestone, sandy clay	Indian Ocean Coast North of Hordio (Hafun) and Gulf of Aden Coast (Dubar)
			Scusciuban Series	Pg_3-N_1sb	150-200	Marl, interbedded gypsum, clay and sandstone	Darror depression
		Miocene-Paleocene	Trap Series	βPg-N_1	60-80	Basalt and tuff	Northern Scebeli-Giuba interfluve
	Paleogene	Oligocene	Middle Daban Series	Pg_3 mdn	800-2,000	Sandstone, siltstone, limestone, lenses of boulder conglomerate	Southeast of Berbera, North West Region
			Marine facies of Hafun Series	Pg_3m	200-220	Biogenic limestone, limy sandstone, clay	Indian Ocean coast between Hordio and Eil
		Eocene	Lower Daban Series.	Pg_2 ld	245	Sandstone, siltstone, marl, lenses of gypsum and conglomerate, occasional silicified wood	South of Berbera, North West Region
			Karkar Suite	Pg_2 kr	80-230	Limestone, minor marl, clayey dolomite, siltstone	Northern provinces. Eastern mountainous zone (Mijurtinia)
			Taleh Suite	Pg_2 tl	350	Anhydrite, gypsum, interbedded dolomite and marl	Eastern mountainous zone, Haud and Sol Haud plateaux, Nogal Valley
			Auradu Series	Pg_2 ar	200-400	Massive limestone, dolomitic limestone, dolomite, marl, siltstone	Eastern mountainous zone and Haud plateau
		Paleocene	Jesomma Suite	Pg_1 js	100-200	Inequigranular cross bedded sandstone, minor siltstone and compact clay	East of Scebeli River and south of Hargeisa
		Paleocene-Cretaceous	Undifferentiated	Cr-Pg_1	200-1700	Massive limestone and sandstone, inequigranular sandstone, gravel, cross-bedded sandstone, siltstone, mudstone.	Western mountainous zone, escarpment, Haud plateau
Mesozoic	Cretaceous	Upper	Fer Fer Suite	Cr_2 fr	55-90	Gypsum, anhydrite, interbedded dolomite	East of Scebeli River at border with Ethiopia
			Belet Uen Suite	Cr_2 bl	200	Limestone, marl, gypsiferous shaly clay	North east of Scebeli River

The remainder of Somalia, to the south and stretching west into Ethiopia and south into Kenya, consists of a broad basin complex. Hydrogeologically this basin can be regarded as two principal separate sub-basins of the Ogaden Basin. The northern sector is referred to as the Northern Ogaden Sub-Basin, and the southern sector is referred to as the Baidoa Sub-Basin. A small sub-basin exists also in the Uadi Giohel area near Hordio; this is the Darror Depression Sub-Basin. Though the Baidoa Sub-Basin has a distinctly different hydrogeological regime, it is part of the same conformable sedimentary sequence, and consists of the lower Jurassic-Cretaceous rock suite. The northern sub-basins consist of the overlying Paleocene Suite.

Geological structure is important in Somalia. The major structure is the long coastal fault, which is downthrown towards the coast. The fault affects not only the underflow regimes of the basin but also the underflow regimes of the alluvial deposits which cross it. In the Northern Ogaden Sub-Basin, a series of anticlinal and synclinal structures trend NW-SE; they also have a hydrogeological influence especially in the Nogal Valley and Erigavo areas, but the nature of this influence is unknown. In the Baidoa Sub-Basin, the strata is draped over, and dips away from, a central bedrock high. This "high" is the Bur basement complex of granites, amphibolites and jaspilites, etc. In the west Baidoa Basin, structure (mainly folding and faulting) develops progressively until the basin crosses the present border with Ethiopia.

From the satellite imagery several stagnated alluvial systems are obvious. In this report these are tentatively named, the

- Uadi Giohel System,
- Erigavo-Uadi Nogal System,
- Galcaio System, and the
- Dusa Mareb System.

With the possible exception of the Uadi Giohel System, all systems, including the Shebelli and Juba River ones, have been affected in some way by the coastal fault.

THE PROJECT

Institutions

The WDA is the principal organization in carrying out the Groundwater Development Project for the rural sector.

The WDA is an autonomous agency under the Ministry of Minerals and Water Resources. It has six regional offices located in Hargeisa, Burao, Galcaio, Giohar, Baidoa and Kismayo.

Under the main administrator, the General Manager, there exist divisions of hydrogeology, drilling, engineering and administration. The WDA employes 235 personnel in Mogadiscio. It has six regional offices in Hargeisa and Burao in the north; Galcaio in the center; Baidoa, Giohar and Kismayo in the south. These offices have a staff of 236 with room overall for 896.

The availability of competent hydrogeologists for field duty in Somalia is extremely limited. There are no hydrogeologists assigned to field duty in the WDA. Two hydrologists, one an administrative post and the other an assistant stationed in Mogadiscio, are all that exist in the WDA. There is one administrative position filled in the Ministry of Minerals and Water. In the 15 Regional Offices of the WDA outside of Mogadiscio, there is no technical staff.

There are reportedly 15 drilling crews of 16 persons each that man the six or seven operating drill rigs within the WDA. This is out of a total of 22, of which 15 are rotary and 7 are cable tool. There are 10 Russian-made rigs, for which no replacement parts are available, and which are cannibalized extensively to keep some of them operating. Geophysical equipment exists at the WDA but is non-operable. There are two drilling rigs within the MMWR -- one is a new Russian rig and the other an old Russian rig. (See Attachment 2).

While the drillers, apparently, are competent to operate a drilling rig, they lack the training to perform systematic analysis of materials encountered or make judgements related to screen size or placement, a necessity when drilling without the aid of a competent geologist.

The manpower shortage, acute at present and with little chance for rapid expansion (particularly due to the high demand for technical personnel in the Arab States), would tend to dictate that the training and expertise in water resources be concentrated in one or two areas and not spread thinly throughout the various government agencies.

Institution building is a major need and a primary objective of the Groundwater Development Project. Neither the WDA, nor the MMWR, whose functions often overlap, appear to be able to fulfill their basic functions in their present state.

The intention of the Project, institutional-wise, is that by the time that the Groundwater Development Project has entered its fifth year, the WDA would have developed a strong enough rural sector manpower base to carry forward the responsibility of developing water supply in the rural sector without outside assistance.

The plan of the Project is to develop the technical manpower capability of the WDA at the regional level where it is most critically needed through an intensive on-the-job training program supplemented with a series of groundwater formal short courses throughout the project life.

Through the Project, which has a strong data base establishing element, the Ministry of Minerals and Water will become an effective repository for all data related to groundwater in the country. As the office responsible for the evaluation and interpretation of these data, it will be able to perform its designated function of making recommendations through publications that identify the most beneficial development of the resources.

The institution-building component will be effected by the presence of 20 expatriate technical task who will contribute 65 man-years in training counterpart technicians as well as assisting in the rural sector well location, drilling, testing, installing and maintenance implementation program.

The Project will also provide for up to 1½ man-years of consulting services to supplement the resident manpower resource. The extent and need for consulting services would be established by the Team Leader in consultation with the General Manager of the WDA and his technical staff.

The Project technical unit, staffed by expatriate experts, would be headed by a Team Leader, headquartered in Mogadiscio. Due to the broad scope of the Project, all the disciplines and functions within the WDA, as well as some of the Ministry of Minerals and Water Resources will be involved.

It will be the responsibility of the WDA and the Ministry of Minerals and Water Resources to furnish the necessary counterpart staff for technical on-the-job training. The Ministry of Minerals and Water Resources is required to furnish counterpart staff for training in water chemistry, water quality analysis, laboratory instrument operations and data collection. The WDA is required to furnish counterpart technical personnel at the regional level for training and implemantation of the Project. A minimum of five hydrogeologists, three geophysical technicians, five drilling crews, three English-speaking mechanics, an English-speaking electrician and all necessary support personnel are necessary for the field organizationsl centers.

Additional counterpart staff will be required in Mogadiscio for training and selected field assignments (particularly engineering design). The counterpart staff will be trained in field exploration, data collection and analysis, well siting, drilling, logging, well development, testing, pumping installation and well equipment maintenance.

The counterpart staff will be under the direction of the Project Management team and will be assigned to the Regional Centers for the duration of the Project.

The WDA will coordinate activities with the Ministry of Minerals and Water and the contractual arrangements for water supply installation for the Ministry of Agriculture and the National Range Agency.

Data will be supplied to the Ministry of Minerals and Water Resources to assist them in carrying out their applied research function and the publishing of basic data and interpretative reports.

The Team Leader will be responsible for organizational preparation and control of the necessary works for the installation of wells and appropriate pump equipment as well as the detailed instruction of the WDA personnel assigned to the Project.

TRAINING PROGRAM

Within the WDA, the technical capability in relation to hydrogeology currently is present only at the administrative level.

To be able to develop a data base, personnel in the hydrogeology section will need to be trained in basic geology and field mapping techniques as well as the basics of hydrogeology such as well inventorying, monitoring of wells and rain gauges, well sampling techniques and materials description, basic well design, supervision of bore-hole drilling, down-the-hole geophysical techniques, etc.

For the maintenance personnel, the need is to learn about pumps and motors, how to install and maintain equipment and perform failure diagnosis and repairs.

The training of the Somali technical staff can take three basic forms:

1. Building the university system to have the capability to offer a curriculum leading to proficiency in groundwater hydrology.

2. Taking a selected few local university graduates and sending them to a U.S. university specializing in groundwater curriculum such as University of Arizona, University of Southern California, University of Missouri, or Ohio State University.

3. Importing experienced groundwater personnel to offer short courses in hydrogeology for several students. This would be specifically oriented toward building a strong foundation of capabilities in those areas of study germane to Somalia.

The local University capability option does not currently exist in Somalia for groundwater hydrology. To develop the same would require the importation of large numbers of expatriate staff and the creation of a new department.

It would take a minimum of two to three years to produce a hydrogeologist ready for field training.

The export of students for overseas training in the U.S. also requires two to three years of state-side training before the student is ready for field training. Additionally, sending a student abroad tends to expose them to a different way of life and opens up avenues for their departure from Somalia into other markets of employment, either in the U.S., with U.S. companies working internationally, or the close proximity Arab Nations, where technical labor is in high demand.

The method for assisting in building the institutional component of the WDA, the MMWR and the NRA is through the Continuing Education Short Course approach.

Short courses are most easily adopted to on-the-job training programs and do not remove the student from the work force for years at a time, as do other professional training curriculum.

Incorporated into the Groundwater Development Project is an on-going on-the-job training component for both the technical staff as well as the support and skilled labor personnel.

A carefully laid-out program of short courses, specifically tailored to the needs of rural water development, mainly the proper location and construction of wells would be more beneficial to the Somali technical personnel than any other.

Having formal educational reinforcement at the types of skills they have been learning and applying in the field, would give them a better understanding of their role in groundwater development in Somalia. It would provide as many students as available (up to 25-30) with a good technical foundation to perform their duties.

Eight short courses have been determined to be tailored to the needs of the Groundwater Development Project and are scheduled to go on through the exploration and into the well construction phases.

The twice-a-year rainy seasons, which make field work difficult to impossible due to the lack of paved roads, are also conducive to this approach, as many man-hours of otherwise idle time can be utilized in training sessions. During these periods when logistics problems, data reduction and analysis is not taking all of the technical staff's time, short courses are scheduled.

The eight short courses are incorporated into the project design and include the full spectrum of groundwater investigation from exploration through drilling and testing. The short courses are listed in Annex 12. The program is spread over a period of five years at a cost of approximately $150,000 for a program that will accomodate 30 students per session.

The short courses can be taught by expatriate, recruited lecturers assisted by the Project Manager and the expatriate water development program staff, who can best direct the lectures to the obvious needs of the Somali technical staff.

It is anticipated that the NRA, MOA, MOH, etc., will send course participants dealing with water resources to some of the training programs.

DATA GENERATION

As a result of the initial studies phase the WDA and the MMWR will have a series of hydrogeologic maps to work with which will show the location of aquifers, stratigraphically and spacially. The data will indicate the type of formations that will be drilled through, the type of drilling equipment best suited for the work, the depth at which water can be expected to be encountered, and the chemical make-up of the water produced (water quality analysis).

This will aid the MMWR in fulfilling their function of publication of data and basic research reports to be used throughout the country in studying the groundwater resources of Somalia, and designing water exploitation programs to best utilize the water resource without depleting it.

The studies phase will best benefit the WDA in helping them plan beneficial groundwater exploitation programs (drilling) and improve the efficiency in constructing productive wells. They will have a clearer concept of where the water is, whether there are sufficient quantities to satisfy the aims of their drilling program, and if a potable groundwater supply is present. This will assist the WDA in decision-making related to the optional use of uars to provide water in any specific location.

The continuous on-going data collection will broaden and improve the quality of the data base. In a country so large and diverse hydrogeologically it will be impossible to precisely define the groundwater regime with so relatively few holes as provided in the exploration program. Consequently, as the new data comes in, hydrogeologic maps, estimates of safe yield, aquifer recharge and discharge will continually be refined and upgraded.

Because the area of the project is so vast and travel is a real problem which will take a heavy toll on equipment and efficiency, the projects anticipated to be served in the five-year time frame will require servicing on a regional basis.

The three operational centers have been selected as field command posts to best serve the Central Rangelands Project (Galcaio, Dusa Mareb), the Bay Region Project (Baidoa with Dusa Mareb support), the Northern Rangelands (Galcaio) and the relief settlements such as Kurtunwaare (Baidoa).

The Phase I exploration program will begin for the Somali rural sector, under the direction of the WDA General Manager, immediately upon the signing of the AID contract. Rapid mobilization of the Project is required to facilitate the timely installation of wells for the Central Rangelands and Bay Region Projects.

The exploration program, led by three hydrogeologists and WDA counterparts, would concentrate on data base collection and exploratory drilling in the Bay, Hiran, Mudug and Gulgadud Regions, expanding to include the Togodheer and other regions toward the end of the exploration effort as illustrated in Attachment 3.

An expatriate hydrogeologist, with the aid of a WDA counterpart will assemble and review all available background hydrogeologic literature and data related to Somalia. It is anticipated that Rome, Italy, the FAO Headquarters will need to be researched for whatever new hydrogeologic data on Somalia exists.

With the aid of 1:60,000 airphotos, 1:100,000 topographic/land use maps and satellite imagery, a well canvas and data base formulation field investigation will begin. The data base gathering exercise will be supplemented with the arrival of two additional expatriate hydrogeologists who, after being brought up to speed, would be assigned two Somali hydrogeologists to complete the data base operation and identify data voids.

Data voids would be filled in by a test hole drilling program using three drilling rigs manned by expatriate drillers and counterpart drilling teams and three expatriate geophysical technicians with geophysical trucks and their Somali counterpart trainees. The hydrogeologists would take water quality samples, make preliminary analysis and send samples to field water quality analysis centers.

The test hole drilling, of year two of the exploration program, will overlap the need for wells in both the Bay and Central Rangelands Projects. Of the 15 test holes scheduled for the Central Rangelands, four planned in the Togodheer and five in the Bay Regions, it is anticipated that half or more exploration holes can be located in areas designated for wells by the other projects. These holes can be readily converted to wells for the Project's use.

The final putpose of the Phase I exploration program is to locate and quantify aquifers of potable quality, and to develop the data base for the scientific selection of wells.

By the development of a data base, the success ratio for well drilling operations should vastly improve over the estimated 40-50% now attained.

The task descriptions and time frame of implementation are outlined below:

SOMALIA WATER RESOURCES EXPLORATION PROGRAM

PHASE I DESIGN

Purpose

To determine the water resources available for development on a safe yield basis, and to attempt to develop those resources in selected areas in such a manner as to deliver high quality water to the rural sector.

Scope of Work

1. Review existing reports on Somalia and ascertain data records available.

2. Interview MMWR and WDA hydrogeologic personnel for information on the area of work; 'nd work being performed or previously done by others.

3. Review existing aerial photographs and 1:100,000 Russian-prepared topographic maps of the Central Rangelands. See hydrogeologic maps prepared by the UNDP Johnson's conceptual review of Somalia's groundwater resources. Perform a hydrogeologic reconnaisance of the rural sector first by air and then by vehicle.

4. Make a well inventory of all existing watering points, locate wells on aerial photos, 1:100,000 topographic maps, or both.

5. Perform a data base operation. Construct an individual well location map, measure depth of well, compare by means of inquiry with original ' depth. Measure depth and static level, perform field water quality analysis (electrical conductivity, pH, temperature, etc.), record condition of the well. Determine a type of water extraction, health consideration, pollution potential, distribution system if pump installed, motor horsepower, type (turbine, submersible, windmill, etc.), check condition of the well equipment (corrosion, encrustation, etc.), and determine energy source (diesel, generator, wind, hand, etc.).

6. From well inventory and data prepare hydrogeologic map including the following depth to water contours, water elevation contours, direction of flow within geographic area.

7. Identify areas of data gaps or insufficient data. Lay out a rainfall and evaporation data collection grid of approximately two data points/ 10,000 Km^2 with emphasis on population centers and potential range reserves well locations.

8. Determine locations and general depths of borings for exploration purposes (approximately 25). Provide for drilling and geophysical borehole logging on new exploratory holes.

9. Perform geophysical borehole surveys including down-the-hole camera inspection on as many non-equipped wells as possible with top priority to those exceeding 20-30 meters.

10. Develop a program of routine data collection from each well point, initially bi-monthly with refinements as needed as program progresses.

11. Perform two-hour specific capacity tests on all wells having mechanical pumps working. Estimate permeability of the aquifer(s).

12. Analyze the data on an on-going basis, refining same with information extracted from exploratory holes. Prepare seasonal water contour maps to determine the effects of rainfall and water use on water levels. Calculate specific yields per meter of aquifer thickness.

13. Plan drilling operations in Phase II based upon hydrogeologic information and NRA needs relating to reserve location preference, livestock water requirements and human requirements.

14. Select most strategic location for Phase II operational centers based on proximity to sites, availability of potable water, and accessibility by existing roads.

PHASE II DRILLING PROGRAM

Drilling Equipment

The arrival of drilling rigs is anticipated at the beginning of the second year of Phase I (exploration program).

Two rigs (rotary) will be immediately assigned to exploratory drilling out of the Regional Center in Baidoa under control of the expatriate hydrogeologist.

One additional percussion rig will be assigned to Galcaio for use in the Northern Rangelands on a time-available basis.

In conjunction with the exploratory drilling anticipated at approximately 24 to 25 in number, it is expected that perhaps half (12) can be converted into permanent well installations during the second year of exploration.

With all five rigs operating in year 1 under the supervision of three expatriate hydrogeologists and drillers, it is expected that 40 production wells can be installed annually (24 in Central Rangelands and 16 in the Bay Region).

In one year, the requirement for the Central Rangelands could be met and rural supply wells drilled in the Central Rangelands as well as 10 wells in the Northern Rangelands. After year 1 of the drilling program with the 24 well/year capability located at Dusa Mareb and Galcaio can be utilized for rural water programs outside the CRDP areas or be reassigned to Bay of Lower Shebelli regions.

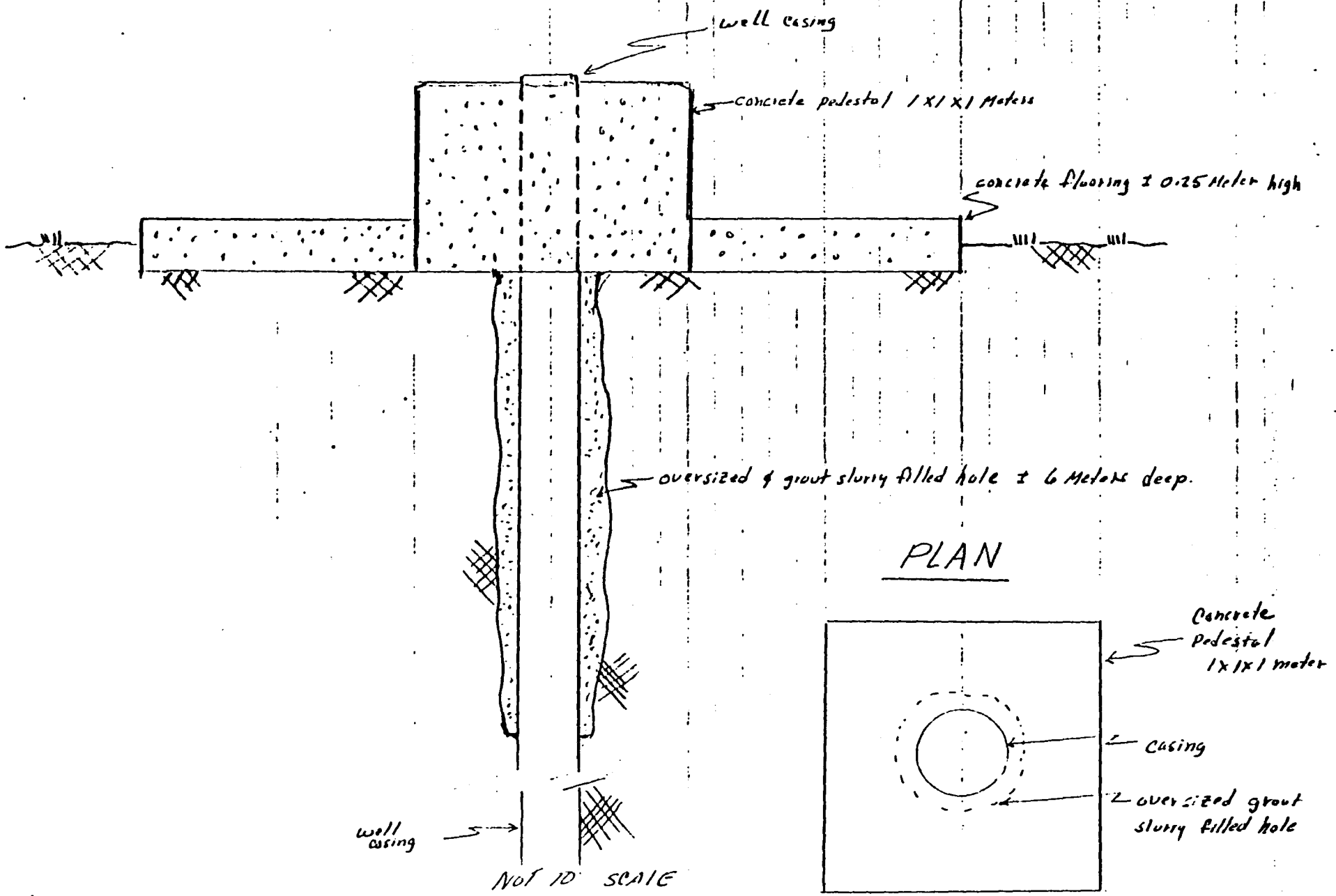
The two drilling rigs operating from Baidoa could provide 16 wells per year and in 3½ years complete the requirements for stockwater and domestic supply in the Bay Region.

