REPUBLIC OF GHANA

RURAL WATER SUPPLY AND SANITATION

SECTOR STRATEGY

MAY 1991

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List of Background Reports Prepared for Sector Strategy and Action Plan

1. Operation and Maintenance of RWS Facilities in Ghana,
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2. Summary Report on RWS/S Activities in Ghana,
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3. Human Resources Development Analysis,
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List of Acronyms

ATMA	Accra-Tema Metropolitan Authority
CCCE	Caisse Centrale de Cooperation Economique
CDRs	Committees for the Defence of the Revolution
CIDA	Canadian International Development Agency
CIF	Cost, Insurance and Freight
CUSO	Canadian University Services Overseas
DCD	Department of Community Development
DRHCI	Department of Rural Housing and Cottage Industries
DRWD	Department of Rural Water Development
ERP	Economic Recovery Programme
ESA	External Support Agency
FRG	Federal Republic of Germany
GDP	Gross Domestic Product
GIMPA	Ghana Institute of Management and Public Administration
GOG	Government of Ghana
GTZ	Gesellschaft für Technische Zusammenarbeit
GWSC	Ghana Water and Sewerage Corporation
HP	Handpump
HRD	Human Resources Development
KfW	Kreditanstalt für Wiederaufbau
KVIP	Kumasi Ventilated Improved Pit Latrine
MFEP	Ministry of Finance and Economic Planning
MH	Ministry of Health
MLG	Ministry of Local Government
MWH	Ministry of Works and Housing
NGO	Non-Governmental Organization
NORRIP	Northern Regional Rural Integrated Program
PAMSCAD	Program of Assistance to Mitigate the Social Costs of Adjustment
PIP	Public Investment Program
PNDC	People's National Defence Council
RWS	Rural Water Supply
RWS/S	Rural Water Supply and Sanitation
TNC	Training Network Center for Low-cost Water Supply and Sanitation
UNDP	United Nations Development Programme
UST	University of Science and Technology
UWS	Urban water supply
VIP	Ventilated Improved Pit Latrine
VLOM	Village Level Operation and Maintenance
VORADEP	Volta River Authority Development Programme
WHO	World Health Organization
WVI	World Vision International

I. SECTOR BACKGROUND

A. Rural Ghana

1. The total population of Ghana in 1990 is estimated to be 14.3 million, 9.7 million (65%) of whom live in rural communities of less than 5,000 persons. Ninety percent of the rural population live in about 16,000 communities with populations between 100 and 5,000 persons; the remaining 10% live in some 40,000 smaller settlements. Between 1970 and 1984 the population growth rate was 2.2 in rural areas and 3.4 in urban areas. Continued growth at these rates will result in a rural population of about 12 million in the year 2000. The rural population is most dense along the coast, between Accra and Kumasi, and in the Upper East Region. The Northern Region and the northern half of Brong-Ahafo Region are the least populated areas.[1]

2. The main economic activities in the rural areas are agriculture and livestock with cocoa production being the most important source of income. Activities of traders, manufacturers and craftsmen are widespread, as are services such as repair workshops; however, they constitute a relatively small share of total income. It is estimated that the average income of a farming household (6 persons) ranges from 40,000 to 100,000 cedis per annum (US$120 to 300) which is sufficient to meet the minimum requirement of food, clothes and housing and allow for some discretionary spending to contribute towards infrastructure improvements such as schools, clinics and water and sanitation facilities; in some areas periods of food and cash shortage occur particularly just before harvest time.