Midway through year 4 the drilling rigs could be assigned to rural village domestic water supply drilling at the rate of 16 wells per year. It would be possible to interchange drilling rigs from the Central Rangelands area to increase production in those areas designated by the General Manager of the WDA as high priority, after the commitment to the Central Rangelands and Bay Region is satisfied.

Shallow wells, where appropriate, can be locally contracted and provided with design improvements to aid longevity, production and sanitation. These wells, due to the larger diameter bore can be equipped with a dual system of operation, the hand pump and the very small submersible pump (100 liter/minute capacity), which can be operated when the hand pump is undergoing maintenance. Should, from a practical point of view, neither pump be operable, the well cover can be removed and buckets used to deliver water to the surface.

The wells installed will be completed with a ½ meter high concrete pump pedestal on a concrete slab, with a pump house constructed around it. The equipment selected for use by the Rangelands Project is a 3-5 Hp submersible pump and motor on a 3" PVC plastic column pipe, operated by a small portable gasoline or diesel generator.

In the Bay Region, hand pumps will be favored in shallow wells, with dual systems in intermediate depth wells and submersible pumps for stock watering and for deep wells.



SHEET NO. ___ OF ___
PROJECT NO. ___
HILL

ATTACHMENT 2

EQUIPMENT LIST

Serial Number	Type	Country	Year Bought	Region Of Service	Condition	Project Used For
1	URB. 3 AM (Rotary)	USSR	1973	Sawag	Lack of spare parts	Development projects
2	URB. 3 AM (Rotary)	USSR	1973	Lower Shebelli	Lack of spare parts	Development projects
3	Failing 2500 Rotary	USA	1960	Togdheer	Old	Development projects
4	URB. 3 AM (Rotary)	USSR	1966	Lower Shebelli	Lack of spare parts	Development projects
5	URB. 3 AM (Rotary)	USSR	1966	Mogadiscio	Lack of spare parts	Special projects
6	Failing 1500 (Rotary)	USA	1968	Mogadiscio	Old	Development projects
7	Franks (Rotary)	USA	1950	Lower Shebelli	Very old	Special projects
8	URB. 3AM (Rotary)	USSR	1966	Geddo	Lack of spare parts	Development projects
9	URB. 3 AM (Rotary)	USSR	1966	Bakool	Lack of spare parts	Development projects
10	Ingersoll (Rotary)	USA	1975	Mogadiscio	Broken	German project
11	Speed Star (Rotary)	USA	1975	Lower Juba	Good	Trans-Juba Project
12	Failing 1500 Jed-A	USA	1975	Mudug	Car-engine not working	Development projects
13	Failing 1500 Jed-A	USA	1975	Lower Shebelli	Good	Development projects
14	Speed Star (Rotary)	USA	1978	Lower Juba	Good	Youth Centers Wells
15	Speed Star (Rotary)	USA	1978	Lower Juba	Good	Trans-Juba Project
16	Percussion	USSR	1966	N.W. Region	Old	Development projects
17	Percussion	USSR	1966	Mudug	Old	Development projects
18	Percussion	USSR	1966	Bakool	Old	Development projects
19	Percussion (Walker Neer)	USA	1952	Eastern	Old	Development projects
20	Dug borehole	USA	1960	Lower Shebelli	Old	Special projects
21	Percussion (Rotary)	England	1950	Eastern	Old	Special projects
22	Percussion (Rotary)	USA	1952	Bay Region	Old	Development projects

ANNEX 7

WATER QUALITY

1. General

In order to determine what capabilities an anlytical laboratory would need, a review of literature concerning water quality in the Somali Democratic Republic was undertaken to identify important chemical characteristics. The salt content limits the use of water in some areas. In the Lower Juba and Bur regions dissolved solids are 6000 - 35000 mg/l, the upper aquifers having the highest salt content. Areas in the north and east coastal regions are low in total salt content, but so high in fluoride as to be a health problem. The incidence of goiter in the north may be related to a lack of iodide in the water. Magnesium sulfate is often high enough to produce laxative affects and calcium sulfate is high enough to be detremental to health. The high choloride and sulfate content is indicative of a very corrosive water. Concentrations are frequently as high as 1000 mg/l and can be as high as 5000 mg/l. (See Attachment 1 for a sample of analyses.)

Bacteriological analysis has been done to a limited extent and indicates that contamination of water sources has been a problem. (See Attachment 2.)

Thus, it is clear that although sampling has been limited, both chemical and biological problems do exist. Techniques are known which can overcome many of the biological problems and a redesign of the well-head will go far toward an amelioration of this problem.

The chemical water quality problem comes down to a matter of identifying poor quality aquifers and then avoiding them. The present "standard gravel packed well" approach serves to exacerbate the water quality problem due to mixing of aquifers. Once the good quality aquifers are identified the poor quality ones can be sealed off and the mixing eliminated.

In order to be able to define good quality aquifers and to spot biological pollution problems, the MMWR must be given water analysis capabilities and data management capacity.

2. Facilities and Needs

A. Water Chemistry Laboratories

The laboratory at the Ministry of Mineral and Water Resources meets most of the basic requirements for a water quality laboratory. The chemestry lab is contained in five rooms of the ministry building for geology.

There is ample cabinet, counter and floor space with the exception of the stockroom, where additional shelving and organization are needed.

The laboratory has not regularly received samples for nearly a year. It has not had tap water for six months and will not until a new well is drilled. When the lab was in full operation, routine analysis included: pH, hardness, $CO_3^{=}$, $HCO_3^{=}$, $SO_4^{=}$, Cl^-, NA^+, K^+, Ca^{++}, Mg^{++} and total dissolved solids. Up to now, the atomic absorption instrument has been used only for heavy metal analysis of mineral samples, but could be used for water samples as well. Metal analysis include Ca, Co, Cu, Fe, K, Pb, Mg, Mn, Na, Ni, and Zn. Colorimetric methods have been used for some metal analyses. Because of instrument failures colorimetric methods are more reliable and use should be expanded.

Although the laboratory has the material for good analytical work, it suffers greatly from a lack of maintenance. In this corrosive environment, special care must be given to electronic instrumentation; an instrument technician is desp rately needed. Much of the equipment provided for the laboratory is nonfunctional. It has been so difficult to have equipment repaired, that replacement became an easier solution (the analytical balance has been replaced four times). Some of the equipment is eight to ten years old, and may need maintenance or replacement soon. Without a competent technician and maintanance program, the lab is forced to rely on basic colorimetric and titrametric procedures.

There is a Maintenance Center at the Somali National University, Faculty of Engineering which is building a supply of electrical components and is staffed with well trained technicians. A report is being prepared suggesting electrical equipment suitable for this environment. Also, Demetrio Picciol of the Chemistry Faculty is noted for his experience in repairing laboratory equipment.

The power supply is often as low as 190 volts and fluctuates greatly. A new power plant has been built in Jisire and will improve the situation. It would still be advised to have voltage stabilizers for some equipment.

Spare parts should be ordered with any new equipment. The manufacturer should be consulted as to what spare parts would be most needed. Instrumentation should be judged by its simplicity and durability. Maintenance and operation manuals for each piece of equipment are a must.

The only major new instrument this water quality laboratory is lacking is a gas chromatograph for pesticide analysis. Pesticides are being used in agricultural districts and monitoring for pesticides would be in order, however, without a proven maintenance program the purchase

of a gas chromatograph would be ludicrous and is not recommended. The Faculty of Chemistry is expecting a gas chromatograph soon and may be able to analyze some water samples.

One piece of equipment needed immediately is a water distillation apparatus with automatic low water cut off.

There has been no exchange of data between labs. The information obtained by laboratories and field crews must be stored in a central data bank so it can be utilized.

The laboratory should be involved in the design of the sampling program to insure samples are taken, proper techniques are used, and accurate records maintained. Initially the sampling program would be centered around the Mogadishu laboratory. In the second year of the project the regional laboratories will be organized at which time some of the sampling responsibility will shift to these three regions. The drill teams will also take occasional samples.

Digfer General Hospital has a small water and food laboratory, recently organized by Dr. Kamel Eldin Hakim, WHO consultant. At this time the lab has very little equipment. More is on order but it has not yet arrived. The lab has no still so distilled water is trucked to the lab. There is an oven, a furnace, balances, and basic glassware.

Water samples are quantitatively analyzed for pH, alkalinity, hardness, chloride and sulfate. Qualitative analyses include NO_3, NO_2, PO_4, and NG_4. Dr. Hakim returns to Mogadishu in June 1979 to give additional training to technicians. He should be consulted to coordinate efforts.

The Faculty of Chemistry has a well equipped lab capable of water analysis. Some students are working on research projects in water chemistry.

B. Regional Laboratories

At present, there are no laboratories for water analysis outside of the Mogadishu-Afgoi area. What samples are received for chemical analysis are often 10-20 days old, by which time the chemical constituents have changed.

With the implementation of a comprehensive sampling program, some of the analytical work will be performed in the field. Chemical analysis can be performed on site, however, since analysis for bacteria requires the use of electricity, several regional laboratories are needed. These could be set up in existing buildings, such as hospital laboratories or veterinary clinics. They would require little space or equipment, but electricity would be necessary 24 hours a day. Dr. Hakim, WHO consultant, has suggested organizing laboratories in Hargeisa and Kismayo. Both have hospital laboratories and electricity. Cities more central to the region would be better if they have the building and the electricity. Also one in or around Galkayo to cover the central rangelands area is needed.

Each laboratory would require a technician and two assistants. The technician would be responsible for the analytical work and records, and would report directly to the Chief Chemist of the Water Qaulity Laboratory. Field personnel would be trained at the laboratory in Mogadishu.

Some chemical and physical analyses (pH conductivity, T°, alkalimity), would be performed on-site. Samples would be taken for chemical and bacteriological analysis and placed in an ice chest for transport. Sampling should begin at the furthest most site and quickly worked towards the lab. Bacteriological analysis would begin immediately upon arrival followed by completion of chemical analysis.

Periodically, samples would be flown in ice chests to Mogadishu for verification and full analysis.

Portable test kits (HACH or equivalent) should be used in these laboratories. These require little space, minimal training and are fast. Accuracy is sacrificed, but with practice and periodic calibration with the laboratories in Mogadischu - results would be good.

4. Public Health Laboratories

The Central Public Health Laboratory is under the direction of Mr. Mahammed Hassan, Dr. Paimond Fontan, WHO Microbiologist, is an advisor. The laboratory is clean and well staffed. The facilities are used mostly for clinical microbiology, but water samples are analyzed. The bacteriological analyses include the standard plate count, multiple-tube fermentation, multiple-tube technician for fecal streptococcel group, and the detection of antropathogenic Escherichie coli.

The only problem has been the lack of samples. At present, up to 12 samples per week can be analyzed. Once a successful sampling program is implemented, the laboratory could be expanded to handle 10 samples per day. This would require the use of another room at CPHL to be used soley for water analysis. Some additional equipment would also be needed.

A distillation apparatus with automatic low water cut off is needed immediately. This lab is also in need of a maintenance technician.

The medical school has the equipment and staff necessary for water analysis, although not actively involved in it.

ATTACHMENT 1.

WELL DATA ANI CHEMICAL ANALYSIS - 5

Quadrangle	Well No.	Location	Depth meters	Static Level meters	Probable Aquifer	Chemical Analysis: Conductivity micromhos	Chloride ppm	Sulphate as ppm	Hardness: Total ppm	Hardness: Calcium ppm	Alkalinity ppm	pH.
3	1	Oddur	10.33	6.4	Main Gypsum	3200	280	2000	2140	1800	160	7.8
	2	Oddur	14.80	7.0	Main Gypsum	1450	240	170	460	-	280	7.5
4	1	Budga Cosar	75	35	Main Gypsum	2800	90	2000	2100	540	160	8.3
	2	Bugda Cosar	4	-	Main Gypsum	-	-	-	-	-	-	-
	3	Tigieglo	8.80	7.6	Main Gypsum	5000	1320	520	1480	780	380	8.0
5	1	Budga Acable	9	3	Jurassic Main Gypsum	2500	50	2000	1890	1560	140	6.7
	2	Debi Adle	50	20	Shebelle alluvium or Mustahil Series	12000	3575	2300	2820	-	500	7.5
	3	Avorei	120	35	Belet Uen Series	6000	1850	450	1520	1140	250	7.6
	4	Jesoma	4	3.8	Jesoma sandstone	880	195	35	320	160	250	5.8
	5	Km.41 Berdale	70	49	Belet Uen Series	4300	1000	1450	1470	1000	50	8.0
	6	KM. 300	113	11	Belet Uen Series	-	-	-	-	-	-	-
	7	Bar Madeghe	3.20	2.5	Main Gypsum	2700	160	1700	1760	-	220	7.3
	8	Belet Uen	7	4.5	Shebelle Alluvium	1700	80	750	950	700	250	8.2
	9	Belet Uen	10.4	5.09	Shebelle Alluvium	7000	1080	3400	1520	-	-	8.5
	10	Belet Uen	-	-	Shebelle Alluvium	9000	1320	4800	2600	1580	-	8.0
	11	El Gal (Hiran)	9.73	6.6	Wadi bed	570	30	180	380	-	150	7.7
	12	Giauil	72	36	Fer Fer Gypsum	3600	660	1100	1580	820	290	8.0
6	1	Mogocori	50	20	Jesoma sandstone	3600	1290	300	980	-	140	7.4
	2	Mogocori	16.3	13.3	Aurado limestone	10000	2800	930	1230	-	310	7.2
8	1	Subban Alla	shallow	-	Main Gypsum	3000	140	2000	2010	-	250	7.5
	2	Irkut	shallow	-	Garandab series	2250	540	78	880	480	390	7.6
	3	Lugh Road	35	-	Garandab or Gaoredarre Series	salty	-	ABANDONED				
	4	Lugh Road	35	-	Hamablei or Garandab Series	salty	-	ABANDONED				
9	1	El Berdale	5.43	5.23	-	9000	3360	510	2740	-	-	8.0
	2	Degit	8.73	8.63	Hamanlei or Garandab	1600	320	150	560	-	-	7.6
	3	Degit	30	7	Hamanlei or Garandab	1800	330	88	680	-	500	8.1
	4	Baidoa	2.33	1.3	Hamanlei Series	2000	500	100	700	600	340	7.6
	5	Baidoa	103	21	Hamanlei Series	1300	160	120	320	200	250	7.5
	6	Baidoa	57	3	Hamanlei Series	1300	220	120	580	440	360	7.7
	7	Iscia Baidoa Upper spring	-	-	Hamanlei Series	1800	450	30	270	-	210	7.3
	8	Iscia Baidoa Lower spring	-	-	Hamanlei Series	-	-	-	-	-	-	-
	9	Bonka	130	50	Hamanlei Series	4500	1610	70	1270	1050	200	6.5
	10	Gorongis	5.14	5	Hamanlei Series	3600	110	90	1280	900	210	7.2
	11	Cassa Cmane	100	14	Hamanlei Series	14000	5480	440	10300	1740	250	7.4
	12	Audinle	30	-	Hamanlei Series	3800	1070	170	1140	500	390	7.7
	13	Seidelo	21	12	Hamanlei Series	1250	140	30	550	300	470	7.5
	14	Tug Ara	-	-	Hamanlei Series	1000	150	33	470	-	-	7.7
	15	Molimat	38	60	Hamanlei Series	1250	30	20	440	270	420	8.3
	16	Berei Berei Hedegu	35	14	Hamanlei Series	1500	200	50	700	380	540	7.7
	17	Tagar Molimat	46	16	Hamanlei Series	-	-	-	-	-	-	-
11	1	Orloe	140	48	Upper Tertiary	-	-	-	-	-	-	-
	2	El Gambolei	1.2	1.0	-	8500	3140	600	2300	1160	170	7.5
	3	El Afful	2.40	2.3	-	7000	2700	450	1860	1080	250	7.2
	4	El Ad	8.45	7	-	9000	2800	3000	3400	2220	260	7.3
	5	Km. 140	102	16	Upper Tertiary	7000	1815	1000	1520	1290	170	7.3
	6	Lebida Codesa	90	40	Upper Tertiary	6700	2680	240	1700	1170	130	7.1
	7	Ali Dere	70	40	Upper Tertiary	6300	1975	470	1960	-	140	7.1

WELL DATA AND CHEMICAL ANALYSIS

Quadrangle	Well No.	Location	Depth meters	Static Level meters	Probable Aquifer	Chemical Analysis: Conductivity micromhos	Chloride ppm	Sulphate so ppm	Hardness: Total ppm	Hardness: Calcium ppm	Alkalinity ppm	pH.
	8	El Bilal	55	11	Mustahil Series	7000	1550	2000	2320	-	180	7.6
	9	El Baraf	10	-	Upper Tertiary limestone	3000	2620	350	2180	1720	250	7.0
	10	Bur Uen	86	12	Mustahil Series	-	-	-	-	-	-	-
	11	Bulo Burti	11.23	10.1	Shebelle alluvium and Caliche	4200	550	1700	-	-	-	7.5
	12	Bulo Burti	12.20	10.7	" "	2000	220	680	860	-	140	7.3
	13	Bulo Burti	-	-	" "	2800	250	1500	-	-	-	7.9
13	1	Hafanle Tug	Spring	-	Conglomerate - Lugh Series	6000	2040	260	1060	-	-	7.9
14	1	Bardera	53	6	Hamanlei Series	-	-	-	-	-	-	-
	2	Bardera	-	-	Hamanlei Series	5500	1250	700	1200	-	-	7.8
	3	Agabierier	50	5	Hamanlei Series	-	-	-	-	-	-	-
	4	Bulo Gudad (Hafato)	194	52	Hamanlei Series Mansa Guda sandstone	4500	990	280	360	270	300	8.0
	5	Dinsor	-	-	Wadi bed	6000	1360	420	1040	610	450	7.6
	6	Dinsor	-	-	Wadi bed	3300	870	100	580	400	370	7.8
	7	Casea Dere	144	50	Hamanlei Series	1400	260	80	550	200	160	8.2
	8	Rahble Ormale	200	Reported dry	Hamanlei Series	-	-	-	-	-	-	-
15	1	Jamia Miera	90	42	Hamanlei Series Mansa Guda sandstone	1200	150	85	450	430	480	7.4
	2	Lourar	136	34	Hamanlei Series	3600	330	1900	2040	1170	310	8.1
	3	Corombot	120	32	Hamanlei Series	2200	430	80	900	450	440	7.9
	4	Oflave	64	-	Hamanlei Series	2600	670	40	1000	500	400	7.5
	5	Dusta	50	20	Hamanlei Series	2300	420	280	660	360	360	7.7
	6	Manas Well	3.45	1.7	Hamanlei Series	5500	1800	130	1600	1440	230	7.9
	7	Manas Spring	-	-	Hamanlei Series	6000	2120	400	1960	-	-	7.7
	8	Kudug Well owned by Moh'd Ali	10.83	10.78	Wadi bed	1400	140	200	420	-	-	7.7
16	1	Udinlei	80	60	-	-	-	-	-	-	-	-
	2	Gelgel Gudad	120	-	Colluvial deposits	-	-	-	-	-	-	-
	3	Cogno Garrei	140	60	Upper Tertiary	10000	-	-	-	-	-	-
	4	Bur Acaba	52	-	Drift filled depression	-	-	-	-	-	-	-
	5	" "	11.33	9.6	" "	1250	110	150	430	340	340	8.0
	6	" "	16	7	" "	1550	120	120	300	-	-	7.7
	7	" "	12.20	8.8	" "	350	30	150	460	300	-	7.5
	8	Madamarodi	121	70	Colluvial sand above Salty Basement							
	9	Cogno Hober	154	61	Upper Tertiary	7000	3050	1040	650	275	550	7.95
	10	Dudumai	197	55	" "	-	-	-	-	-	-	-
	11	Wanle Uen	153	50	" "	4000	1250	2250	475	225	2100	8.0
	12	Hacao	110	57	" "	-	-	-	-	-	-	-
	13	Duanle	130	60	" "	-	-	-	-	-	-	-
	14	Hacao owned by "Tifo"	11.4	-	-	1500	200	920	450	425	-	7.8
	15	Abornol	5.20	4.1	-	750	50	190	270	110	-	7.5
	16	Olo Gof	10.40	10	-	1600	340	100	630	400	410	7.4
	17	Olo Biole	9.20	8.3	-	2400	720	120	940	520	390	7.5
	18	Uambatti	3.70	3.5	-	7000	2660	700	2640	1600	220	7.3
	19	Gurumai	81	-	Colluvial deposits	-	-	-	-	-	-	-
	20	Furukulei	100	70	Upper Tertiary	5800	-	-	-	-	-	-

WELL DATA AND CHEMICAL ANALYSIS

Quadrangle	Well No.	Location	Depth meters	Static Level meters	Probable Aquifer	Chemical Analysis: Conductivity micromhos	Chloride ppm	Sulphate so ppm	Hardness: Total ppm	Hardness: Calcius ppm	Alkalinity ppm	pH.
17	1	Afgoi	114	55	Upper Tertiary	1200	100	300	500	260	220	7.3
	2	Afgoi Forest Nursery	10	-	" "	-	-	-	-	-	-	-
	3	Afgoi	-	-	" "	3000	470	1500	1540	1110	270	7.7
	4	Italian Embassy Afgoi	90	17	" "	1500	160	600	700	500	100	7.3
	5	Hellman Afgoi	96	20	" "	-	-	-	-	-	-	-
	6	Hellman Afgoi	111	40	" "	-	-	-	-	-	-	-
	7	Boldei	84	35	" "	2200	250	1400	1050	660	240	7.6
	8	Smaniotto	95	38	" "	-	-	-	-	-	-	-
	9	Lante Bur	116	61	" "	1400	110	190	90	50	440	7.6
	10	T.T.I. (Afgoi)	155	34	" "	-	-	-	-	-	-	-
	11	F.A.O. Office	105	70	" "	1200	120	140	440	440	350	7.3
	12	Fema Well	77	50	" "	1800	315	220	-	-	-	6.5
	13	National Bank	45	30	" "	2000	790	510	640	-	-	8.4
	14	Scek Saad Afgoi	70	-	" "	-	-	-	-	-	-	-
	15	Alito	146	63	" "	-	-	-	-	-	-	-
	16	Lama Donka	80	63	" "	1700	275	500	325	200	-	7.3
	17	Magle	112	62	" "	950	105	302	180	60	-	7.3
	18	Magle	-	-	" "	-	-	-	-	-	-	-
	19	Omar Bere Afgoi	102	61	" "	-	-	-	-	-	-	-
	20	Afgoi	63	61	" "	-	-	-	-	-	-	-
	21	Folchi	110	35	" "	2100	380	200	1130	600	180	7.7
	22	Aliale	100	75	" "	800	65	216	500	325	-	7.7
	23	Gar Mahan	90	66	" "	3500	850	850	750	400	-	7.5
	24	Lancat	136	71	" "	3200	600	300	700	350	-	7.9
	25	Aua Barei	125	62	" "	1900	-	-	-	-	-	-
	26	Balad	110	44	" "	300	50	248	325	250	-	7.6
	27	Gololei Daud	102	54	" "	3000	325	320	500	-	450	7.4
	28	Al Boralei	1	-	" "	9500	-	-	-	-	-	-
	29	Adei Dere	187	-	" "	9500	-	-	-	-	-	-
	30	Dondere	128	-	" "	4500	70	1300	-	-	300	7.4
	31	Hadiga Moblin	115	55	" "	2400	250	700	600	-	260	7.2
	32	Sarsarei	78	45	" "	2150	195	470	620	540	120	7.2
	33	Fagi Mohamed	103	55	" "	2000	-	-	-	-	-	-
	34	Gololei Moblin	105	54	" "	-	-	-	-	-	-	-
	35	Theslei	96	62	" "	2400	240	850	710	490	350	7.3
	36	Donadiga	96	-	" "	2900	465	300	1150	750	-	7.7
	37	Gabanei	96	54	" "	3600	815	1050	1700	-	170	8.0
	38	Johar	112	11	" "	2700	175	900	360	220	190	7.5
	39	Johar	35	12	" "	1500	85	340	160	-	260	7.3
	40	Giama Miliole	-	-	" "	-	-	-	-	-	-	-
	41	El Dere	9.10	8	-	2100	600	100	800	400	340	7.4
	42	Manadei	125	21	Upper Tertiary	1700	130	650	-	-	-	8.1
	43	Manadei (Mission)	9.5	6.5	" "	1400	115	550	700	-	-	7.3
	44	Garas Barco	127	60	" "	9000	2000	2650	1940	300	380	7.3
	45	Gar Dagah	-	-	" "	10000	3700	3400	2200	1000	320	7.3
	46	Bio Ado	93	63	" "	9000	2830	1000	1600	1440	150	7.1
	47	Mir Nagot	110	80	" "	9500	-	-	-	-	-	-
	48	Chicken farm (Balad Road)	-	52	" "	-	-	-	-	-	-	-
	49	Jokm test hole	91	62	" "	-	-	-	-	-	-	-
	50	15 Km. test hole	91	59	" "	-	-	-	-	-	-	-

WELL DATA AND CHEMICAL ANALYSIS

Quadrangle	Well No.	Location	Depth meters	Static Level meters	Probable Aquifer	Chemical Analysis: Conductivity micromhos	Chloride ppm	Sulphate so ppm	Hardness: Total ppm	Hardness: Calcium ppm	Alkalinity ppm	P.
20	1	Saco	-	-	Juba River Alluvium	4500	1110	800	1010	550	230	8.
	2	Bohol Macuda	-	-	Hamanlei Series	6000	2160	340	1600	480	130	7.
21	1	Mudul	0.5	-	Upper Tertiary	3300	490	1400	1260	750	200	8.
22	1	Brava	42	27	" "	1450	240	50	110	100	340	7.
	2	Brava	18.23	16.6	" "	3300	870	750	-	-	-	7.
	3	Brava	25.90	25.7	" "	1400	230	40	120	-	300	7.
	4	Marin Gubai	110	46	" "	2100	210	700	920	770	250	8.
	5	Doblai	-	-	" "	3000	660	1780	-	-	-	8.
	6	Bulo Mererta	71	31	" "	2200	190	800	1000	-	210	8.
	7	Gol Ten	28	6.9	" "	3400	460	1000	1660	1120	260	7.
	8	Genale	225	6	" "	3200	285	850	1260	-	-	7.
	9	Scialmabot	116	60	" "	1800	-	710	350	300	300	7.
	10	Merca	30	18	" "	4000	1030	610	1120	820	250	6.
	11	El Mungne	12	11.6	" "	7000	2150	1400	2080	-	-	7.
	12	El Ado	8	7.4	" "	6000	1635	880	1140	-	-	7.
	13	El Mallet	3.90	3.0	" "	5000	1365	450	1160	-	-	7.
	14	El Monghia	4.90	3.9	" "	6000	1510	1300	1200	-	-	7.
	15	Fidda Gudud	93	60	" "	1500	-	-	-	-	-	-
23	1	Beles Cogani	63	35	" "	-	-	-	-	-	-	-
	2	Beles Cogani	105	35	" "	-	-	-	-	-	-	-
	3	Gighes	62	-	" "	-	-	-	-	-	-	-
	4	Golgia	4.5	-	Wadi bed	550	40	20	200	180	300	7.
	5	Fankal	6.02	5.8	Wadi bed	2600	450	200	710	480	-	7.
	6	Kora	4.73	4.7	Wadi bed	1400	140	90	270	-	-	-
26	1	Andaraf	120	40	Upper Tertiary	7000	2460	350	200	120	440	7.6
	2	Soia	90	25	" "	-	-	-	-	-	-	-
	3	Bivio Afmadu	58	24	" "	7000	2110	230	220	140	740	7.9
	4	Giamama -	7.52	4.9	Juba alluvium	3000	2190	490	1000	-	240	7.9
	5	Giamama	9.48	2.7	Juba alluvium	1100	150	100	340	230	640	8.0
	6	Revia	106	43	Upper Tertiary	-	-	-	-	-	-	-
	7	Mido	94	36	" "	7000	2200	250	110	80	700	8.0
	8	Gelib	14.8	13	Upper Tertiary Juba alluvium	1950	330	280	840	580	360	8.2
	9	Gelib	30	8.3	" "	600	6	70	250	160	140	7.9
	10	Gelib	-	-	" "	2600	670	280	800	600	150	7.9
	11	Afmadu	90	35	Upper Tertiary	10000	3100	520	180	50	1000	8.1
	12	Afmadu	13.63	4.4	Wadi bed	350	20	50	360	380	550	7.3
27	1	Borama	95	50	Upper Tertiary	-	-	-	-	-	-	-
	2	Billik Taleh	112	32	" "	4700	-	-	-	-	-	-
	3	Malailei	85	28	" "	4000	-	-	-	-	-	-
	4	Cogno Barei	-	20	" "	10000	-	-	-	-	-	-
	5	Uaian	132	32	" "	10000	-	-	-	-	-	-
32	1	Kismayu	34.46	2.4	" "	4500	990	210	680	-	-	7.4
	2	Kismayu	30.00	2.8	" "	5500	1530	690	830	250	550	7.3
	3	Kismayu	2.90	2.36	" "	10000	3360	700	-	-	-	7.0
	4	Kismayu	5.00	4.65	" "	6000	470	160	580	380	700	7.2
	5	Kismayu	5.60	4.3	" "	4500	700	340	870	-	-	7.5
	6	Kismayu	20.10	19.6	" "	10000	3880	390	-	-	300	7.3
	7	Kismayu	2.76	1.9	" "	6000	1580	300	350	-	-	7.9

Taken from: Agricultural and Water Surveys
Somalia
Final Report Vol. II

FAO/SF: 30/SOM

ATTACHMENT 2

ANNEX 7

Water Examinations, Bacteriology — Only made on the pH Central Laboratory since the origin

Year	From Mogadischu				Out of Mogadishu		
	No. Samples	Sarisf	Unsar		No. Samples	Sarisf	Unsar
1973	-	-	-		11	3	8
1974	54	38	16		15	1	14
1975	52	31	21		12	0	12
1976	21	16	5		26	7	19
1977	34	18	16		23	4	19
1978	12	9	3		10	0	10
1979 (Jan-Apr)	14	11	3		9	2	7
(June-April) Total	187	123	64	34	106	11	89

Grand Total = 293 Samples in 6 years

There are 140 satisfactory and 150 nonsatisfactory

ANNEX 8

SURFACE WATER DEVELOPMENT

INTRODUCTION

Surface water development alternatives are severely limited in Somalia because there are only two perennial streams in the country -- the Juba River and the Shebelli River. Developments on both rivers provide water for people, livestock and irrigation. Elsewhere there are only two sources of surface water: 1) intermittent streams called wadis; 2) sheet flow runoff. Both intermittent streams and sheet flow runoff offer several possibilities for development: However, any system which relies on direct rainfall is subject to periodic failure due to the high variability of rainfall in Somalia. Surface water cannot be considered a reliable source and consequently during a prolonged drought, people who depend on surface water will be forced to move to locations with reliable groundwater supplies. Developing surface water creates a dependence on a supply that is certain to fail at some time, whereas groundwater supplies are unlikely to fail and therefore preferrable over surface water supplies. It will always be necessary, however, to develop some surface supplies because groundwater is not available in the required quantity or quality in part of Somalia.

The Groundwater Development Project (GWP) will concentrate on developing groundwater supplies but will also provide surface water supplies for two specific projects -- the Bay Region Agricultural Development Project and the Central Rangelands Development Project. It is anticipated that some surface water development will be necessary in the Rangelands Project but the extent of the need cannot be determined until after completion of the rangelands inventory and groundwater survey. Four experimental surface water catchments will be built for the Bay Region Project. The design considerations and institutional requirements for surface water development are described here, assuming that a limited amount of surface water development will be required. This assumption is consistent with existing information on groundwater potential and water needs It is also consistent with the position of local government to concentrate on groundwater development rather than surface water catchments.

EXISTING SURFACE WATER DEVELOPMENT

Present practice in surface water development (except on perennial streams) is limited to two types of surface water storage reservoirs: birkhads and uars. These reservoirs rely on sheet flow runoff for their supply and usually do not have carryover storage from one year to another. They are filled during the rainy season and provide a supply during the following dry season.

The most common storage reservoir is the privately-owned birkhad. It consists of a rectangular hole excavated into the ground and lined with clay or concrete to make it water tight. The tank is covered with brush and sticks in an attempt to reduce evaporation losses. Improvements to the catchment area to increase runoff are limited to small ditches that concentrate and direct the flow. Water is removed from the birkhad with buckets and sold to villagers and nomads for both human and livestock use. The size of the birkhad is variable but many of them store up to 150 cubic meters.

The other type of storage reservoir, the uar, is much larger than the birkhad but fewer have been built. They are found mostly in the area between the Juba and Shebelli Rivers but some have been built in the Central Rangelands and Northern Regions. The storage capacity ranges from 20,000 to 70,000 cubic meters. They are usually rectangular, below ground reservoirs, with an earth berm to keep animals away from the water and a pump system to deliver the water to distribution troughs. In soils with high permeability, a PVC liner has been used to stop infiltration. The uars that have been constructed to date were all planned, financed and constructed by the Somali Government. Operation and maintenance is provided by the Government and water fees are collected to cover those costs.

The other major source of surface water, wadis, has not been developed. Very little is known about the amount of flow in the wadis or the statistical frequency of flow. During intense rainstorms surface water drains into the wadis where it eventually infiltrates or evaporates. In some places, shallow wells have been dug in the stream bed to recover water that infiltrated. The potential is very good for developing storage reservoirs filled by a wadi where an underground dam or an offstream storage reservoir could be built. More information is needed about the quantity of water available before a design can be made to develop this source.

Much of the rural population of Somalia does not have continual access to a developed water supply. Many people rely on natural low spots in the terrain that collect sheet flow runoff during the rainy season. This intermittent supply is generally very poor quality because there is is no control to prevent bathing or to prevent animals from entering the water. These natural ponds do, however, supply a major part of livestock water needs during the rainy season.

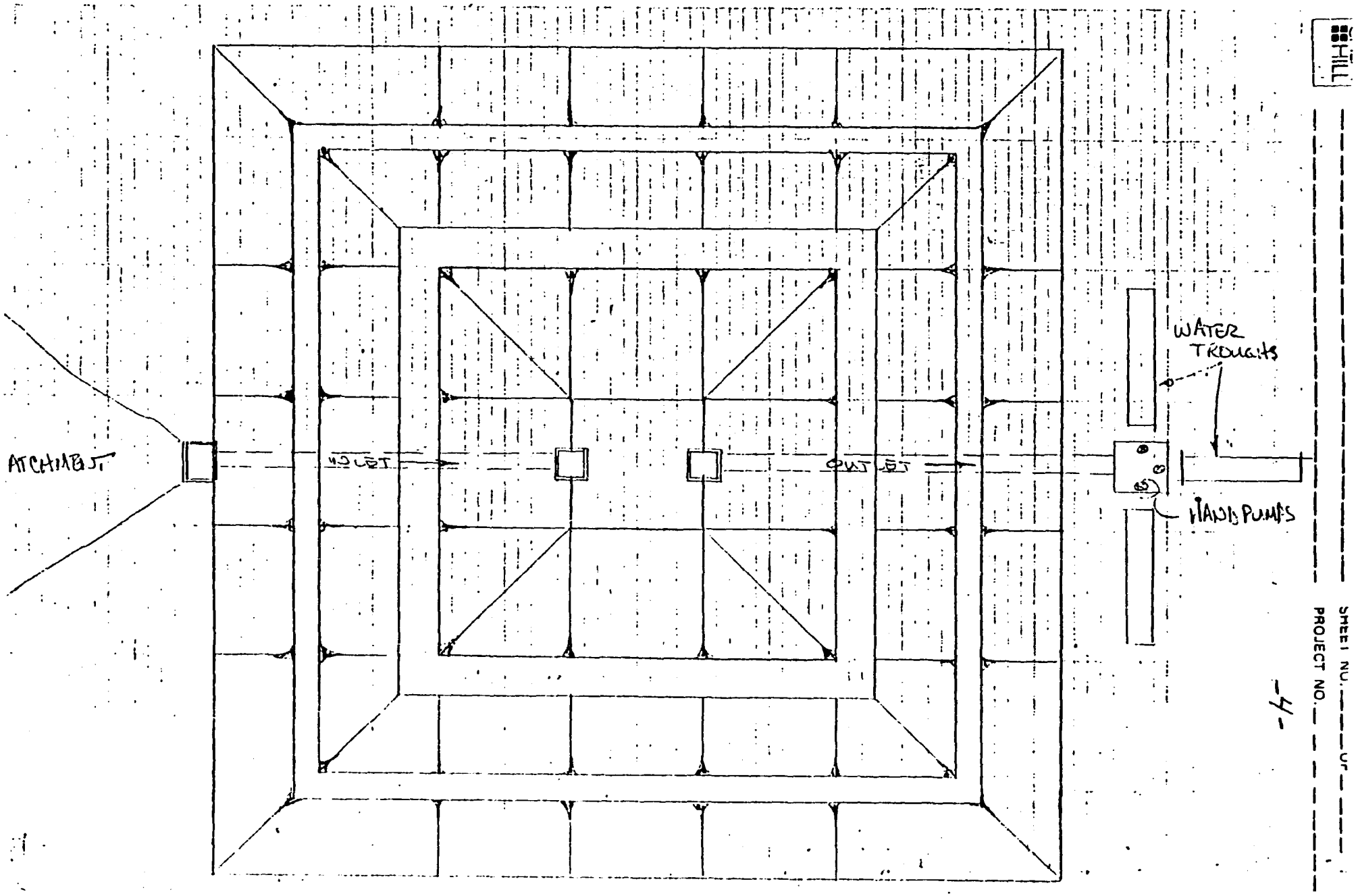
TECHNICAL FEASIBILITY

Surface water development for livestock and human needs is technically feasible, provided basic design data is available. Current surface water development practices do not rely on rainfall and soils data and consequently many failures have occurred due to lack of adequate rainfall catchment or inability to contain water in the reservoir.

To assure successful operation of a surface water reservoir, data such as monthly rainfall, monthly evaporation, and soil permeability is needed for designing the reservoir. Rainfall data specific to the proposed storage site is generally unavailable and would take years to collect, but average monthly rainfall maps are available and should be used as a guide for determining areas with enough rainfall for surface water development. The maps should be used carefully because they are based on only a few widely separated rainfall gauges. Evaporation is generally uniform over large areas and can be estimated from existing monthly evaporation maps. Permeability data can be easily estimated based on soil type.

Rainfall data is the most critical item to the success of the catchment and should be determined as accurately as possible. Rainfall data is also very scarce in Somalia. A report prepared by the Food and Agricultural Organization contains an analysis of existing data in the inter-river area. They found that the average storm is 27.3 mm during the April-June rainy season and that 5 such storms usually occur each year. During the September-November rainy season, the average storm is 29.1 mm and 5.7 such storms occur each year. The catchment area required for each uar can be calculated using the average storm and an assumed rainfall-runoff relationship (actual rainfall-runoff measurements have not been made). The reliability of the reservoir is dependent on the number of storms that are assumed to occur each year; assuming less than the average requires a larger catchment area and increases the odds that the reservoir will fill. Assuming more than the average has the opposite effect. Based on the average storm it is apparent that surface water storage should be built only in areas where the average annual precipitation is 100 mm or greater. During design of surface water storage, existing rainfall analyses and maps should be updated using all available data. The rainfall analysis will provide data to size the catchment and storage reservoir.

There are two basic catchment designs that should be used; one design applies to soils with high permeabilities and the other to soils with low permeability. Drawings of the two designs are shown in Figures 1 and 2. Both designs are very similar to catchments that have been constructed in the inter-river area. Modifications have been made to the design to reduce construction, operation and maintenance costs. In soils with high permeability, a PVC liner is installed in the reservoir to prevent infiltration. A silt trap outside the reservoir is necessary to allow sediment in the runoff to be trapped and removed without damage to the PVC liner. In soils with low permeability, the PVC liner and silt trap are not needed. Both designs rely on hand pumps to remove water from the reservoir for use by people and livestock. If the hand pump fails, water may easily be withdrawn using buckets. Because there is no power-driven pump, the operation costs will be minimal and the maintenance can be done by low-skilled workers with a minimal number of tools and spare parts.



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PROJECT NO. ___

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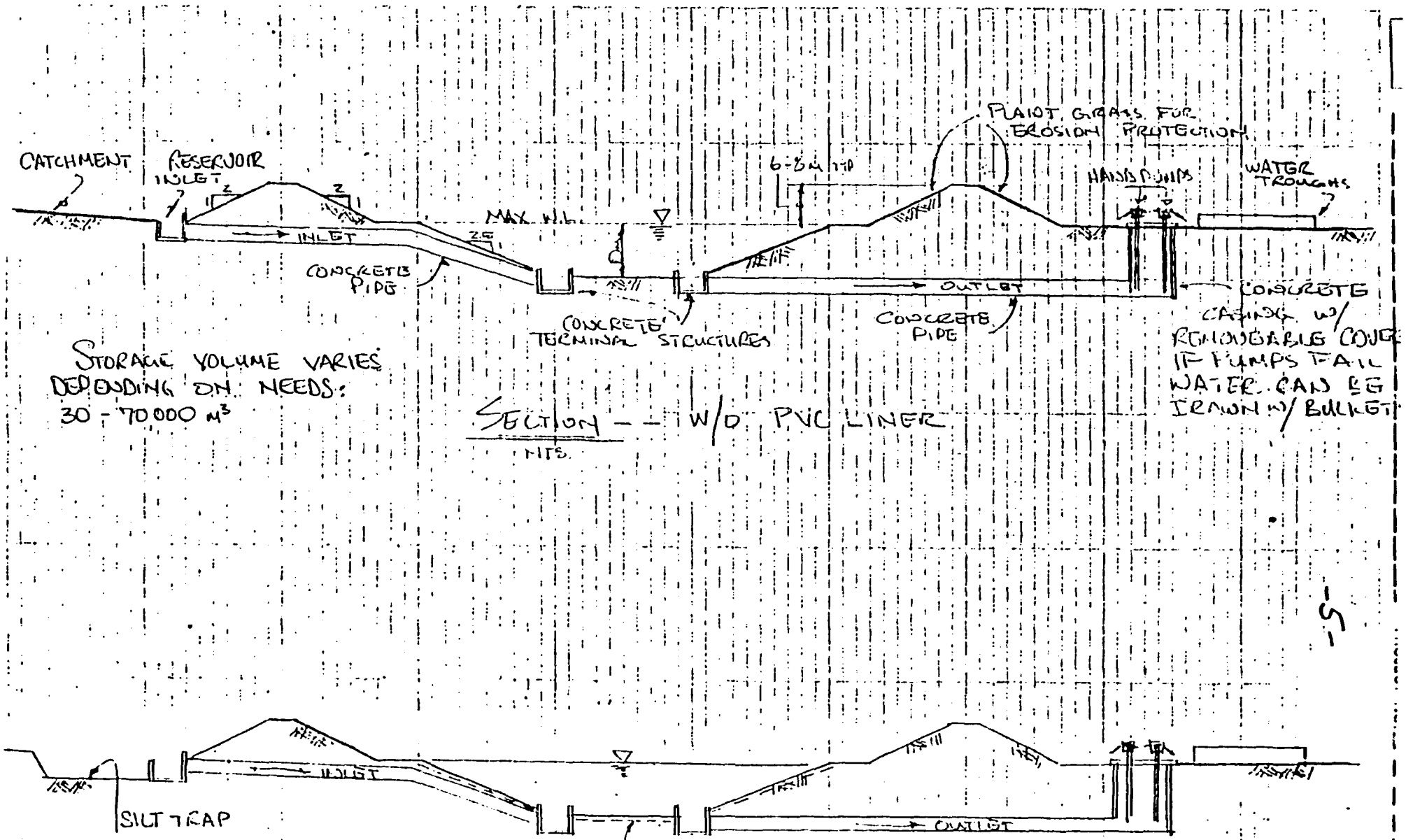
CATCHMENT
RESERVOIR INLET
INLET
CONCRETE PIPE
MAX W.L.
CONCRETE TERMINAL STRUCTURES
6-8m TYP
PLANT GRASS FOR EROSION PROTECTION
HAND PUMPS
WATER TROUGHS
OUTLET
CONCRETE PIPE
CONCRETE CASING W/ REMOVEABLE COVER IF PUMPS FAIL WATER CAN BE DRAWN W/ BUCKET
STORAGE VOLUME VARIES DEPENDING ON NEEDS: 30 - 70,000 m³
SECTION -- W/O PVC LINER
NTS
SILT TRAP
INLET
OUTLET
PVC LINER COVERED WITH 0.3m SOIL
ALTERNATE: LINING COULD BE CLAY, OR ASPHALT DEPENDING OF AVAILABILITY

5

The uars proposed for the Central Rangelands and Bay Regions are large enough that heavy earthmoving equipment (bulldozers, scrapers, front-end loaders, and compactors) will be required for excavation and embankment construction. Equipment to lay concrete pipe and construct concrete structures will also be required. All of this equipment is available in limited quantities in Somalia and has been used on previous construction projects.