3. Health conditions are poor but improving, with the infant mortality rate falling from 120 to 90 per 1000 births between 1965 and 1988. In comparison, the infant mortality rate in 1988 was 110 in West Africa, 50 in middle income countries and 10 in high income countries. In Ghana the rate is about 25% higher in rural areas than in urban areas. This mortality rate is largely attributable to inadequate health care and household sanitation facilities, poor water quality, and insufficient knowledge of the best child health care practices. Related diseases include diarrhea, dysentery, typhoid, cholera, schistosomiasis, and guinea worm. Dehydration caused by infant diarrhea is the main cause of death and could largely be avoided by simple methods of oral rehydration. Mortality rates could also be lowered by broader immunization coverage of children. Guinea Worm is also prevalent in parts of the country, particularly in the Northern Region and the lower Volta Region where about 5% of the population is infected. Only about 45% of communities in rural areas have ready access to health facilities. While community health workers and medical assistants are available at the district level, their ability to serve the rural population effectively is restricted by lack of funds for allowances and transport. In the education sector, the rural areas have experienced a steady increase in both primary and secondary school enrollment since independence. Nevertheless, it is estimated that less than half the population in rural areas is literate.

B. Government Decentralization and Economic Recovery Programs

4. The Governments's decentralization program is designed to make local governments more autonomous, more responsive to local needs and technically and financially capable of providing services. The program is intended to end dependency on central Government and "top down" planning. This is being achieved by giving the country's 110 district assemblies primary responsibility for planning and administering their own development programs, including collecting taxes. With the recent creation of 45 new districts, most are understaffed

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[1] Maps of the regions, rivers, rainfall and vegetation, rural population density and Guinea Worm prevalence are given in Annex 1.

and have minimal facilities. In this decentralized approach individual communities are expected to take the lead in decision making, financing and implementing development projects based on their particular needs. They are to receive support from district staff who in turn are supported by line ministries.

5. Since 1983, the Government of Ghana (GOG) has been implementing an Economic Recovery Programme (ERP) aimed at reversing the severe decline in the economy that began in the early 1970s. The recovery program has appreciably revived the economy with the GDP growing at an annual rate of 6% over the period 1984-1989. Agricultural output increased from a growth rate of less than 1% in 1987 to 5% in 1989 although the falling price for cocoa on the world market has been hampering further growth in the sector. Meanwhile recovery and expansion in the industrial sector has continued with output expanding at a rate of 8% in 1989. Domestic savings and investment have increased in both the public and private sectors, while the overall rate of inflation dropped from 40% in 1987 to 25% in 1989.

6. Measures to achieve the central objectives of the ERP include the further promotion of incentives for efficient production, export and import substitution, increasing domestic resource mobilization by improving the contribution of the tax system to economic growth, reforming the financial system, promoting the role of the private sector and encouraging better resource management in the public sector. It is anticipated that these measures will, in the short run, lead to a curtailment of public expenditure and an emphasis on directing the major portion of public investment towards productive purposes and revenue generating projects. However, special provision is being made to protect the disadvantaged from potentially adverse effects of structural adjustment such as rising costs and increasing unemployment. The Program of Assistance to Mitigate the Social Costs of Adjustment (PAMSCAD) is designed for this purpose and places strong emphasis on building up the necessary social infrastructure to enable the poorer sections of the population to become more productive as well as more effective participants in the process of economic growth in the country. The current National Hand-dug Well Program is part of the PAMSCAD Program (para. 21).

C. Water Resources

7. The country can be divided into five geographic regions: the coastal plain, the forested plateau, the savannah high plain, the Voltaian sandstone basin and the ridges and escarpments bordering the Voltaian sandstone basin. The coastal plains generally do not exceed 75 meter elevation while the forested plateau and the more gently rolling savannah high plain vary between 180 and 300 m. Rainfall generally decreases northwards with the southwest getting more than 2000 mm of rainfall per year and the north getting about 1000 mm; however, the southeast coastal plain with 750 mm is the driest part of the country. The Volta Lake stretches some 300 kilometers through the central part of the country.

8. Stream flows are intermittent in the north of Ghana; while in the south groundwater storage maintains dry weather flows at about 15% of the monthly average in the middle and lower reaches of most streams. Groundwater is generally available close to the surface throughout the country with static water levels generally less than 10 meters, except in the western parts of the Northern and Brong-Ahafo Regions where they are more often between 10 and 20 meters. There are a few locations where static water levels exceed 20 meters. Static water levels vary by less than two meters during the year in most locations. Well yields are generally adequate for handpumps (minimum 20 lpm) with the borehole success rate reaching 80% if geophysical siting techniques are used.