Operation of uars is very simple and does not require special equipment or highly-trained personnel. Each uar should have a full-time resident operator whose main function is to collect water fees and report maintenance needs to proper government agencies. Water will be removed from the uar using hand pumps operated by the person buying the water.

Maintenance should be minimal at each uar. A regular program for sediment removal will be required to prevent the reservoir from filling with sediment and reducing the storage capacity. No data is available to estimate the silt load of surface runoff in Somalia so predictions of required sediment removal cannot be made until the reservoir is in actual operation and silting is observed. It is reasonable to assume that annual silting could amount to as much as 10% of the reservoir storage capacity. The hand pumps will require a minimum amount of periodic maintenance.

Embankment erosion is a major problem on uars currently in operation. This maintenance item can be minimized by stabilizing the embankments with a grass cover.

There should be few problems with the quality of water from uars. Salts left on the catchment by evaporating rainwater will be washed into the reservoir but the concentrations should be very low -- lower than levels found in groundwater sources. Bacteria could be a slight problem, especially if livestock are allowed to graze in the catchment area. The quality of water stored in the reservoir should not deteriorate with time because people and livestock are prevented from taking water directly from the edge of the reservoir.

The economics of surface water development are not as attractive as groundwater development. Less water can be developed, the reliability is not as good and consequently the construction unit cost is higher. The operation and maintenance costs, however, are lower for surface water than for groundwater, if proper design features are used to minimize operation and maintenance.

INSTITUTIONAL CAPABILITIES

The Water Development Agency (WDA) is the most logical agency to assume responsibility for design and construction of surface water catchments (uars). The Engineering Department within WDA is presently responsible for:

1) constructing the storage and distribution facilities for wells; 2) con structing surface water storage facilities; 3) constructing water distrib tion systems for small towns. Because of underfunding and understaffing, the department has not been able to carry out programs in all areas of responsibility. According to a recent report by the World Health Organization, 60% of the employee positions in the Engineering Department are vacant. A similar situation exists in the entire WDA. This has caused the WDA to operate in a "crisis planning" manner, devoting all resources to responding to emergencies rather than advance planning. "Understaffing poor distribution of personnel, insufficient inventory of supplies and equipment, non-standardization of equipment, and communication and accessi bility difficulties are all factors contributing to this situation", WHO Report. The WDA is weakest on the regional level. All of the managers and professional staff and 90% of the second level administrative and technical staff are located in Mogadiscio. There is a strong need for planners, engineers and mechanics at the regional level.

The Engineering Department's experience constructing surface water storage is limited to 40 uars built in the inter-river area, and 6 built in the northern regions. Each of these were built under contract to the National Range Agency; most of the 46, however, were subcontracted by WDA to privat construction firms. Although the Engineering Department has some equipmen and trained staff, the amount of work they can do is limited by the lack o trained equipment mechanics and repair tools and the lack of management level staff.

Table 1 lists the equipment owned by the Engineering Department and Table 2 gives the number of staff assigned to the Department. Staffing is done on a project basis rather than a department basis. Some of the staff shown in Table 2 are hired locally for the duration of the project. The Department has a strong need for upper-level engineering staff capable of planning, design and management.

TABLE 1

Water Development Agency
Engineering Department Construction Equipment

Description	Year of Delivery	Number of Machines	
		Operable	Inoperable
Wheel Tractor-Scraper CAT-621B	1975	3	4
Bulldozer CAT D8K	1975	1	1
Bulldozer CAT D7	1960	0	1
Bulldozer CAT D6	1960	0	1
Bulldozer CAT D4	1975	1	1
Grader CAT 14G	1975	0	1
Compactor CAT 815	1975	1	0
Loader CAT 966C	1975	1	1
Bulldozer Allis HD21	1975	0	1

TABLE 2

Water Development Agency; Engineering Department
Management and Construction Staff

Office Staff	
Engineers	6
Juba Sugar Project	
Management Staff	13
General Foreman	2
Earthwork Foreman	8
Equipment Operators	46
Mechanics	5
Electrician	2
Surveyors	2
Carpenters	31
Mason	15
Steel Fixer	11
Drivers	11
Miscellaneous Labor	76
Unskilled Labor	148
Jowhar Off-Stream Storage Project	
Engineers	2
Higher Technicians	4
General Foreman	2
Mechanics	6
Equipment Operators	27
Carpenters	24
Steel Fixers	10
Masons	19
Plumbers	3
Welders	2
Electricians	2
Miscellaneous Labor	145
Unskilled Labor	90

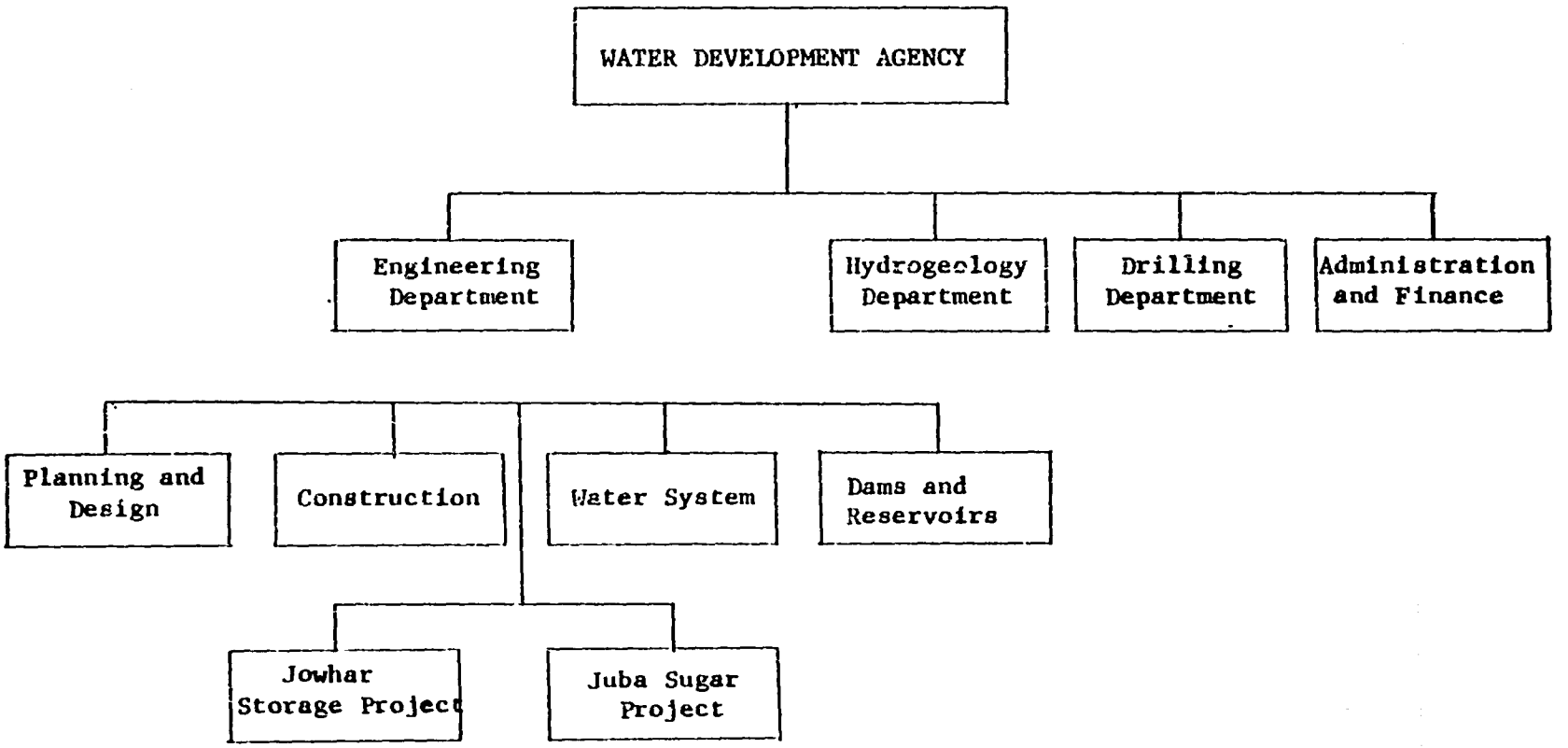

Figure 3: Showing the organization of the Engineering Department and the two main projects currently underway.

RECOMMENDED DEVELOPMENT PLAN

Phase 1 of the Groundwater Development Project is a groundwater survey that will identify the availability of groundwater throughout the country. Areas where the groundwater quantity or quality is inadequate will be considered as possible sites for surface water development. Since at this time surface water catchments will only be constructed to supply needs of the two regional projects, the livestock management and other constraints of the two projects must also be considered in siting catchments. Data from Phase 1 will be useful to plan future surface water development for specific projects or for rural water supply.

Several factors must be evaluated to assess the feasibility of surface water development at each specific location and determine design parameters:

1. Soil permeability - soil samples must be collected and analysed to give an approximate permeability based on soil type;

2. Site topography - a site must be found with a natural catchment area draining toward a site for the storage reservoir;

3. Average annual rainfall - estimates of average annual rainfall must be made from recorded rainfall data if available, or by observing vegetation patterns, measuring erosion channels, talking to nearby villagers and consulting published rainfall maps.

The above data will need to be collected after completion of Phase 1 and identification of general locations for surface catchments.

The plan for data collection and reservoir design and construction has been formulated only in general terms because at this time it is not known how much surface water will be required. Four uars will be constructed for the Bay Region Project, the number of uars constructed for the Central Rangelands Project is dependent on the availability of groundwater. After the groundwater and rangelands surveys are completed, detailed plans can be formulated showing precise numbers and scheduling for staff and equipment.

All surface water development in this Project will be done under the direction of an expatriate civil engineer with a background in hydrology, hydraulics and water system development. He will coordinate the data collection, design and construction for surface water storage reservoirs and at the same time, train Somali counterparts in design and construction techniques, thus increasing the institutional capability of WDA in surface water development.

The initial responsibility of the engineer will be to collect design data for each catchment site identified in Phase 1. Soil samples for permeability estimates, rainfall data, evaporation data ans site topography must be obtained prior to design of the surface water catchment.

Each uar should be designed by the water engineer with assistance from Somali counterparts and the Engineering Department. Collection of design data will be the responsibility of the engineer. Input on sizing, locating and special features will be provided by the National Range Agency (NRA) for the Central Rangelands Project and the Ministry of Agriculture for the Bay Region Project.

The WDA, through the Engineering Department, will construct the uars using existing equipment and new equipment provided through the Project. All materials (pumps, pipe, PVC liner, etc.) will be provided by the regional projects. Since few uars will be constructed, all construction management and equipment can be centered in Mogadiscio. Regional capabilities for design and construction should not be developed at this time.

Sufficient equipment and materials have been budgeted to construct two uars in the Central Rangelands and four in the Bay Region. After completing Phase 1, the budgeting should be reevaluated; if more uars are needed, then fewer wells will be needed and budgets can be adjusted accordingly. If no uars are needed then funds can be transferred to well construction.

Operation of the uars will be the responsibility of the National Range Agency in the Central Rangelands and the WDA in the Bay Region and other areas. The operating agency will provide an operator, pay the operators' salary and expenses, collect fees for the water and control the availability of the water. The operating agency will also provide maintenance for the uars.

The WDA does not currently operate or maintain any of the wells or surface catchments they construct. One of the emphasis of the GWDP is to provide WDA with equipment and training to assume responsibility for operation and maintenance of wells and catchments. The engineer will need to set up specific schedules and procedures for operation and maintenance, and train the WDA staff to implement them. Establishing overall management of operation and maintenance functions will be the responsibility of other expatriate staff.

Operation and maintenance capabilities for both wells and surface water catchments will be established on a regional basis. Equipment and personnel will be centered in Baidoa, Dusa Mareb and Balkayo.

Any surface water catchments constructed for the Central Rangelands Development Project will be operated and maintained by the NRA through the Stockwater Service that will be created under the Project. The expatriate engineer will need to assist the Stockwater Service by suggesting specific operation and maintenance procedures for uars.

ATTACHMENT 1

REFERENCES

Food and Agricultural Organization of the United Nations, Agricultural and Water Surveys, Somalia. Vol. V, 1967.

World Health Organization/World Bank, Somalia Water Supply and Sewerage Sector Study, 1977.

ANNEX 9

THE SOCIAL ANALYSIS

I. GENERAL

A. Introduction: The Somali Democratic Republic and the Comprehensive Groundwater Project

B. Research Methodology

II. THE ANTHROPOLOGY OF WATER UTILIZATION IN SOMALIA

III. WATER UTILIZATION PRACTICES AND HEALTH PROBLEMS

IV. RECOMMENDATIONS FOR DATA COLLECTION FOR THE GROUNDWATER PROJECT

I. GENERAL

A. Introduction

The Somali Democratic Republic is situated on the northern coast of Africa. The country's 3.5 million people live on 637,000 square kilometers. About 40 percent of the population are nomadic pastoralists. In rain-fed areas and where water is available for irrigation, agricultural communities are formed. Cotton, vegetables, maize, sorghum, millet and edible oils and bananas are grown in the southern part of the country.

Somali social organization presents a real challenge to social scientists. The flexibility and fluidity of social units makes it difficult to classify, or for that matter categorize social groups. At a very general level one can say that large rural communities exist in the south, while small nomadic hamlets prevail in the central and northern parts of the country. However, these types of social groups are not mutually exclusive of one another. In the south, nomadic groups graze their cattle, camels, goats and sheep close by villages, and small farming is practiced whenever water is available in the central and northern regions.

Population movements are motivated by a desire to seek sources of fresh water and better pasture conditions. Although the general pattern of migration is to settle during the rainy seasons and move during the dry seasons other matters have to be taken into consideration. The decision to settle or move is made by individuals on the basis of a total evaluation of the following:

1. Size of herd owned;
2. Type of animals;
3. Type of vegetation available;
4. Quality of pasture;
5. Water sources and quality of water;
6. Social considerations;
7. Knowledge available about other locations.

Individuals make their decisions to maximize their chances in finding water and pasture. Sometimes a person finds that the best strategy is to split the family in order to procure a more efficient system. Animals are divided into smaller and more managable units. Women and small children might settle with their herds of goats, sheep, cows and a few camels. Men might find it more advantageous to practice transhumance with their large camel herds.

To a Somali nomad the most precious things in life are water and livestock. Herding animals is both a way of making a living and a way of life. The Scarcity of water endangers the lives of humans and animals. Under drought conditions, migratory routes become longer and competition over limited water and pasture leads to loss of lives. Cemetaries of the 1975 drought victims can be seen in the northern regions of Somalia.

Faced with environmental constraints that include both erratic annual patterns of rainfall (about 50-200m), and the threat of cyclical droughts every 4/5 years, the Somalis have developed a flexible social system that maximizes the individual's chances to locate water and pasture. Ecological insecurity forces people into adopting flexible social arrangements that with the passage of time assume a value of their own and become a way of life. In other words, nomads might be nomads because of scarcity of permanent water sources, but also it might be the "free-wanderer" part of the nomad wich refuses to settle even when water becomes available. The tremendous sense of freedom that a nomad has in moving around and joining groups on temporary basis is not to be ignored. As a matter of fact, settlements that were established by the Somali Government to accommodate drought stricken nomads have lost about 40 percent of their population back to nomadism.

It is true that women and children tend to accept sedentary living more willingly than adult males. Sedentary life offers them better educational and health services. Although it could also mean a loss of freedom. The new generation of "ex-nomads" who are growing up in a settled community are likely to view sedentary life as the norm and thus maintain a settled life.

The Comprehensive Groundwater Project will offer the agro-nomadic population of Somalia access to good quality underground water for human and animal consumption. It will also give individuals a chance to participate in sedentary life if they choose to do so.

The project is divided into two phases. Part of the phase I program is to conduct a thorough sociological study to determine (1) local criteria for the selection of well-sites, (2) the nature of water utilization practices, (3) community leaders, and (f) the best methods to involve members of the communities in the project.

B. Research Methodology:

The data base for the social soundness section of this project paper is based on a brief one month field work period in Somalia. Field visits to Afgoi, Kurtunwaare, Balad, Giohar, Belet-wayne, Dusa-Mareeb, and Galcaio proved useful in terms of accessing people's needs for water. A special visit was paid to the rural communities between Mogadishu and Baidoa. These visits helped gain first-hand information on local needs and water practices.

Because of time constraints and other logistic reasons, the informal free-flow of information method was preferred over structured questionnaires. Some times conversations were carried on soley in Arabic, and in other instances a Somali interpreter was used. I viewed my task as a limited one that is specificly designed to answer the following questions:

1. Who are the beneficiaries of this project?
2. Is there a need for utilizing underground water in Somalia?
3. How is water used by people?
4. How can local communities participate in the project?

Conversations with Somali officials, regional representatives of the Water Development Agency, were useful in helping understand the government's concern with water management issues.

II. THE ANTHROPOLOGY OF WATER UTILIZATION AND THE CULTURAL CONTEXT

Travelling through Somalia, one realized that the issues of water availability, water quality, and water delivery systems are some of the main concerns of the Somalis. In a semi-arid country where rainfall is erratic, and droughts present an imminent threat every four or five years, the availability of a steady water supply is one of the perceived needs of the population.

Somalis have developed a flexible social organization that allows them to utilize their limited water and pasture resources. The system gives the individual maximum freedom to move about with their herds to seek fresh water sources and pasturage. Pragmatism, egaliterianism, and individualism are some of the qualities that help Somalis cope with water shortages and limited vegetation for livestock. In a country where ecological pressures are tremendous, individuals have devised an open and a fluid social system. The only stable social unit is formed around women and their children. A woman might choose to stay with her herd of goats, cows, sheep and a few milch camels in a rural settlement, or she might move with her husband to new locations.

Agriculture is practiced by much of the rural population. Individual gardens are cleared and planted with cereals, oil crops and vegetables and fruits. There are different systems of land tenure. In the past, land was controlled by tribal lineage leaders. At present, the government is instituting a land registration program to give title to property to the users. Title to land can be claimed through usage, or by applying for an agricultural permit. Private plantations grow cash crops like cotton and bananas. However, agriculture depends on a constant source of water. The two rivers in Somalia, the Shabelli and the Juba are both located in the south and hence spotted or no agriculture is more typical of other regions of the country.

Pasturage is "God's gift to the nomad" so individuals are free to choose any area they see suitable for their herd's needs. Water for human consumption is also a "gift of God". A thirsty person cannot be denied access to water. Water for livestock consumption is subject to another set of rules. Wells dug by the Water Development Agency, and private owners charge fees for water to be used by livestock. The prices vary from one region to another, but water is less expensive in the south than in the northern regions of the country. Current prices are charged on the basis of the type of animal using the water. In the south the prices are 5 cents for a goat or a sheep, 10 cents for a cow, and 20 cents for a camel (100 cents = 1 shilling and 1 shilling = 16 cents U.S.). In the north prices almost double.

There are different types of water points that can be distinguised:

1. Wells
2. "Birkads" (subsurface rain water cisterns of cement, occuring mainly in the northern and central regions. These denote subsurface basins with cement lining.)
3. "Bellehs" (natural depressions in the terrain to collect rainwater, normally without an artificial catchment system).
4. "Uars" (surface rainwater basins with artificially built catchment systems).
5. "Hillos" (water points on the banks of Juba and Shabelli rivers).

In the northern parts of Somalia, the sale of water is a flourishing trade. Cement-lined tanks, (birkads) are constructed by private owners. The tank is usually covered by bushes that keep the water cool. In the dry season nomads gather around "birkads" and buy water from traders. The commercialization of water resources is most developed in the areas of the north where livestock is taken to sea ports for export purposes. Water traders usually cultivate areas close to their tanks. It is interesting to note that these traders are not threatened by the government's efforts to build more wells. In an interview with a water trader, he mentioned that there is always a need for water and new wells will not affect his business.

Sometimes wells are dug with communal labor, and those who participate in the digging process have exclusive right over the water. Access to water from these home wells is dependent on active participation in digging and building the well.

"Uars" are often owned and managed by the Water Development Agency. People who live close to "Uars" can procure water for their own use free of charge, but, they have to pay for water used for livestock. Guards are appointed by the Water Development Agency and fees are handed over to the WDA regional office on a monthly basis.

Women and children congregate and socialize by water points. Some women wash clothing close to sources of water, and others carry the water home to do the washing while attending to other household activities. Often water has to be carried for long distances except in areas where government water trucks are available. Plastic containers, water baskets, and clay jars are all used to haul water. Camels are sometimes used for carrying heavy water jars.

III. WATER UTILIZATION PRACTICES AND HEALTH PROBLEMS

In the home water is usually placed in clay jars and tin cans are used for taking water from the jars. Water contamination results from using dirty buckets, dung stained ropes, flies, dirt and dust. Gastrointestinal diseases cause a high infant mortality rate. River water is known to be the primary source of bilharzia, and in the southern regions of the country the rural population drink the water of the Shabelli and Juba rivers. Bilharzia snails find the best environments to multiply in river banks where people swim or wash their clothing.

In some parts of the country underground water has a high rate of magnesium sulfate which is harmful to humans and animals. People avoid drinking this water and are sometimes forced into migrating long distances to river banks where they are exposed to bilharzia. Some people prefer the taste of water from old wells over the taste of water from newly dug wells.

IV. RECOMMENDATIONS FOR DATA COLLECTION: PHASE I

A. Population Distribution:

1. Where do people live?
2. How many people use a well, an Uar.....etc?
3. Do nomads frequent the area seasonally? How many? What are their water needs?

B. Livestock Distribution:

1. How many animals does the average family own?
2. Herd composition and water needs.
3. How much does the average family spend on water for livestock monthly?
4. Can vegetation around proposed water ponits support livestock?
5. The effect of an increased supply of water on livestock.

C. Water Utilization Practices and Health Problems:

1. Basic data on effect of water on peoples' health.
2. Statistics on infant mortality rates and percentage attributed to water contimination.
3. What kind of diseases are prevalent in what areas?
4. Are people aware of the relationship between contaminated water and diseases?

D. Well Sites and People:

1. Where do people prefer to have wells? Why?
2. What types of water points are preferred by the local population? Why?

E. The Anthropology of Droughts:

1. How do people procure water during drought conditions?
2. How do droughts affect social organizations?
3. Under drought conditions which segment of the population suffers most?
4. Effect of droughts on herd size.

For items A and B above, the data will be collected under the Central Rangelands and Bay Region Projects, each of which have significant demographic and inventory components. For item C, the A.I.D. Rural Health Project will be collecting this data systematically in Bay, Togdheer and Mudung Regions. This data will be utilized in this social study.

Table 1

SOMALIA: Population by Sex and Region
as of February 1979
(in thousands)

Region	Male	Female	Total	%
W. Galbeed	228	212	440	12.6
Togodheer	137	121	258	7.4
Sanaag	72	74	146	4.2
Bari	82	73	156	4.4
Nugaal	43	42	85	2.4
Mudug	115	100	215	6.2
Galguduud	94	88	182	5.2
Hiiraan	76	71	147	4.2
Sh. Dhexe	124	113	237	6.8
Mogadishu	189	182	371	10.6
Sh. Hoose	204	194	398	11.4
J. Hoose	130	116	246	7.0
Gedo	112	100	212	6.1
Bay	157	145	403	8.6
Bokool	54	46	100	2.9
Total	1,817	1,677	3,494	100.0

Note: Population figures are preliminary, and not yet officially published
Source: Data provided by the State Planning Commission

Table 2

Population by Age Group inthe Settlements and Area Under Cultivation
(as of April 1979)

Settlement Locations	Population 0-5	6-14	15-45	46-50	51+	People on Vacation	Total Settled	Area Under Cultivation (Ha.)
Dujuma	5238	18096	14747	2003	566	141	40791	840
Sablale	2945	11050	8282	1191	357	-	23825	770
Kurtum Warey	2841	9724	7997	1024	329	149	22064	441
Total	11024	38870	31026	4218	1252	290	86680	2051

Source: Data provided by the Settlement Development Agency

ANNEX 10

ECONOMIC/FINANCIAL ANALYSIS

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ANNEX 10

ECONOMIC FEASIBILITY

BACKGROUND AND OBJECTIVES

The purpose of this economic analysis is to determine: 1) if the proposed project will return sufficient benefits to justify the investment and 2) if the project represents the best allocation of resources when compared with other projects to acheive similar objectives.

The primary objective of the Groundwater Development Project is to provide water to the human and livestock populations of rural Somalia. This objective is to be achieved through two types of projects:

1. Projects in sectors where water supply is one of several components, e.g., the Central Rangelands Project, the Bay Region Agricultural Development Project, and

2. Projects exclusively for rural water supply.

The feature which distinguishes the proposed project from other alternatives to be discussed below is in approach more than intended output. The Groundwater Development Project is essentially an institution-building project. It is designed to make the Water Development Agency (WDA) a viable, trained organization capable of carrying out the short term technical needs, and the intermediate and long-range planning, management and implementation functions of non-urban water resource development. The costs associated with this approach will be compared to the alternative of segmenting water supply responsibility among individual project-related entities in order to evaluate the least cost means of providing the required services.

ASSESSMENT OF NEED - THE BENEFICIARIES

There is currently no data base from which to estimate the total water requirements of the rural areas. Information on existing groundwater capacity, development supply and current per capita or total consumption is also lacking. Until such data can be collected as part of Phase I of this project, all estimates should be viewed as relative measures of project worth.

Rural Water Needs

Human and livestock population densities and range productivity are all closely intertwined in Somalia. For purposes of this analysis, estimates of livestock needs will be based on the Northern and Central Rangelands Project while water to rural settlements will be separately determined.

Human Needs

According to the WHO/World Bank Water Supply and Sewerage Sector Study (1977), in 1975 51% of the rural population in "settled" villages have no access to water service while the nomadic population was considered to be essentially without service[1/]. Even rough estimates of population to be served at various levels of consumption demonstrates the validity of the project objectives:

DAILY WATER REQUIREMENTS (000's)

Rural Population To Be Served (000's)		Level of Service: Liters Per Capita Per Day			
		Current (5 lcd)	Low (15 lcd)	Adequate (30 lcd)	Optimum (50 lcd)
Nomadic[1/]	1112.0	5,560 M^3	16,680 M^3	33,360 M^3	55,600 M^3
Villages	315.0	1,575 M^3	4,725 M^3	9,450 M^3	15,750 M^3
TOTAL	1427.0	7,135 M^3	21,405 M^3	42,810 M^3	71,350 M^3
Annual Water Supply Needs		2,604,275	7,812,825	15,625,650	24,042,750

1/ 80% considered without access to village supply.

Estimates of the number and density of wells in rural settlements by region show that approximately 1,000 villages are without a permanent water supply. At the 50 lcd consumption level, an average village would need 16 M^3 per day. Livestock associated with the village would use another 8 M^3 per day. The location of 1,000 rural wells in settled area delivering water at a capacity of 72 M^3 would provide both the village, its livestock and a portionate nomadic population (1.1 million nomads distributed over 1,000 water points using 40-50 lcd) with a substantial improvement in permanent water supply.

Livestock Needs

Livestock needs to be served by this Project have been estimated as part of the Bay Region Agricultural Development and the Central Rangelands Projects. Some of the water development to occur under the additional component of rural water supply will provide water to village livestock, just as there will be dual function of wells on a non-permanent basis for human use in the Bay Region. It is, however, useful to evaluate the order

1/ Clearly some of the nomadic population is attached to settled villages.

of magnitude of total livestock water requirements in Somalia and of the two regions (Bay Region and Central Rangelands) to be served. This allows some measure by which to evaluate benefits of the proposed Project.

WATER REQUIREMENTS: LIVESTOCK

Somalia

Livestock Numbers (Millions)		Daily PCC	Daily Total Reg.	Annual (212 Days)	Annual Dry (365 Days)
15	Sheep/Goats	1.7 L	25,500 M^3	5,406,000 M^3	9,307,500 M^3
2.5	Cattle	5.0 L	12,625 M^3	2,676,500 M^3	4,608,125 M^3
2.5	Camels	8.0 L	20,000 M^3	4,240,000 M^3	7,300,000 M^3
	TOTAL		58,125 M^3	12,322,500 M^3	21,215,625 M^3

Central Rangelands and Bay Region

Central Rangelands					
1.2 3.9	Sheep Goats		8,670 M^3	1,838,040 M^3	3,164,550 M^3
0.9	Cattle		4,500 M^3	954,000 M^3	1,642,500 M^3
1.0	Camels		8,000 M^3	1,696,000 M^3	2,920,000 M^3
	TOTAL		21,170 M^3	4,488,040 M^3	7,727,050 M^3
Bay Region					
0.4	Sheep/Goats		680 M^3	144,160 M^3	248,200 M^3
.2	Cattle		1,000 M^3	212,000 M^3	365,000 M^3
.28	Camels		2,240 M^3	474,880 M^3	817,600 M^3
	TOTAL		3,920 M^3	831,040 M^3	1,430,800 M^3

The beneficiaries of the Project will be the settled rural and nomadic population currently without a permanent, good quality water supply (over 1.7 million prople). This represents 53% of the total population.

DESCRIPTION OF PROJECT

The Groundwater Development Project consists of a planning and data collection phase and an implementation phase. The six-year investment period will provide technical staff, training and equipment necessary to drill 140 wells, 66 for livestock use and 74 for rural human consumption.

COST ESTIMATES

The cost of the Project are as follows:

1. Capital Costs - all costs of construction, equipment, vehicles, staff salaries, training and machinery operating during the actual exploration for and construction of 140 wells. Included also are capital costs associated with the water quality laboratories. Replacement parts are considered a capital investment during the six-year development period for purposes of building up an inventory of spare parts.

2. The costs of "dry wells" based on a success rate of 80% following the extensive studies, have been subsumed in the costs of each successful well. Basis for Project is 140 producing wells.

3. Operation and Maintenance - the annual costs of operating and maintaining 98 wells. The Central and Northern Rangelands Projects will operate and maintain the remaining 42. Costs include the maintenance of equipment required to maintain the pumps and engines, fuel and necessary manpower.

4. All base cost estimates are in January 1979 prices. Price contingency allowances have been applied to all Project components as shown.

5. When appropriate, specific and comparable cost item estimates have been based on the Central Rangelands and Bay Region Development Projects. This has been done so that all Project alternatives are on the same base. This allows for an evaluation of the incremental value of the resources committed as it reflects the benefit foregone in the most productive alternative use.

ECONOMIC PROJECT COST ESTIMATES

Financial project and recurrent costs have been transformed into an economic cost stream. The following approach has been used:

1. Basic year for all economic Project costs and benefits is year 1 of the Project.

2. The economic cost of the Project includes inputs from other projects. Those costs carried by the Central Rangelands Project (materials, maintenance and operation of 42 livestock wells) and the Bay Region Agricultural Development Project (materials) have been included at their stated value as costs to this Project in the determination of Project worth.

3. Only those costs which will produce measurable benefits have been included. Costs which will produce benefits which are measurable but not quantifiable and costs which produce quantifiable benefits have also been broken out separately.

4. All costs associated with the water quality component (staff, equipment, fellowships, operation and maintenance) have been excluded.

5. All costs associated with surface water development (vehicles and operation) have been excluded.

6. One-half of the salaries of the technical staff over the six-year period (with the exception of the drillers) has been excluded and is considered to be charged to the "institution building" function of the Project. The other 50% of the salaries of the technical exploration team have been included due to the cost averted in future unsuccessful boreholes. The full salaries of the economist and sociologist have been excluded, as part of pre-Project studies.

7. The life of a drilling rig is considered to be 20 years, or 800 wells, Each Project component (CRDP livestock, BRDP livestock, BRDP domestics and rural supply) was charged the percentage of the cost based on the number of wells, The full Project investment period of years 1-6 was considered at 18% of the rig cost.

8. The life of all other machinery and vehicles was considered to be 10 years or 400 wells with the wells drilled during the investment period charged with 35% of the cost.

9. Cost of the exploration phase (minus 1/2 technical staff) was spread over project components as follows:

CRDP livestock	- 23%
NRDP livestock	- 7%
BRDP livestock	- 17%
BRDP domestic	- 26%
Rural supply	- 27%

10. In any given year of the drilling stage, the Project components were charged proportionately for the number of wells drilled in a given year.

11. All training has been excluded as not having measurable benefits.

12. Costs include operation and maintenance of 98 wells beyond year 6. The intended expansion of WDA drilling operations to 40 wells per year to year 20 (660 wells) using the initial capital investment and GSDR annual expenditures is discussed but not included in the economic cost stream.

13. All local cash salaries and allowances are included with the full financial value.

14. All direct and indirect foreign exchange costs have been shadow priced at the rate of 1 US $ = 9 So.Sh. or about 43% over the official exchange rate.

PRODUCTION AND BENEFITS

There are three types of benefits which are produced by this Project: quantifiable benefits which can be assigned an economic value; measurable benefits which cannot be given an economic value, and non-quantifiable benefits. Each of these types will be discussed separately and only the first two will be considered within the measures of Project worth.

1. Quantifiable Benefits: Quantifiable benefits would be derived from increased production of animals and the resulting incremental off-take due, in part, to improved water supply in the Central Rangelands and the Bay Region. It is, however, virtually impossible to separate out those benefits made possible by the investment in water supply alone. All of the Project elements of improved range management and livestock production are necessary and interdependent.

A. Benefits Resulting From Range Management - Central Rangelands

ECONOMIC BENEFIT STREAM - CRDP (So.Sh. Millions)

Village and Town and Range Grazing Reserves	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Years 15-29	Year 30
Value of Incremental Off-Take 1/ 2/											
Sheep/Goats	10.8	11.7	12.5	13.8	16.9	21.1	27.2	29.4	31.0	32.2	32.2
Cattle	-	0.2	0.2	0.4	0.7	1.7	2.2	2.6	2.8	2.8	2.8
Camels	2.2	2.4	2.7	3.0	3.2	3.5	4.1	4.3	4.6	4.9	4.9
Incremental Value of Herd 1/ 3/											
Sheep/Goats	-	-	-	-	-	-	-	-	-	-	230.0
Cattle	-	-	-	-	-	-	-	-	-	-	37.8
Camels	-	-	-	-	-	-	-	-	-	-	129.6
Famine Reserves 4/	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
TOTAL	16.7	18.0	19.1	20.9	24.5	30.0	37.2	40.0	42.1	43.6	441.0

(Footnotes, see following page)

Central Rangelands Development Project. World Bank Report 2163-50.
1/ Economic Value per animal (grazing unit): sheep/goats So.Sh. 316; Cattle So.Sh. 1,868; Camels So.Sh. 2,700 (See Annex 13, Para. 19).
2/ Incremental Off-take see Annex 13, Appendix II, Page 1.
3/ Total animal numbers of year 30 converted into grazing units using the conversion factors for sheep/goats: 0.8; cattle 0.5; camels 0.8; (Annex 13, Para 2).
4/ Average incremental benefits per year (See Annex 13, Appendix 11, Page 2).
5/ Incremental off-take see Annex 13, Appendix 11, Page 3.

Since the GWDP will provide exactly the same product to the CRDP through a different vehicle, it is valid to accept these benefits as those of the project. The GWDP would, however, alter the stream of benefits by providing the wells one year earlier. Thus benefits would be returned beginning in year 5 of the project as follows:

ECONOMIC BENEFIT STREAM
GWDP/CRDP
(So.Sh.Millions)

Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Years 14-29	Year 30
16.7	18.0	19.1	20.9	24.5	30.0	37.2	40.0	42.1	43.6	441.0

B. Benefits Resulting From Livestock Wells - Bay Region

Based upon the Bay Region Agricultural Development Project (World Bank Report 2406-50), it was not possible to estimate benefits derived from improved water supply for livestock. This was primarily due to the functional relationship between water, other inputs, and improved crop and livestock production benefits. The GWDP specifically excludes irrigation water and the information available for the Bay Region does not facilitate the separation of costs and benefits on this basis.

2. "Measurable" Benefits

Benefits of the GWDP which can be quantified, but for which no economic value can be derived, are reflected in the numbers of people served by new domestic rural wells. This estimate is based on the people who, without the project, would have no access to a permanent, safe water source.

At current consumption levels, over one million of the rural population could be served. However, current consumption levels are well below adequate standards and improved levels of service must also be considered a

ESTIMATE OF POPULATION SERVED

Project Component	Number Wells	Well Capacity M^3 Per Day	Current Consumption Level: Per Capita Consumption LCD	Current Consumption Level: Population Served Per Well	Current Consumption Level: Total Population Served (Benefits)	Improved Consumption Level: Per Capita Consumption LCD	Improved Consumption Level: Population Served Per Well	Improved Consumption Level: Total Population Served (Benefits)
BRDP Domestic	36	72 M^3	5	14,400	518,400	30	2,400	86,400
GWDP Rural	38	72 M^3	5	14,400	547,200	30	2,400	91,200
TOTAL	74	72 M^3	5 LCD	14,400	1,065,600	30 LCD	2,400	177,600

project benefit. It is probable that over 30 LCD would be more than one family would retrieve from a well without a distribution system. Thus, depending upon selection criteria for settlement populations to be served, beneficiaries may realistically range from 200,000 to 1,000,000. At the adequate consumption levels of 30 LCD the project would need to continue at the rate of 40 wells per year to year 17 to fulfill all rural domestic requirements. This does not include increased demand due to population growth.

3. Other Benefits

A. Two of the major benefits of developing the groundwater supply through this project relates to years of drought: 1) The stabilization of pastoralist income due to a more reliable water source and 2) the costs averted by lessening the magnitude of drought relief projects. Needless to say these are not "unquantifiable" benefits. They are, in fact, the most important economic impacts that this project will have. However, within the constraints of the study it has not been feasible to estimate the value of resources which will not be required due to the project compared to those which, as in any drought-prone area, will continue in dry years. An indication of the massive diversion of resources to crisis programs is given in the UNDP "Notes on Drought Rehabilitation In Somalia" (8 November 1975).

- Loss of the equivalent of 20-30% of GDP in direct export losses and increased import requirements (400,000,000 So.Sh.).
- Relief operations costing So.Sh. 250,000,000.
- Food aid valued at U.S.$43,000,000.
- Financial assistance of U.S.$65,000,000.

As in the United States, where losses averted due to flooding are considered benefits of a flood control project, some portion of these resources, (as well as the cost of governmental disruption) should be considered a project benefit.

B. Social benefits of rural water supply are typically difficult to quantify although they may represent the true objective of the project. The following are potential benefits to the rural areas:

1. Public Health Benefits
   - Reduction in water-borne disease.

   For these benefits to occur, a rural helth education program is necessary.

2. Productivity Benefits
   - Reduction in the time and effort spent fetching water. It is estimated that in some rural areas of East Africa over 1/4 of one person's daily energy requirements is used in fetching water; for individual households the figure could be as high as 80-90%.
   - Increased output through improved health.

3. Slowing of Migration
   - Improvement in overall rural services may slow migration to the cities.

4. Alteration of Settlement Patterns and Livestock Grazing.

   - Rural water development can be used to direct settlement and land use patterns so as to minimize impacts by livestock and maximize the use of the range.

ECONOMIC FEASIBILITY

Rural water supply as an investment resembles investments in many other "social" sectors. Because it is rarely possible to measure benefits adequately, intersectoral allocation cannot be made on the basis of cost/benefit analysis. Instead it is essentially a matter of public policy, reflecting the national priorities.

In order to measure the economic feasibility of the GWDP it is necessary to define the "without" project condition. With the exception of the 38 rural wells to be supplied in years 5-6, all the wells proposed to be drilled as part of the GWDP are currently proposed as part of alternative regional development projects. Thus, the "without" project condition means that 102 of the 140 wells would simply be supplied through different vehicles. The most important economic consideration must be whether or not this project represents the most efficient allocation of scarce resources since the water supply elements of this project and its alternatives are mutually exclusive.

There are several ways in which project worth can be evaluated and then ranked in relation to the proposed alternatives. Table 1 shows the undiscounted costs of the project and its alternatives:

1. Discounted at the opportunity cost of capital of 12% it is clear that for benefits which are equal but largely unquantifiable, the GWDP represents the least costly of these mutually exclusive alternatives.

PROJECT WORTH

Project	Cost (at 12%)	Cost Per Well
BRP & CRDP	$6,552,000	$71,217
GWDP	4,987,000	54,207
Benefit	1,565,000	17,010

TABLE 1

GROUNDWATER DEVELOPMENT PROJECT

COMPARATIVE COST OF WELLS
(Millions of Dollars)

WDA Project Component	Budget Source			Total Cost	Number Wells	Average Cost Per Well	Alternative Project	Cost	Number Wells	Average Cost Per Well	Cost Savings (Benefit)	
	WDA	BRDP	CRDP								Total	Per Well
Livestock-CRDP	1.92	0	1.47	3.39	42	$80,700	CRDP	3.53	42	$ 84,000	.14	$ 3,300
Livestock-BRDP	1.40	.47	0	1.87	24	$78,000	BRDP	2.90	24	$121,500	1.03	$43,500
Domestic-BRDP	1.96	.86	0	2.80	36	$78,000	BRDP	4.13	36	$114,800	1.33	$36,800
TOTAL (Other Project Related)	5.28	1.33	1.47	8.10	102	$78,500	TOTAL (Other Project Related)	10.60	102	$103,900	2.50	$25,400

2. Since the alternative projects will proceed if the GWDP is not implemented, the benefit of the project is reflected in cost savings, or reallocation of resources by not choosing the other projects. In this case the benefit is 1.5 million dollars. This benefit is equal to the cost of drilling 60 new rural wells.

3. In terms of the individual project components, the GWDP would result in twice the benefits of the Bay Region Project or achieve the same benefits at half the cost.

PROJECT WORTH

Project	Number Wells	Cost (D.F. 12%)	Cost Per Well	Beneficiaries (30 LCD)	Cost/Person Served
BRP - Domestic	36	$3,577,400	$99,372	86,400	$41.41
GWDP-BRP Domestic	36	$2,543,000	$70,639	86,400	$29.43
GWDP-BRP Rural	74	$3,828,000	$51,724	177,600	$21.55

Not only does the cost per person decline when the GWDP takes over the drilling, operation and maintenance of the Bay Region wells, it also declines futher when the resources are centralized into a total rural supply component.