9. Surface water must be treated to meet WHO water quality guidelines for fecal coliform and turbidity. Groundwater is of good quality throughout most of the country with low levels of

dissolved minerals, typical of the non-carbonaceous rock formations that underlie much of the country. In the north of the country where surface water is scarce, people readily use groundwater for all purposes; however, in the south surface water is generally preferred because it tastes better and is softer, requiring less soap for clothes washing. This has serious implications for user acceptance of groundwater wells and suggests the importance of users appreciating the health advantages of a protected water source.

10. The lack of carbonate buffering causes groundwater to be corrosive. In the northern savannah and in the southern forest about 50 and 70% of the water points respectively have Ph levels below 6.5, the value below which waters are too corrosive for galvanized iron downhole components on handpumps. Iron concentrations are nearly always below WHO guidelines, except after a handpump with galvanized iron downhole components has been in place for several years. The resulting high concentrations of iron cause the water to taste metallic and to discolor food and clothing. Use of corrosion resistent materials can correct this problem.

D. Service Coverage

11. Some 250 piped water supply systems have been constructed in Ghana during the last 40 years, half of them in the seventies. 208 of these are currently operational and under the management of the Ghana Water and Sewerage Corporation (GWSC); the others have fallen into disrepair. Half these systems use surface sources and 80 are classified as rural. They provide water for 3.6 million urban and 1.7 million rural people. In addition, there are about 8,600 water points, many of which were installed in the early seventies primarily through two major projects: the Water Utilization Project in the Upper Regions (2,600 boreholes financed by Canada) and the 3,000 Wells Project in the six southern regions (3,200 boreholes financed by the Federal Republic of Germany); and more recently by others, principally the National Catholic Secretariat, World Vision and Japan. About 175 of these are open wells; all the others are boreholes fitted with handpumps.

12. About 30% of the rural population has had an improved water supply system (handpump or piped) installed in their community during the last 20 years, potentially providing service to 3.7 of the country's 9.7 million rural population. Currently, piped service is intermittent with frequent and sometimes long outages. Also about 30% of the handpumps in the country are not operational, reducing rural service coverage to about 20%. Annex 2 provides details of rural water supply coverage in each region. Canada plans to finance the change to VLOM pumps (village level operation and maintenance) in the Upper Regions and Germany is doing so in the 3,000 Wells Project area. Greater reliance will have to be placed on private mechanics in the 3,000 Wells area than in the Upper Regions because the pumps planned for the 3,000 Wells area will not be as easy to repair as those planned for the Upper Regions. Communities will require the continued assistance of an external entity until the pumps are replaced by VLOM types (Ref. Community Water Supply: The Handpump Option, World Bank, 1987).

13. Inadequate information is available on the demand for new or improved water supplies in the country and on the proportion of hand-dug, hand-drilled and machine drilled wells that will be required. An effective monitoring program operating at the district/regional level is essential for proper planning of RWS service. Such a program would begin with a needs assessment in all communities in a district and lead to a prioritization of communities to receive a water supply construction grant.

14. During the 1940's and 50's the Department of Community Development assisted almost every community in the southern part of the country to construct one or two trench

latrines (dimensions 1 x 3-4 x 4-5 meters LxWxD). Most communities continue to replace the latrines when they collapse. During the 1960s bucket latrines and aqua privies were introduced into some communities. Most of these facilities have fallen into disrepair because conservancy laborer salaries and pumper truck operation and maintenance exceeded district council resources. In the late 70s research at UST lead to the development of the Kumasi Ventilated Improved Pit Latrine (KVIP) which reduced maintenance costs and eliminated the health hazards associated with handling excreta. Only some 200 of these have been installed in rural communities in the country, primarily due to fragmented program execution and increasing materials costs. Presently about 60% of the rural population has access to trench latrines, 5% to bucket latrines and 1% to flush toilets; the remainder have no facilities. Greater reliance on (i) local building materials for public KVIPs, (ii) the low-cost household model of the Ghana-modified Mozambique VIP that is under development in the Upper Regions and (iii) an improved trench latrine design, together with effective training of local artisans and promotion would result in greater coverage.