Two measures of project worth have been used to evaluate the GWDP component to supply livestock wells to the CRDP.

The preferred method for ranking mutually exclusive alternatives having quantifiable benefits is to determine which has the greatest present worth. Using 12% as the opportunity cost of capital in Somalia, the GWDP was found to have a present worth of +$4.80 million while the CRDP had one of +$.35 million.

The economic rate of return (ERR) for the Central Rangelands-Range Development component, without the GNDP was found to be 12%, marginal in terms of its investment potential. However, the substitution of the GWDP for the water supply component of the CRDP increased the economic rate of return to 14%. This is attributed both to decreased costs and an earlier occurance of project benefits due to moving the well project up one year. Sensitivity analysis of the ERR for the only factor which the GWDP could influence (independent of the sensitivity runs in the CRDP) shows that a delay in the GWDP which would hold up the Rangelands Project for two years would bring the ERR down to 12%, the rate of return operable without GWDP participation.

FINANCIAL ANALYSIS

The financial analysis will focus on: 1) the project costs; 2) the recurrent costs of the project and the ability of WDA and the GSDR to finance such expenditures once AID financing has terminated; 3) the financial effect on project participants and 4) the overall cost effectiveness of the project in terms of unit output costs.

A. Project Costs and Financial Plan

Table 2 shows a summary financial plan for the development period of the project.

TABLE 2
SUMMARY - FINANCIAL PLAN
(US $000)

Component	AID	GSDR
Technical Assistance	5,421	172
Training	607	50
Construction	506	672
Commodities	3,999	250
Operations	0	937
Salaries	0	1,216
Inflation	2,166	1,526
Contingencies	237	142
TOTAL	12,936	4,965
	17,901	

Tables 3 and 4 show detailed costing of the Project. It is anticipated that local currency will be supplied through sale of commodities by GSDR under the PL 480 Title I program. Disbursements required by GSDR are shown in Table 3, Expenditure Schedule of GSDR Contribution, for each of the six years. These costs are for local staff of WDA and are considered reasonable in review of current commitments. The Expenditure Schedule - AID Contribution, shows detailed fiscal year expenditure levels required by project component for both dollars and PL 480 local currency.

B. Recurrent Costs: Operations and Maintenance

There are two types of recurrent costs associated with this project. The first are those costs required to operate and maintain 98 of the 140 wells which will be drilled during the investment period until year 20. The second are those associated with program expansion in years 7-20.

TABLE 3

EXPENDITURE SCHEDULE
GSDR BUDGET CONTRIBUTION
($000)

COMPONENT	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	TOTAL
Training and Salaries							
Hydrogeologist (3)	0	28	28	28	28	28	140
Water Engineer (2)	0	0	11	11	11	11	44
Geophysicist (3)	0	17	17	17	17	17	85
Drillers (5)	0	15	15	15	15	15	75
Rig Hands (30)	0	16	49	49	49	49	212
Hydrology Technician	3	6	6	6	6	6	33
Other	13	49	107	139	156	163	627
Mechanic (5)							
Carpenter (4)							
Steel Fixer (4)							
Pipe Fitter (4)							
Electrician (5)							
Drivers							
Heavy Equipment Operators (2)							
Cook							
Labor							
Sociologist							
Masons							
Pump Operator							
Per Diem							
Uniforms							
Base Cost: Training	16	131	233	265	282	289	1,216
Price Contingency (10%)	2	28	77	122	172	223	624
TOTAL	18	159	310	387	454	512	1,840

TABLE 4

EXPENDITURE SCHEDULE - AID CONTRIBUTION
($000)

COMPONENT	Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		TOTAL	
	FX	LC	FX	LC	FX	LC	FX	LC	FX	LC	FX	LC	FX	LC
Construction														
Pump houses	0	0	0	0	31	39	31	39	24	28	24	28	110	134
Troughs, pipes and fittings	0	0	0	0	70	47	70	47	52	35	52	35	244	164
Staff Houses	100	325	0	0	0	0	0	0	0	0	0	0	100	325
Dug Wells	0	0	0	0	0	0	12	11	12	11	12	11	36	33
Water Distribution	0	0	0	0	8	8	8	8	0	0	0	0	16	16
Base Cost: Construction	100	325	0	0	109	94	121	105	88	74	88	74	506	672
Physical Contingency (10%)	0	33	0	0	11	9	12	10	9	7	9	7	41	66
Price Contingency	0	36	0	0	31	34	48	53	46	49	57	52	182	234
Total Construction	100	394	0	0	151	151	181	168	143	130	154	143	789	972
Equipment, Vehicles, Machinery and Materials														
Geophysical Trucks	0	0	100	5	0	0	0	0	0	0	0	0	100	5
Four-wheel Drive Vehicles	128	7	12	0	0	0	0	0	0	0	0	0	140	7
Trucks	0	0	201	11	112	9	241	13	0	0	0	0	554	33
Rotary and Cable Tool Rigs	1253	66	0	0	0	0	0	0	0	0	0	0	1253	66
Pump Setting Rigs	0	0	100	6	0	0	0	0	0	0	0	0	100	6
Bulldozer and Motor Grader	0	0	245	13	0	0	0	0	0	0	0	0	245	13
Test Pump Units	0	0	28	1	0	0	0	0	0	0	0	0	28	1
Tractor, Roller Compressor	0	0	95	11	0	0	0	0	0	0	0	0	95	11
Water Quality Laboratory	59	3	17	1	34	2	25	1	1	0	1	0	137	7
Casing and Screen	0	0	50	0	50	0	0	0	40	1	164	9	304	10
Pumps and Engines and Spare Parts	0	0	0	0	50	0	0	0	37	2	138	7	225	9
Other Miscellaneous	0	0	0	23	17	1	10	6	10	6	10	6	47	42
Spare Parts	414	22	236	12	49	2	72	4	0	0	0	0	771	40
Base Cost: Vehicles/Equip.	1854	98	1084	83	312	14	348	24	88	9	313	22	3999	250
Physical Contingency (5%)	93	5	52	4	13	1	17	1	5	0	16	1	196	12
Price Contingency	156	10	185	18	71	5	131	11	44	5	194	18	781	67
Total Equipment/Vehicles	2103	113	1321	105	396	20	496	36	137	14	523	41	4976	329

TABLE 4 (Continued)

COMPONENT	Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		TOTAL	
	FX	LC	FX	LC	FX	LC	FX	LC	FX	LC	FX	LC	FX	LC
Technical Staff														
Project Manager	110	0	110	0	110	0	110	0	110	0	110	0	660	0
Hydrogeologist (3)	0	0	305	0	305	0	204	0	102	0	0	0	916	0
Water Engineer	0	0	0	0	102	0	102	0	0	0	0	0	204	0
Geophysicist (3)	0	0	179	0	179	0	120	0	60	0	0	0	538	0
Drillers (3)	0	0	225	0	225	0	225	0	75	0	0	0	850	0
Hydrology Technician	30	0	60	0	60	0	60	0	0	0	0	0	210	0
Consultancies	204	0	204	0	55	0	50	0	0	0	0	0	512	0
Supplementary Studies	150	0	50	0	50	0	50	0	50	0	50	0	400	0
Chemist	75	0	75	0	75	0	25	0	0	0	0	0	250	0
Laboratory Technician	55	0	55	0	0	0	0	0	0	0	0	0	110	0
Instrument Technician	55	0	55	0	55	0	55	0	0	0	0	0	220	0
Mechanics (3)	0	0	125	0	225	0	225	0	75	0	0	0	650	0
Staff Housing (Rental)	0	50	0	50	0	40	0	32	0	0	0	0	0	172
Base Cost: Technical	679	50	1443	50	1441	40	1226	32	472	0	160	0	5421	172
Price Contingency (7%)	37	4	209	7	320	9	365	10	169	0	55	0	1155	30
Total: Technical	716	54	1652	57	1761	49	1536	42	641	0	225	0	6576	202
Training and Salaries														
Professional Fees	149	0	98	0	2	5	6	3	2	0	6	2	263	10
In-Country Training	19	5	38	10	38	10	38	10	19	5	0	0	152	40
Fellowships	96	0	96	0	0	0	0	0	0	0	0	0	192	0
Base Cost: Training/Salaries	264	5	232	10	40	15	44	13	21	5	6	2	607	50
Price Contingency	8	0	16	2	6	5	10	6	6	3	2	0	48	16
Total: Training/Salaries	272	5	243	12	16	20	54	19	27	8	8	2	655	66
Operating Costs														
Vehicle Operation	0	4	0	20	0	184	0	180	0	83	0	78	0	549
Pump Operation	0	0	0	0	0	13	0	54	0	94	0	227	0	388
Base Cost: Operating Costs	0	4	0	20	0	197	0	234	0	177	0	305	0	937
Physical Contingency (7%)	0	0	0	1	0	14	0	16	0	12	0	21	0	64
Price Contingengy (10%)	0	0	0	4	0	70	0	115	0	115	0	251	0	555
Total: Operating Costs	0	4	0	25	0	281	0	365	0	304	0	577	0	1556
Total Base Cost	2897	482	2759	163	1902	360	1739	408	669	265	567	403	10533	2081
Physical Contingency	93	38	52	5	24	24	29	27	14	19	25	29	237	142
Price Contingency	201	50	410	31	428	123	554	195	265	172	308	331	2166	902
TOTAL EXPECTED PROJECT COST	3191	570	3221	199	2354	507	2322	630	948	456	900	763	12936	3125

Recurrent costs due to operation and maintenance of the initial 98 wells include the operation of the pumps (fuel and pump operators); salaries, vehicle and equipment use for pump maintenance and replacement of vehicles, pumps and engines. The following assumptions are used to estimate operation and maintenance requirements:

- Well life assumed at 30 years
- One person-day per well will be required for 20% of the wells each year after year 6.
- Average distance of 300 km round-trip for maintenance.
- Staff required: mechanics, pipe-fitters and laborers.
- Vehicles and equipment required: parts van, maintenance truck, generator welder and four-wheel drive trucks.
- Spare parts until year 13 of the project have been included in the development budget. After year 13, new engines, pumps, vehicles and spare parts will be required.
- Pumps will operate 2225 hours/year for livestock wells and 2920 hours/year for domestic wells.

RECURRENT COSTS TO OPERATE
AND MAINTAIN 98 WDA WELLS
(Sh.Sh. 000)

Costs	Project Year	So.Sh.
Outflow		
Capital Expenditures		
Replacement of machinery and equipment	12 (one-time)	4473
Operation and Maintenance Expenses	7-20 (annual)	
Salaries		41
Vehicle and Equipment Use		29
Pump Operation		1688
Annual Cost		1758

Operation and Maintenace Cost/Well/Year = annual cost + capital cost (year 12) spread over life of well:

Domestic		Livestock	
So.Sh.	U.S.$	So.Sh.	U.S.$
22,300	3,600	18,300	2,957

1. Recovery of Recurrent Costs: Operation and Maintenance

The minimum test for financial feasibility is whether the levels of service achieved with AID financing are at a cost which could be maintained entirely through local involvement.

It is recommended that the cost of water to small rural settlements with low per capita income should at least recover the operation and maintenance costs. However, these annual charges should not exceed 5% of the annual income of the head of household (or the monthly charge should not exceed one day's wage at the prevailing minimum wage.)

User Charges - Financial Impact on Participants

Based upon an estimated well capacity of 72 M^3 per day, giving an annual operation and maintenance cost of 22,277 So.Sh., the cost of operation and maintenance per capita for domestic wells is as follows:

Water Consumption/Well			Cost to User		
			Annual		Monthly
Population Served	Per Capita Use LCD	Daily Use Total	Per Person	Per Family*	Per Family
2,400	30	72 M^3	9.3	51-74	69¢ to $1
3,600	20	72 M^3	6.2	34-50	46¢ to 67¢

* Range represents household size of 5.5 to 8 persons.

Based upon the above guidelines at a cost of $8/year/family, the head of household income would have to be over $150/year. Using the minimum daily wage criteria the $8 fee compares favorably: 70¢/month is far less than $2.75/day of casual labor. If estimates of income are accurate for Somalia, this may be too high a rate to pay. Some alternatives would be to decrease the time of pump operation to 6 hours, serve larger villages with lower per capita consumption to spread the cost. None of these options sufficiently alter the cost of the water.

The following indicators offer somewhat contradictory evidence regarding willingness or ability to pay:

- Currently the rural population is rarely expected to pay for domestic water from wells.
- Somalis are accustomed to pay for water from uars for domestic use and for livestock.
- Fees, when collected, range from 1 to 3 So.Sh. per 1,000 L for domestic use.

- Water represents a high priority in the lives of Somalis and they have expressed an appreciation of its economic value through a willingness to pay.
- Although the per capita income of the nomad is assumed to be only about $85/year, there is considerable evidence that this is an understatement of cash transferred or available goods which could be marketed for cash income if cash were needed.
- One measure of ability to pay is what is currently paid. The tariff recommended here for the operation and maintenance recovery is actually lower than reported fees of 1-3 So.Sh./M^3. It is approximately 0.85 So.Sh./M^3. This is an indication either than such a rate can be paid or that it is already too high and is not collected.

The costs of operation and maintenance which should be recovered do not appear unraasonable and warrant further assessment on actual income levels. It may be that the problem is more with failure to collect fees. It is very important, however, that fees be set low enough to encourage the use of the more healthful supply. Since almost all rural families maintain livestock, this issue of domestic water charges should be resolved in conjunction with that of livestock (see below).

Overall the rural supply component of the GSDP compares favorably with recommended costs per capita. The cost per capita of developing the supply (capital cost) is between $15-$17. This represents the cost financed by AID. In future years it will be necessary for the GSDR to subsidize rural water if well drilling and water supply are to be expanded. This issue is discussed under "Recurrent Costs: Expansion of Rural Supply and Well Program" below.

Livestock Charges

The WDA will operate 24 livestock wells in the Bay Region and will receive fees collected from user charges. Current charges are:

Livestock	So.Sh.
Sheep/goats	5¢
Cattle	10¢
Camels	20¢

For details, see Table 5 .

Although the WDA will not collect fees for the Rangelands Projects, the difference in cost per family in the Central Rangelands is significant to note for comparison. See Table 6

It is evident that more research must be done on average herd size, current water charges and cost of operation since there is great sensitivity to all these variables. However, based on the present research some conclusions may be drawn:

TABLE 5

BAY REGION - LIVESTOCK CHARGI

Costs to Recover 1/			Use and Estimated Fee Collection 2/					Cost to User 3/		
Well Capacity Per Day M^3	O&M Cost Per M^3 (So.Sh.)	Amount to Recover O&M/Well (So.Sh.)	Animals	Consumption Per Watering L	Number Animals Per Day	Tariff Collected Per Day (So.Sh.)	Well Revenue Per Year (So.Sh.)	Average Herd Per House-hold	Cost Per Watering (So.Sh.)	Costs Per Year (So.Sh.)
72	1.2	18,300	Sheep/ Goats	5	2,400	120	25,440	6.7	.34	24
			Cattle	15	1,200	120	25,440	3.3	.33	23
			Camels	80	525	105	22,260	5.0	1.00	21
TOTAL		18,300	All		4,125	345	73,140	15.0	1.67	68

1/ Based on 72 M^3 x 212 days operation.
2/ 1100 families/well. Leaves approximately ½ families unserved in the Bay Region,
3330 cattle @ 15 L every three days,
5500 camels @ 80 L every 10 days,
7370 sheep/goats @ 5 L every three days.
3/ Average herd size from Bay Region Agricultural Development Project Report.

TABLE 6

CENTRAL RANGELANDS - LIVESTOCK CHARGES

Costs to Recover 1/			Use and Estimated Fee Collection 2/					Cost to User 3/		
Well Capacity Per Day M^3	O&M Cost Per M^3 (So.Sh.)	Amount to Recover O&M/Well (So.Sh.)	Animals	Consumption Per Watering L	Number Animals Per Day	Tariff Collected Per Day (So.Sh.)	Well Revenue Per Year (So.Sh.)	Average Herd Per Household	Cost Per Watering (So.Sh.)	Costs Per Year (So.Sh.)
72	3.54	54,035	Sheep/ Goats	5	11,250	563	119,356	75	3.75	266
			Camels	80	188	38	8,056	14	2.80	59
TOTAL		54,035	Total		11,438	601	127,412	89	6.55	325

1/ From CRDP Report (2163-50)

2/ Using current charges, not proposed CRDP charges.

3/ This is approximately $10/year less than estimated in CRDP yet appears to be sufficient to cover operation and maintenance.

- Current water charges, if collected, should be sufficient to cover operation and maintenance for livestock wells. Even if costs of the GWDP are underestimated by 100%, the conservative estimates of the Bay Region would cover the need.

- Both the CRDP and the BRDP recommend water charges that will amount to about $60 (US) or 400 So.Sh. per year per family under these projects - effectively wiping out gains to pastoralists. This may be overstated since O&M costs may be lower than estimated for these projects. It appears that lower charges may be possible creating an additional incentive to participate.

- If average herd sizes and current water charges collected in the Central Rangelands are reasonably accurate, the average nomad as head of household is paying about $50 per year for water. This implies a higher income than thought and is critical to setting water charges for domestic use.

Recommendations for water charges:

- If current estimates of livestock water charges are accurate, the nomad as head of household will be able to assume the additional $8/year charge ($.67 U.S. or So.Sh. 4 per month) for domestic use.

- Since the livestock wells will result in greater milk production/ animal fewer head will be necessary to provide milk for a family. The sale of one additional goat for cash will more than pay for water for domestic use.

- If livestock charges more than recover the O&M costs, it is preferable to use the surplus revenue to WDA rather than reduce the current charges.

- If charges for family use to recover O&M are too high (resulting in the use of a free but unsafe supply), livestock charges may be used to subsidize domestic use. This will only be possible to the degree that WDA collects livestock well fees (as in the Bay Region).

- Water charges for Livestock and human use must be viewed together since the combined burden falls on a single household.

2. Recurrent Costs: Expansion of Rural Supply and Well Program

The GWDP is an institution-building project which is intended to go beyond a specific numbers of boreholes drilled and pumps maintained. Capital investments such as drilling rigs are expected to have a life of 800 wells. Training of Somalis to carry on the program also is designed for a well expansion effort. Over the years 7 - 20 of the project period, these

initial investments should result in an additional 660 wells. At the same time, however, the expenditures to continue the program on an annual basis must be made as part of the GSDR-WDA budget allocation.

The estimated incremental expenditure for expanding rural water supply by 40 wells a year to year 20 are as follows:

	1979 Prices - 000's			
	Annual		Year 12 Only	
	U.S.$	So.Sh.	U.S.$	So.Sh.
Capital Expenditures				
Salaries	214.0	1,327.0	0	0
Construction	186.0	1,153.0	0	0
Pumps and Engines	194.0	1,200.0	0	0
Casings and Screens	230.0	1,424.0		
Equipment Replacement	0	0	856.0	5,300.0
TOTAL	824.0	5,104.0	856.0	5,300.0

For financial projections for project years 7 - 20, see Table 7 .

The implications of the financial projections are that the cash transfer from NRA and the Bay Region Project in Year 6, as payment for the wells drilled during the development period, will allow WDA to continue operating and expanding its rural supply program up to year 12. At that time the GSDR will need to make a $2 million investment to cover equipment needs. The annual costs which are not defrayed by water revenues and must be covered to continue the program are not unreasonable in terms of past GSDR budgetary allocations.

SELECTION CRITERIA

The following Table shows the recommended well siting priorities:

	Year 3	Year 4	Year 5	Year 6	Total
Central Rangelands	16	16	0	0	32
Northern Rangelands	10	0	0	0	10
Bay Region - Livestock	12	12	0	0	24
Bay Region - Domestic	2	12	22	0	36
Rural Supply	0	0	8	30	38
Total					140

These priorities will create the greatest immediate economic impact.

TABLE 7

FINANCIAL PROJECTIONS - YEARS 7 - 20
(US $000's)

	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15	YEAR 16	YEAR 17	YEAR 18	YEAR 19	YEAR 20
OUTFLOW														
Equipment	0	0	0	0	0	723	0	0	0	0	0	0	0	0
Replacement	0	0	0	0	0	856	0	0	0	0	0	0	0	0
Salaries	824	824	824	824	824	824	824	824	824	824	824	824	824	824
Operation and Maintenance	285	408	531	654	777	900	1023	1146	1269	1392	1515	1638	1761	1884
Subtotal: Outflow	1109	1232	1355	1478	1601	3303	1847	1970	2093	2216	2339	2462	2585	2708
INFLOW														
Fees-NRA & BRDP (Carryover)	2400	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Revenue														
Rural	266	414	562	710	858	1006	1154	1302	1450	1598	1746	1894	2042	2190
Livestock	284	284	284	284	284	284	284	284	284	284	284	284	284	284
Subtotal: Inflow	2950	698	846	994	1142	1290	1438	1586	1734	1882	2030	2178	2326	2474
NET CASH BALANCE	1841	(534)	(509)	(484)	(459)	(2013)	(409)	(384)	(359)	(334)	(309)	(284)	(259)	(234)

Within the rural supply-domestic sector a whole series of selection criteria should be developed to maximize the net social and economic benefits per unit of investment.

A. Technology and Cost

The primary question which should be answered prior to a decision to put in a borehole for a rural population is: Is the level of technology involved in the drilling program necessary to supply an area with water. What are the alternatives? Pre-selection criteria should be applied. If another approach to the water problem is more cost-effective, support to local government should be given to best implement the least cost alternative in the most efficient way. While these pre-selection criteria may appear peripheral to the drilling program, WDA should still have as a part of its training program and its decision-making authority, the capability to respons with flexibility to make the most efficient use of resources at its disposal.

Example: Alternative approches to meeting water needs:

Basic Assumptions

	(1)	(2)	(3)
Village Population	1000	3000	5000
Per Capita Consumption (LCD)	15	15	15
Average Daily Consumption (M^3)	15	45	75
Annual Requirement (365 D ays)	5,475	16,425	27,375
Livestock Population	9,400	28,200	47,000
Average Daily Consumption (M^3)	27.3	82	136
Annual Requirement (212 Days)	5,792	17,377	28,832
Total Village Water - Daily Requirement (M^3)	42	127	211
Total Annual Requirement (M^3)	11,270	33,800	56,200

For typical costs and per capita costs, see Table 8.

TABLE 8

TYPICAL COSTS
(So.Sh.000's)

Village Size	(1) Dug Well-Hand Pump		(2) Drilled Well		Uar (3) Simple		Uar (3) Complex	
	Construction	O&M	Construction	O&M	Construct	O&M	Construct	O&M
1,000	34.0	1.0	280.0	18.0	151.3	19.6	312.0	19.6
3,000	102.0	3.0	330.0	21.0	333.7	34.3	936.0	34.3
5,000	170.0	5.0	370.0	24.0	493.8	51.0	1,557.0	51.0

PER CAPITA COSTS
(So.Sh.)

1,000	34	1	280	18	151	20	312	20
3,000	34	1	110	7	111	11	312	11
5,000	34	1	74	5	99	10	311	10

(1) Dug Well - 15 M deep with concrete casing, 1 M diameter.
- Includes piped distribution system to livestock water troughs and hydrant stand.

(2) Drilled Well - 6 inch diameter well 115 M deep, including 15 M of well screen.
- Plastic casing.
- Submersible pump with pump house, small storage tank, livestock water troughs and hydrant stand.

(3) Simple Uar - Excavated below grade and surrounded with protective embankment.
- Inlet and outlet formed with large diameter concrete pipe.
- Hand pumps for removing water.
- Watering troughs and fenced enclosures for livestock.

Complex Uar - Same as simple uar except includes PVC reservoir liner and silt trap located outside reservoir.

Preselection criteria should consider the relative per capita costs of the alternatives in terms of a village's ability to pay or the government's ability to subsidize. Reliability of the systems and costs of maintenance may be a more important featureof an alternative than the initial capital cost.

B. Economic Considerations for Siting of Wells

- Population distribution: larger, more densely populated areas need lower investment costs per capita.

- Growth potential.

- Clustered villages with wells may lower capital cost, cheaper to maintain and administer.

- Nature of new water source

- Level of service required

- Accessibility

- Relationship of livestock to vegetation in surrounding area

- Ability to pay for water

- Presence of local skills for maintenance

- Relationship to economic, regional development projects.

C. Social Considerations for Siting of Wells

Village Need

- Prevalence of water-bourne disease
- Lack of alternative supply
- Current distance traveled to water point
- Local interest and involvement
- Potential impact on desired land settlement patterns.

Ultimately ranking will be subjective in order to consider technical, economic and social considerations. For example, the most expensive system may be required in areas least able to afford it. Similarly a predetermined fee for water without consideration of regional differences could go against social needs in favor of economic growth. Phase I should attempt to set up criteria of selection which involve a mix between meeting social and economic goals within the development phase.

INSTITUTIONAL AND FINANCIAL CONSIDERATIONS

The following are current institutional and financial problems in the operation of the WDA or associated with the project which could have negative impacts on its economic and financial feasibility:

*1. Under-staffing.

2. Poor distribution of personnel.

*3. Insufficient inventory of supplies and equipment.

4. Non-standardization of equipment.

5. Communication and accessibility difficulties.

*6. Lack of data base on population, water supply or demand.

7. Past diversion of resources from resource development to drought relief.

*8. Lack of Systematic record keeping.

*9. Lack of technical and management ability.

*10. Lack of central and regional coordination.

11. Lack of skilled support administrative staff.

*12. Insufficient incentives to attract and retain qualified staff.

13. Lack of rural water supply policy.

*14. Lack of project development, evaluation and priority selection capability.

15. Lack of local village government infrastructure to mobilize resources for fee collection, cooperative maintenance.

16. Inadequate public health education.

17. Low level of cooperation between the National Range Agency and the Water Development Agency.

* Should be positively affected by this program, Inshaallah.

PHASE I

SCOPE OF WORK

DATA COLLECTION REQUIREMENTS FOR ECONOMIC ANALYSIS

DETERMINE WATER NEEDS

A. Population

1. Location of rural settlements
2. Size of settlements
   - Population
   - Household size and households/village
3. Stability of population
   - Core settlement
   - Nomadic population
   - Population growth
4. Livestock population
   - Head per household
   - Livestock mix

B. Current Water Consumption

1. Current per capita use
   - Number times/day water is fetched
   - Size of container
2. Availability of existing supply
   - Distance
   - Seasonal
3. Uses of water besides drinking

C. Potential Water Consumption

1. Perception of availability
2. Increase in use if more readily available
3. Potential village growth

D. Ability to Pay - Pricing Policy

1. Cost of service required
2. Current water charges per unit of water
3. Current collection
4. Livestock water charges
5. Cost of livestock water per family
6. Family income
7. Basis for sale of additional livestock

F. Fee Collection

1. Existence of local leadership

G. Cost of Service

1. How many people is it reasonable to serve from one faucet per hour
2. Distance to roads
3. Level of service to improve health standards

The number of villages to be served should be adjusted during project execution in light of data collected and cost requirements.

ANNEX 11

OTHER DONOR PROGRAMS

Other Donor Programs in the Water Resource Sector are being done by the World Bank (IBRD), The Peoples Republic of China (PRC), and the Federal Republic of Germany (FRG). These programs all focus primarily on urban and large town water systems.

IBRD - The IBRD is undertaking a renovation and expansion of the Mogadishu water supply through the Mogadishu Water Authority (MWA). It is renovating the existing system installed by Parsons, Inc. under an earlier A.I.D. loan, expanding the distribution system and developing a new complimentary well field. The program is being contracted as a turnkey type of operation with some institutional support for the MWA.

PRC - The PRC has been focusing on regional town water supplies having installed water systems in Hargeisa and Baidoa. It has discussed moving a rural well program in the northern area of the country. The program is run entirely as a turnkey operation with no institutional support.

FRG - The FRG program is the most complimentary to the A.I.D. program since it provides some institutional support for the WDA as well as town water supplies. Past activities have been entirely in the town water supply area. Wells have been installed in Afgoi, Balad, Merka, Johar and Burao. Additional feasibility studies have been done for water supplies in Erigavo, Gardo, Garoe, Dusa Mareb and Galciao.

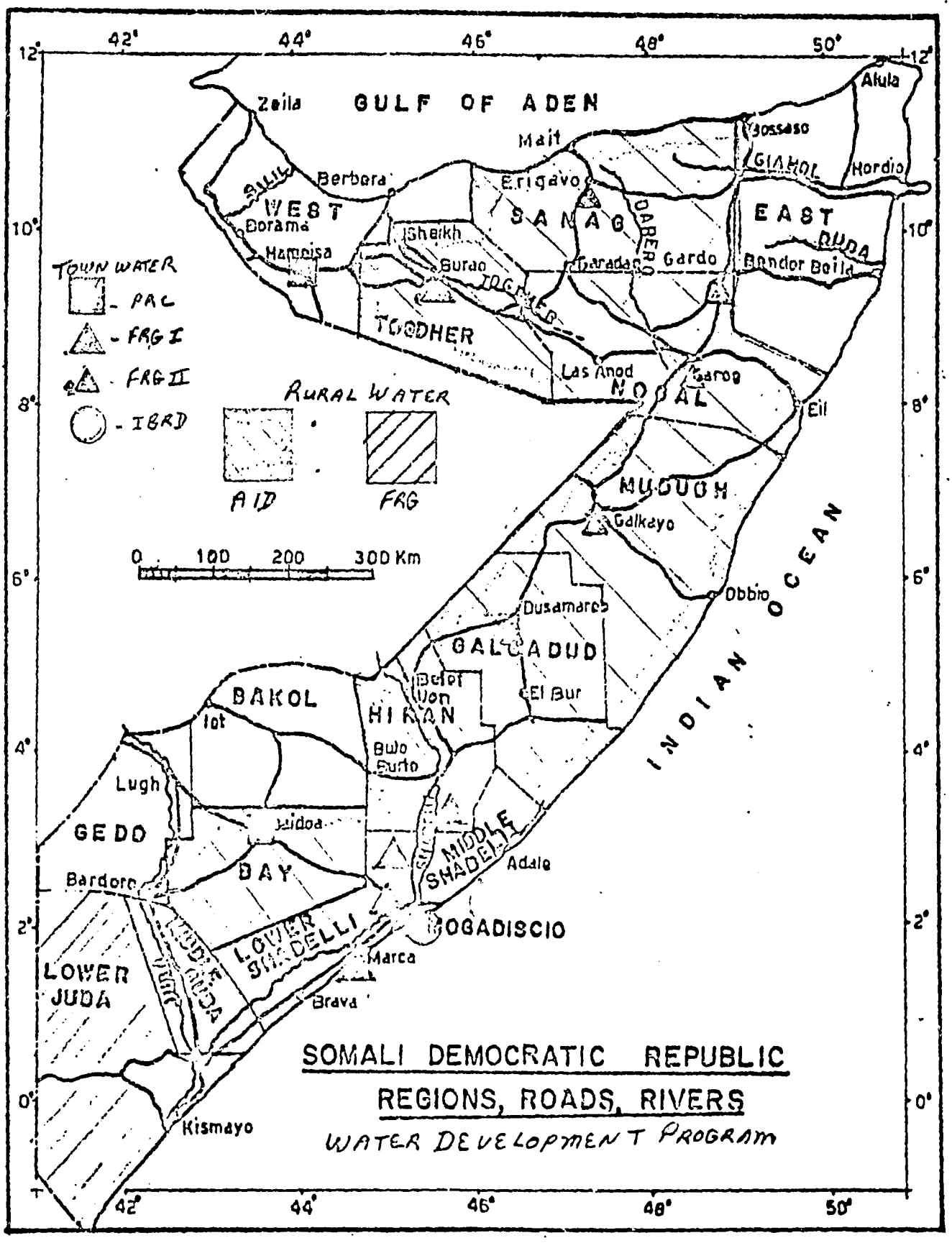
In phase II of their program, the FRG anticipates drilling wells in Erigavo, Gardo, Garoe, Dusa Mareb and Galciao for town water supplies. This phase will also find the FRG providing technical assistance to the WDA both directly linked to town water supplies and more generally.

FRG Institutional Support

Town Water	General
2 Civil Engineers	1 Hydrologist
1 Driller	1 Accountant
1 Water Supply Instructor	1 Logistics
	1 Workshop Supervisor
	1 Workshop Instructor
	1 Hydrogeologist - Chisimaio

This program has been considered in the A.I.D. project design to make the two program complimentary and mutually supportive.

The attached map indicates the priority areas of various donors.



SOMALI DEMOCRATIC REPUBLIC

REGIONS, ROADS, RIVERS

WATER DEVELOPMENT PROGRAM

ANNEX 12

IN-COUNTRY TRAINING PROGRAM

Technical Staff Training Program

The recommendation for training Somali technical personnel in the field of groundwater resources development is to offer a series of 8 short courses of approximately 3 weeks duration each. The short courses would be staffed by consulting expartiate Groundwater Specialists, experienced and familiar with instructing students from under developed countries. These instructors would be assisted by the Project Manager and expatriate staff in scoping the sessions and teaching the Somali personnel.

The program of instruction would be open to the technical staff of the WDA, the Ministry of Minerals and Water, the Mogadishu Water Development Agency, the National Range Agency (lecturers 3-7) and on the basis of available space to qualified engineering and geology students from the Somali Universities.

The course prerequisites are a thorough understanding of the English language, and a technical background.

Certificates of Completion will be issued to participants in the following short course programs:

1. Basic Groundwater Geology

    a. Topographic map reading and interpretation;
    b. Air photo reading, use and interpretation;
    c. Groundwater Geology;
    d. Groundwater exploration techniques.

2. Applied Geophysical Techniques

    a. Borehold geophysical investigation techniques;
    b. Operation of geophysical equipment for borehole investigation;
    c. Downhole video survey techniques and equipment operation.

3. Collection of Correlative Data

    a. Well and spring records;
    b. Water level measurement devices;
    c. Rainfall gaging.

4. Constructing Wells

    a. Well drilling techniques, components and design;
    b. Well development, testing and sterilization.

5. Well Design

   a. Well specifications;
   b. Construction inspection.

6. Well and Aquifer Data Analysis

   a. Aquifer characteristics;
   b. Pumping data and analysis.

      1) Specific capacity;
      2) Transmissivity and shortage determination.

   c. Pump and Motor selection criteria.

      1) Total head;
      2) HP requirements;
      3) Types of pumps and motors.

7. Well Rehabilitation

   a. Investigation, detection;
   b. Corrective measures.

8. Groundwater Maps

   a. Construction of maps, Cross-sections, hydrographs;
   b. Interpretation and analysis.

Water Quality Section

Training Institutes

The Health Personnel Institute, run by the Ministry of Health, offers a two year program for laboratory technicians and many of the technicians at the Central Public Health Laboratory (CPHL) and Digfer General Hopsital were trained in Somalia. The training is medically oriented but offers basic instruction in math, physics, chemistry, bacteriology, and general methods and techniques. An average of 15-20 technicians graduate each year and this year twenty five are graduating.

The Chemistry Faculty at the Somali National University offers a four-year degree in chemistry and up to ten students graduate each year. Included in the fields studied is qualitative water analysis. The laboratory is well equipped for cation, anion and metal analysis and an atomic absorption and gas chromatograph are on order. The university also houses the only technical library in Mogadishu.

The Engineering Faculty has organized a Maintenance Center which is well equipped and well staffed for instrument repair. The Maintenance Center would be very useful in training a technician and may be able to assist in instrument repair.

Training

Prior to learning specific testing procedures, there are some basic laboratory procedures which all laboratory staff should know. These concern:

Samples - Proper techniques and containers must be used in order to obtain a representative sample. Records of samples should be clear and accurate. Samples without identification will not be analyzed. One technician must be responsible for logging samples in. The log book information should contain an assigned laboratory number, data received, from whom it was received, and analyses to be performed.

Weighing - Good weighing techniques are important as it is reflected in the accuracy of nearly every test. Calibration of balances should periodically be checked.

Measuring - Volumetric glassware is also basic to most tests. Proper technique and good, clean glassware are essential to accuracy.

Maintenance - Periodic cleaning, covering when not in use and proper techniques help prolong instrument lifetime.

Records - Precise records must be kept.

Safety -

Technicians should be assigned specific tests. Once these have been mastered, additional responsibilities could be assigned. Eventually, each technician would be familiar with all analyses.

The Chief Chemist should make periodic reviews of methods and techniques and check calculations. Monthly reports must be made to summarize results. Inventory should be watched closely.

The final responsibility for the lab lies with the Chief Chemist.

ANNEX 13

TECHNICAL ASSISTANCE

This Annex presents the timing chart for technical assistance, the staffing pattern for the Technical Assistance team and job descriptions for each team member.

GROUNDWATER DEVELOPMENT PROJECT EXPATRIATE STAFF

Expatriate Staff		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Time (Year)	Location
Project Manager	E-6	———	———	———	———	———	———	6	Mogadiscio
Hydrogeologist	E-3		———	———	———	———		4	Baidoa
Hydrogeologist	E-3		———	———				2	Galcaio
Hydrogeologist	E-3		———	———	———			3	Dusa Mareb
Engineer	E-3			———	———			2	Mogadiscio
Driller	T-5		———	———	———	———		4	Baidoa
Driller	T-5		———	———	———			3	Galcaio
Driller	T-5		———	———	———			3	Dusa Mareb
Mechanic	T-4		———	———	———	———		4	Dusa Mareb
Mechanic	T-4		———	———	———			3	Galcaio
Electrician	T-4		———	———	———			3	Baidoa
Hydrology Tech.	T-3		———	———	———	———		4	Mogadiscio
Chemist	E-3	———	———	———	———			4	Mogadiscio
Lab. Technician	T-3	———	———					2	Mogadiscio
Instrument Tech.	T-3	———	———	———				3	Mogadiscio
Geophysical Tech.	T-4		———	———	———	———		4	Baidoa
Geophysical Tech.	T-4		———	———	———			3	Galcaio
Geophysical Tech.	T-4		———	———				2	Dusa Mareb
Consultant	E-5	- - -	- - -	- - -	- - -	- - -	- - -	4½	-

TECHNICAL ASSISTANCE ALLOCATION BY COMPONENT
(Person Years)

	Hydro-geological		Insti-tution	Drilling[1/]			Data Collec-tion	Total
	I	II		B	D	G		
Team Leader	1	.5	2.5	0	0	0	2	6
Hydrology Technician	.5	1	0	0	0	0	2	3.5
Hydrogeologist		3	0	2	1	1	2	9
Geophysical Technician		3	0	0	0	0	6	9
Chemist	1	1	1	0	0	0	.5	3.5
Laboratory Technician	1	1	0	0	0	0	0	2
Instrument Technician	1	.5	1.5	0	0	0	1	4
Driller		3	1	2	2	2	0	10
Mechanic		2	1	2	2	2	0	9
Civil Engineer	0	0	1.5	0	0	0	.5	2
Consultants								
Economics	0	0	.8	0	0	0	.4	1.2
Social	0	0	.8	0	0	0	.4	1.2
Environmental	0	0	.4	0	0	0	.4	.8
Technical	.5	.2	0	0	0	0	.4	1.1
TOTAL	5.0	15.2	10.5	6	5	5	15.6	62.3

1/ B = Baidoa
D = Dusa Mareb
G = Galcaio

Title of Post: Team Leader/Water Resource Planner
Duration of Appointment: 6 Years
Duty Station: Mogadiscio, Somalia

Job Description:

a) Responsible to the General Manager, WDA, under advisement by the Minister of Minerals and Water Resources and in consultation with the AID Project Officer.

b) Coordinates implementation of the Groundwater Development Project with concerned departments of the MMWR, WDA and NRA.

c) Assist the General Manager of the WDA in administrating the GWDP.

d) Assist in developing annual work plans and budgets.

e) Supervises all technical aspects of the GWDP.

f) Coordinates the GWDP Educational Program through the General Manager of the WDA.

g) In charge of the GWDP which includes surface and groundwater studies, well location and construction, minor storage reservoirs and operation and maintenance thereof.

Qualifications:

a) University graduate, Water Resources background.

b) Experience in management of Groundwater Resources Development Programs.

c) Experience in water resource planning.

d) Experience in supervising people from a variety of Water Resources Development backgrounds.

e) Experience in working with people in developing nations.

Title of Post: Hydrology Data Technician
Duration of Appointment: Two years
Duty Station: Mogadiscio, Somalia

Job Description:

a) Responsible to the Project Manager and Hydrogeologists.

b) Organize and reduce hydrogeological data supplied by the hydrogeologists.

c) Set up a data storage and retrieval filing system.

d) Prepare hydrographs and plot hydrogeologic data on base maps.

e) Train counterpart personnel in the tabulation and use of hydrogeologic data.

f) Perform other related duties as directed by the Project Manager.

Qualifications:

a) Experience as a hydrology technician.

b) Background in water resources.

c) Drafting experience.

d) Experience supervising and training other technicians an advantage.

e) Willingness to spend two years in an undeveloped country.

Title of Post: Civil Engineer
Duration of Appointment: Three years
Duty Station: Mogadiscio

Job Description:

a) Responsible to Team Leader.

b) Review the design and use of uars (surface collection structures) and establish criteria for siting and design of such structures to supply livestock and small villages with a perennial water supply.

c) Establish a program for collecting design data (rainfall, permeability, topography, etc.).

d) Design and supervise construction of four experimental uars in the Bay Region and monitor their performance. Design and supervise construction of uars in the Central Rangelands as needed.

e) Establish operation and maintenance procedures for uars and supervise their implementation.

f) For the Bay Region Agricultural Development Project:
   - View present practices in small scale irrigation in the region and provide advice on how to improve it.
   - Design the two proposed pilot irrigation schemes based on drilled well levels.
   - Supervise the construction of two pilot farms and devise a suitable operating regime.

g) Evaluate present dug well practices and recommend design and procedural practices for improvement.

h) Perform any other related duties as directed by the Project Manager.

i) Participate in the preparation of various operating manuals connected with surface water and irrigation.

j) Train Somali staff to carry out design construction, operation and maintenance of uars.

Qualifications:

a) University degree in Civil Engineering.

b) Broad experience in hydrology particularly in arid regions.

c) Experience with well digging.

d) Experience managing construction crews and equipment on large earthmoving jobs.

e) Willingness and ability to spend considerable time in the field in a rugged environment.

Title of post: Chemist
Duration of Appointment: Four years
Duty Station: Mogadiscio, Somalia

Job Description:

a) Responsible to Director, Hydrogeology Division, MMWR.

b) Organize laboratory activities to process water samples.

c) Organize laboratory records.

d) Set up data center to maintain and report data.

e) Start sampling program.

f) Organize regional laboratories.

g) Train chemists to operate laboratories.

h) Train counterparts to maintain and utilize data system.

Qualifications:

a) B.S. in chemistry.

b) Five years experience in water chemistry.

c) Willing to spend some time in the field.

d) Experienced in laboratory and data management.

e) Experience in a developing country and in training are desirable.

Title of Post: Laboratory Technician
Duration of Appointment: Two to Three years
Duty Station: Mogadiscio, Somalia

Job Description:

a) Responsible to Senior Chemist.

b) Organize laboratory equipment and supplies.

c) Conduct specific tests on water samples.

d) Organize sampling program.

e) Train counterpart technicians.

f) Assist in setting up Regional Laboratories.

Qualifications:

a) Two-year degree.

b) Three years experience in water quality laboratory.

c) Experience as an instructor.

d) Willing to spend some time in the field.

Title of Post: Instrument Technician
Duration of Appointment: Three years
Duty Station: Mogadiscio, Somalia

Job Description:

a) Responsible to Senior Chemist.

b) Survey existing equipment and order needed spare parts or replacement.

c) Repair existing equipment.

d) Begin routine maintenance and calibration program.

e) Assist in setting up regional laboratories.

f) Train counterpart technicians on-the-job, in seminars, in formal classes at the University.

Qualifications:

a) Two-year degree.

b) Three years of experinece in repair of water quality equipment.

c) Experience as a teacher would be useful.

Title of Post: Hydrogeologist (3)
Duration of Appointment: Two to Three years
Duty Station: Baidoa, Somalia
Galcaio, Somalia
Dusa Mareb, Somalia

Job Description:

a) Responsible to the Project Technical Manager.

b) In charge of the field component of the Project which includes surface and groundwater studies, construction of wells and minor storage reservoirs and operation and maintenance thereof.

c) Participate in planning, designing, administration and direction of the Project's water program.

d) In cooperation with the drilling staff and with the assistance of one of the Project's engineers, prepare specifications and appraise bids for all equipment and materials necessary to execute the water component of the Project

e) With the assistance of the expatriate and counterpart staff, carry out or supervise all the necessary studies such as geological mapping, water points inventory and borehole geophysical surveys.

f) Supervise all aspects of drilling and well construction and make sure that all such works are up to the required standard.

g) In close cooperation with other members of the Project staff, select well sites and be responsible for all the geological prerequisites involved in drilling.

h) Would supervise preparation of site reports, borehole logs, water quality reports, yield records, water level records and any other observations normal to the history of each borehole; and insure that all data are faithfully recorded.

i) Would perform any other related duties as directed by the Project Technical Manager.

j) Would pay close attention at all time to the effective training of Somali staff.

Qualifications:

a) University degree in geology or hydrogeology.

b) Broad experience in hydrogeology particularly in arid regions and including some work in both limestone and basement aquifers.

c) Experience in the supervision of large drilling programs.

d) Experience in successfully supervising people of various nationalities and cultures.

e) Willingness and ability to spend considerable time in the field in a rugged environment.

Title of Post: Mechanic (2)
Duration of Appointment: Two to Three Years
Duty Station: Baidoa, Somalia
Dusa Mareb, Somalia
Galcaio, Somalia

Job Description:

a) Responsible to the Driller.

b) In charge of maintenance of one-three drilling rigs, several heavy and light vehicles and a large number of well pumps.

c) With the assistance of the Drilling Superintendent, he would lay out standard procedures of maintenance of all mechanical equipment such as machinery, vehicles and pumps.

d) Control the requisitioning and issue of spare parts from stores.

e) Be responsible for the training of counterpart mechanics in the maintenance of all machinery, vehicles and equipment.

f) Assist with the establishment of a preventive maintenance program for pumps and engines.

Qualifications:

a) Broad practical experience.

b) Experience as mechanic in charge of a workshop.

c) Experience in developing countries would be an advantage as would experience in training mechanics.

Title of Post: Electrician T-3
Duration of Appointment: Three years
Duty Station: Baidoa, Somalia
Dusa Mareb, Somalia
Galcaio, Somalia

Job Description:

a) Responsible to the Hydrogeologist.

b) In charge of electrical maintenance.

c) Lay out precedures of maintenance of all electrical equipment such as motors, generators and control panels.

d) Control the requisitioning of spare electrical parts from stores.

e) Be responsible for the training of counterpart electricians in the installation and maintenance of all electrical equipment.

Qualifications:

a) Broad practical electrical experience.

b) Experience as electrician in charge of a workshop.

c) Experience in developing countries and training experience desirable.

Title of Post: Driller (3)
Duration of Appointment: Two-Three years
Duty Station: Baidoa, Somalia
Dusa Mareb, Somalia
Galcaio, Somalia

Job Description:

a) Responsible to the Hydrogeologist.

b) Responsible for operation of drilling rig and/or some other major equipment such as test pumping unit.

c) Responsible for the routine maintenance of machinery under his control and the activities of the crews.

d) Keep records and logs of all drilling and pumping operations.

e) Ensure that designs and instructions relating to casing installation, well development and test pumping specified by the hydrogeologist were strictly followed

f) Train counterparts in drilling and crews in all aspects of drilling and other activities associated with well installation and operation.

g) Perform other related duties as directed by the hydrogeologist.

Qualifications:

a) Broad experience in water well drilling.

b) Experience as a tool pusher or driller in charge of a drilling rig.

c) Experience in water drilling work in a developing country.

d) Some experience in training of drillers would be an advantage.

e) Willingness and ability to spend considerable time in the field in a rugged environment.

Title of Post: Geophysical Technician (3)
Duration of Appointment: Two years
Duty Station: Baidoa, Somalia
Dusa Mareb, Somalia
Galcaio, Somalia

Job Description:

a) Responsible to the hydrogeologist.

b) Responsible for the operation of the borehole geophysical equipment.

c) Responsible for maintenance and repair of the geophysical equipment under his control.

d) Keeps geophysical logs of all borings and wells.

e) Assist hydrogeologist and driller in interpreting geophysical logs for well design.

f) Trains counterpart geophysical technicians in all aspects of borehole geophysical logging techniques and the care and maintenance of geophysical equipment.

g) Perform other related duties as directed by the hydrogeologist.

Qualifications:

a) Three or more years experience in borehole geophysical logging.

b) Education and training in physical sciences and electronics with mechanical aptitude.

c) Ability to train personnel in theory and application of geophysical borehole logging.

d) Willingness to spend considerable time in the field in a rugged environment.

Short-Term Consultants

1. Initial Surveys

A. Sociologist

The sociologist's primary task will be to develop a series of social profiles of water users and then, utilizing demographic and migration data from other studies, aggregate this data to define the sociological basis for water use. As part of this task an on-going program of sociological data collection will be developed.

This effort will require original field work in the sociology of water utilization. The end result of the initial studies should be sociological criteria for establishing priorities for wells and sites for wells.

It is expected that the sociologist will draw upon data generated under the Central Rangelands Project, the Bay Region Agricultural Development Project and the AID Rural Health Project, each of which have significant social science inputs on a permanent basis.

B. Economist

The economist will develop water utilization models to serve as a basis for allocating costs and adjusting water charges as necessary.

The economist will also work with the sociologist in developing criteria for judging relative priorities of wells for different areas and different functions. He will also develop a system for ongoing economic/financial data collection.

C. Environmentalist

The environmentalist will work closely with the Range and Environment section of the National Range Agency to define environmental criteria and environmental standards to be utilized in the well program. The NRA is responsible for ecological monitoring and a voting member of the National Water Committee. The environmentalist will also develop a plan for the ongoing data collection to permit impact analysis.

2. Data Collection

During this phase the sociologist, economist and environmentalist will return to modify data collection procedures or tabulation methods and assist in analysis to measure the impacts of the Project.

ANNEX 14

IMPLEMENTATION

Equipment Listings

Waiver Request - Vehicles

Implementation Schedules

- Exploration
- Exploitation

GROUNDWATER DEVELOPMENT PROJECT

EQUIPMENT AND MATERIALS LIST

Drilling Program	Number
Drill Rigs - Rotary	3
Drill Rigs - Cable	2
Small Rigs - Cable (pump setting)	3
Compressor	3
Test Pumps	2
Station wagon - four-wheel drive	4
Pick up - four-wheel drive	7
Pick up - four-wheel drive, Long wheelbase	1
Truck - 7 T	5
Water Tanker	3
Casing - 8"	4500 M
Screen - 8"	800 M
Pumps and Engines	38
Camp Equipment	Miscellaneous
Training Equipment	Miscellaneous
Phase I Exploration	
Water quality laboratory equipment 1/	Miscellaneous
Geophysical equipment 1/	Miscellaneous
Geophysical Trucks	3
Light vehicles as listed above	
Camp equipment	Miscellaneous
Maintenance	
Maintenance truck with cable rig and tools	1
Parts Van	3
Surface Water Development	
Bulldozer	1
Motor Grader	1
Tractor and Roller	1
Dump Truck	3
Machinery Trailer	3
Concrete Mixer	3
Cement	1000 T

1/ See lists attached.

TRAINING PROGRAM

Items	Cost
Lecture hall for 30 persons	Provided by WDA
Books, 30 each of: "Groundwater and Wells" Johnson, 1966	$350
"Groundwater Manual" U.S. Department of Interior, Bureau of Reclamation, 1977	$300
"Ground Water Hydrology" H. Bouwen, McGraw-Hill, 1978	$600
Equipment	
Pocket Stereo viewers, 30 each	$750
Aerial photo stereo pairs, 15 each	Project supplied
Somalia, 1:100,000 topographic maps, 30 each	Project supplied
Geophysical Truck and operator	Project supplied
Access to WDA drilling equipment yard	Project supplied
Graph paper, 500 each	$100
3-cycle semilog graph paper, 500 each	$100
3-cycle log, log paper, 500 each	$100
Protractors, triangles, scales, paper, etc., lump sum	$500
Short course outline and certificates, 240 each	$1,700
Sub-Total for Books and Equipment	$4,500
Expatriate Instructor	
Expatriate Instructor (per course 20 days)	$12,000
Air Travel (per course)	2,500
Travel pay (per course, 5 days)	2,000
Per diem (per course, 35 days each @ $40/day)	1,400
Miscellaneous expenses, lump sum	100
Sub-Total for Expatriate Instructor	$18,000

EDUCATIONAL COST SUMMARY

Item	Cost
Books, Equipment and Supplies	$4,500
Expatriate Instructors, 8	$144,000
TOTAL	$148,500

HYDROGEOLOGIC EQUIPMENT

Technical Equipment List	Cost
Hydrogeologist:	
Brunton Compass	$100
200 Meter Chain	200
150 Meter electric probe	250
Stereo viewer, 8 x 20	500
Each Hydrogeologist	$1,050
Expatriate supply	3,150
Somali Counterpart supply	5,250
Sub-Total	$8,400
Geophysical Technician:	
Short and long normal electric logger, 3 each	
Radiation logger, 3 each	
Down-hole flow meter, 3 each	
Down-hole video camera, 1	$3,000
Geophysical Trucks with loggers, 2	35,000 each
Geophysical Truck with video tape and loggers, 1	38,000
Sub-Total	$108,000
TOTAL	$116,400

WATER QUALITY EQUIPMENT

Equipment Needed for the Mineral and Water Resources Laboratory

Equipment needed now	Cost $U.S.
Water distilling apparatus	1,000
Automatic low water cut off	400
2 Conductivity Meters (YSI Model 33 S-C-T or equivalent)	800
Specific Ion Meter	800
3 Fluoride Specific Ion Electrode	1,050
Nephelometer	700
Voltage Stabilizer	300
4 Magnetic stirrers/Hot plate	700
Sample Containers (cubitainer or equivalent)	500
Class "S" Calibration weights	250
Books	200
Sub-Total	$6,700

Future Equipment Costs

Refrigerator	1,000
Spectrophotometer, Year 3	1,200
*Atomic Apsorption Spectrophotometer, Year 3	16,000
Chemicals - $10,000 1st year, $5,000/year, 3 years	
Glassware - $10,000 1st year, $5,000/year, 3 years	
Safety Equipment	1,000
Maintenance Equipment (Oscilloscope, electrical supplies, etc.)	15,000
Equipment Installation	3,000
Spare Parts	10,000

-- All equipment must be for 220 Voltage

*If necessary

Recommended Equipment for Field Laboratories		Cost $U.S.
Portable Test Kit (HACH or equivalent)	HACH No.	
Alkalinity	A1-A-P	
Hardness	HA-4-P	
Chloride	7-P	
Fluoride	-F1-1	
Iron	-IR-18	
Nitrate-Nitite	-NI-3	
Sulphate		
Phosphate	PO-15	
Confirmed tube assembly, Cat. No. 322		1,000/yr/lab
		800/yr/lab
Test tube holders, Cat. No. 634		50
Direct read colorimeter, Model DR		600
Turbidity, Model 1860 220 V Sueps		600
YSI Conductivity Meter		400
Ice Chests		200
Refrigerator		500
Sample Containers		300
Autoclave, Portable		250
pH Meter		500
Buffer Solutions		100/year

	1st Year	2nd Year	3rd Year
	5,800	1,900	1,900
35% of cost for shipping	2,030	665	665
Sub-Total Per Lab	7,830	2,565	2,565
TOTAL	23,490	7,695	7,695

Equipment for Central Public Health Laboratory	
1 Water distillation apparatus, 2 gallons/hour	1,000
1 Automatic low water cut-off	400
1 Refrigerator	1,000
2 Incubators	2,400
2 Air Conditioners, 1 ton	1,000
Chemicals, media, miscellaneous equipment	4,000
Installation of equipment	2,000

Equipment for Drilling Teams	Cost
10 YSI Conductivity meters (or equivalent)	4,000
10 pH meters (for field work)	5,000
Buffer solutions	800/year

DRAFT PROJECT VEHICLE STANDARDIZATION REQUEST

To: SER/COM
From: USAID/Somalia
Subject: Approval for Project Vehicle Standardization
Reference: PIO/C 649-0101-9-00001

As we have previously informed SER/COM, in Somalia, there are no U.S. vehicle manufacturer's representatives or maintenance facilities or spare parts upport for U.S. vehicles. Due to this problem, the Government of Somalia and USAID/ SOmalia decided that, rather than request a source/origin waiver to purchase project vehicles from Code 935 countries, we would standardize on a single U.S. manufacturer and require that the supplier establish the needed facilities. Based on the manufacturer that receives the award for project vehicles under PIO/C 649-0101 S-8000, a project vehicle standardization plan for utility vehicles and passenger vehicles would be instituted. The intent to use this award as a basis for establishing a vehicle standardization plan for vehicle procurements in other AID projects was expressed in Section L-2 of the PIO/C (see Attachment). Further the PIO/C gives favorable consideration to manufacturers which give a firm committment to establish a local representative (see Attachment).

On _____, 1979, AAPC, Inc. informed the Government of Somalia and USAID/Somalia that the award for project vehicles purchased under PIO/C 0101-9-00001 was awarded to _____. Also, _____ has made a firm commitment to establish a local representative in Somalia who shall be able to give adequate local service, spare parts and warranty backstopping.

With this firm commitment by _____, the Government of Somalia and USAID/Somalia request SER/COM's approval to allow the standardization of all project utility vehicles and passenger vehicles to be those that are manufactured by _____.

L. SPECIAL INSTRUCTIONS (Cont'd):

2. Local Representation in Somalia: It is recognized by A.I.D. that there are currently no U.S. manufacturers of vehicles represented in Somalia. In order to encourage U.S. manufacturers to enter the market and establish local representation, including spare parts inventories, trained maintenance personnel and adequate workshop facilities, it is the intent of the U S. Agency for International Development's Mission to Somalia to establish a vehicle standardization plan, using the vehicles covered by this procurement as the base for the plan. Although this procurement covers only 10 vehicles, it is anticipated that over the next 18 to 24 months projects will be developed by the USAID which will include requirements for approximately 100 vehicles, Accordingly, when evaluating the offers received for the vehicles covered by this procurement, favorable consideration will be given to those offers received from manufacturers which include firm commitments to establish a local representation in somalia.

To amend specifications and special provisions as indicated.

All other provisions remain the same.

GENERALIZED EXPLORATION AND DRILLING SCHEDULE (OPTIMUM)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	
Hydrogeologic Exploration							
Bay							
Central Rangelands							
Other							
Exploratory Drilling 3 rigs							
Bay 1 rig							
Central Range 2 rigs							
Other 0 rigs							
Exploitation Program							
Bay 2 rigs		4	16	16	16	16	68 wells
Central Range 2 rigs		8	16	16	16	16	72 wells
Other 1 rig			8	8	8	8	32 wells

Jamhuuriyadda Dim. Soomaalia

Akaaladda Horumarinta Biyaha

S. Boostada 525 - Tel. 8393/8914

Taar. WABI

ANNEX 15

جمهورية الصومال الديمقراطية

وكالة تنمية المياه

ص. ب. ٥٢٥

—«0»—

WATER DEVELOPMENT AGENCY

P.O. Box 525 - MOGADISCIO

10 JUN. 1979

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aar. .....

jeeddo : .....

Mr. Charles Cambell
Director USAID Mission
Mogadiscio

Copy to: Ministry of Mineral & Water Resources
Mogadiscio

Dear Mr. Cambell,

This is confirm to your continuing interest in the Groundwater Development Project. We have discussed the project with your staff and the project development team and feel that nearly $ 18.000.000 project will be of great assistance in partly meeting our needs for development of water resources in Somalia.

The contribution of nearly $ 5.000.000 from the GSDR of which $ 1.000.000 is budgeted for salaries and remaining $ 3.000.000 is to be drawn from PL480 proceeds to pay operating costs demonstrates the GSDR commitment to the project.

We agree that begining theprogram with a detailed survey of priority regions is preferable to other approaches and fully support the effort to keep water resources development centered in our organisation.

We feel that with proper support we may exceed the 140 well target for the life of the project.

Sincerely

(Khalif Haji Farah)
General Manager

	INFO	ACTION
DIR		
D/DIR	C/P	
COMT		
PR		
PR. DIR.		
AGR.		Nelson
HEALTH		

JUN 13 1979

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5. PREPARATION OF GROUNDWATER PP SHOULD BE UNDERTAKEN CONCURRENTLY WITH DEVELOPMENT OF RANGELANDS PP DUE TO CLOSE RELATIONSHIP OF TWO PROJECTS. PLAN USE SAME DESIGN STAFF FOR BOTH ACTIVITIES. IT IS RECOGNIZED THAT GROUNDWATER PROJECT DESIGN WILL TAKE LONGER THAN THAT OF RANGELANDS BUT AS FORMER PROJECT NOT UNDER SAME TIME CONSTRAINTSAS LATTERTHIS DOES NOT CREATE PROBLEMS. SPECIFICALLY COMMITTEE NOTED FOLLOWING POINTS FOR GUIDANCE OF PP DESIGN TEAM:

A. COMMITTEE ENDORSES THRUST OF PROJECT TO CONCENTRATE GROUNDWATER RESOURCE DEVELOPMENT CAPABILITY WITHIN WATER DEVELOPMENT AGENCY RATHER THAN FRAGMENTING AMONG INDIVIDUAL PROJECTS.

B. AS POINTED OUT IN PID AND IEE AND REEMPHASIZED BY COMMITTEE, THERE IS POTENTIAL FOR ADVERSE IMPACT ON THE ECOLOGY IF ADEQUATE MANAGEMENT OF OVERALL RESOURCE BASE IS NOT INCORPORATED WITHIN PROJECT. THEREFORE TO INSTALL SYSTEM OF CHECKS AND BALANCES WITHI WATER RESOURCE SECTOR THE SUBJECT PROJECT SHOULD FOCUS PRIMARILY ON DEVELOPING THE INSTITUTIONAL CAPABILITY WITHIN MINISTRY OF NATURAL RESOURCES TO UNDERTAKE DRILLING PROGRAMS. FUNDS, HOWEVER, FOR ACTUAL DEVELOPMENT OF WELLS SHOULD BE PROVIDED THROUGH OTHER USAID PROJECTS (CENTRAL RANGELANDS, RURAL HEALTH, BAY REGION, ETC). THUS IT WILL BE RESPONSIBILITY OF TECHNICAL STAFFS OF OTHER PROJECTS TO PLAN WELL PROGRAMS FOR THEIR PROJECTS SINCE THEY WILL HAVE THE EXPERTISE TO CONSIDER THE ECOLOGICAL IMPACTS AND RESOURCE MANAGEMENT ASPECTS OF THE ACTIVITY. THE PROJECTS WOULD THEN HIRE WDA TO DRILL THE WELLS TO MEET PROJECT REQUIREMENTS. THEREFORE IEE AS ATTACHED TO PID IS ACCEPTED.

C. SUFFICIENT REVIEW OF EXISTI G HYDROLOGICAL DATA SHOULD BE DONE AS PART OF PP PREPARATION TO VERIFY THAT AQUIFERS LIKELY TO BE TAPPED UNDER THE PROGRAM ARE INDEED BEING RECHARGED AND THUS ANY WELLS DRILLED ARE NOT IN POSITION OF MINING WATERS.

D. IT IS RECOGNIZED THAT EXPLOITATION OF SURFACE WATER IS PART OF AN OVERALL WATER DEVELOPMENT PROGRAM. HOWEVER AS SKILLS, TECHNOLOGIES AND EQUIPMENT REQUIRED ARE QUITE DIFFERENT FROM THOSE NEEDED FOR GROUNDWATER EXPLOITATION, GROUNDWATER PROJECT SHOULD CONCENTRATE ONLY ON GROUNDWATER DEVELOPMENT LEAVING DEVELOPMENT OF SURFACE WATER RESOURCES TO RANGELANDS PROJECT.

6. AID/W PROCEEDING WITH RECRUITMENT/FIELDING OF DESIGN TEAM (S) TO PREPARE TWO PPS. WILL KEEP YOU CLOSELY ADVISED.

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7. SINCE OVERALL AGENCY FUNDS AVAILABILITIES NOT LIKELY SHOW SIGNIFICANT INCREASE N NEXT TWO-THREE YEARS, BUREAU CAREFULLY ASSESSING BUDGETARY REQUIREMENTS OF NEW PROJECTS NOT ONLY IN FY 79 AND 80 BUT ALSO IMPACT ON FY 81 AND FY 82. CENTRAL RANGELANDS WITHIN BUREAU'S LEVELS FOR FY 79 AND 80 BUT NO FUNDS AVAILABLE NOW TO FUND GROUND-WATER START IN FY 79. MISSION MAY PROCEED WITH PLANS FOR FY 79 START BUT MAY FACE DELAY TILL FY 80 IF BUREAU CANNOT FIND FUNDS FOR THIS YEAR.

8. MORE IMPORTANTLY, BUREAU ADVISES MISSION THAT ESTIMATED FY 81-82 FUNDS REQUIRED FOR THESE TWO PROJECTS PLUS AG DEVELOPMENT PROJECT TOTAL 6.5 MILLION DOLLARS IN FY 81 AND 8 MILLION DOLLARS IN FY 82. BUREAU CANNOT ASSURE AVAILABILITY OF SUBSTANTIAL INCREASES IN NEAR-TERM FUTURE AND ADVISES MISSION TO ASSESS CAREFULLY FUTURE YEARS REQUIREMENTS. VANCE

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