E. Operations and Maintenance of RWS Systems - Handpumps

15. GWSC maintains about 6,600 handpumps while individual communities with the assistance of the NGOs that financed them maintain another 1,000. GWSC has established maintenance units to service the pumps in Upper Regions and in the 3,000 Wells Project in the south. The maintenance system in the Upper Regions and in the 3,000 Wells Project are nearly the same. Each relies on regionally based crews, that use a truck, fitted with a winch, to make repairs requiring pump extraction; district based staff with motorbikes to do preventive maintenance and minor repairs[2]; and community members to report breakdowns to district staff.

16. Effective maintenance is complicated by different handpumps being specified by donor agencies for each project, lack of fuel or funds to procure fuel, lack of motivation due to low salaries, delays in transporting supplies and equipment to district facilities, and corrosive groundwater. Serious problems arise when spare parts are not available. With importation procedures generally taking more than a year and with other delays, as few as 40% of the pumps have been operational at times.

17. Most countries in the region have shifted from centralized to privatized maintenance systems due to the large numbers of pumps that are typically out of order and the inability of government to collect sufficient revenues to cover the cost of maintenance. A policy recommendation of private maintenance was also adopted in Ghana in the 1987 National Rural Water Supply and Sanitation Conference. However, GWSC has made no substantive move in that direction.

18. The organization of handpump maintenance in many countries in the region, for example - Burkina Faso, Mali, Niger, Cote d'Ivoire and Guinea, are quite similar. At the community level, water committee members are responsible for: preventative maintenance and making all repairs for which they have sufficient skill and the necessary tools; collection of money to pay for repairs, cash savings and accounting, and upkeep of the well surrounds. A private area mechanic performs repairs on 10 to 80 pumps when hired by the community, the number of pumps per mechanic tending to increase as the distance between communities decreases and as repairs become more difficult. A spare parts retailer (one for every 100 to 500 pumps) stocks basic parts and sells them to the water committees or private mechanics.

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2 The 3,000 Wells Project is now introducing motorbikes so that district based staff can repair the 3,200 pumps in the Project area. 2,400 India Mark II pumps are being fitted with light weight stainless steel rising mains and 800 Moyno pumps are being replaced by Ghana Modified India Mark IIs.

At the national level, an importer procures parts from an off shore manufacturer and distributes them to local retail outlets. A problem that typically arises with this privatized system is maintaining a reliable spare parts supply; this is generally because of government controls which set prices at a level below which distributors and retailers can make a profit. This problem is exacerbated by the multiplicity of pumps and therefore an insufficient market to make spare parts distribution a viable business. Provided that (i) communities are trained to manage their water supply system including operations, maintenance and revenue collection, (ii) spare parts are available at the district level, and (ii) private area mechanics have been trained to make all repairs, the above system has been shown to have a large chance of success.[3]

F. Operation and Maintenance of RWS Systems - Piped Systems

19. GWSC operates and maintains 80 piped water supply systems in rural communities with populations under 5,000. Service is intermittent with frequent and sometimes long outages. Water production is below demand and below design capacity at essentially all piped facilities and capacity is below demand at about 65% of them. All are in need of rehabilitation and many should be expanded. A study of 55 rural and urban piped systems made the following general findings: (i) structures are sound but in need of general repair, (ii) conventional treatment plants are in generally good shape but most of the package treatment plants should be replaced, (iii) pumping, flow measuring and chlorination equipment should be replaced, (iv) water storage capacities are well below those required to guarantee continuous flow and (v) the maintenance agreement for borehole submersible pumps between GWSC and a private firm is working well.

G. Technology

Technology - Water Wells

20. At present, the following guideline is used by GWSC to determine the type of water supply that a community should receive.

Population range	Type of System
2000 - 5000	Piped systems
500 - 2000	Machine drilled boreholes with handpumps
<500	Hand-dug wells without handpumps

21. Technologies must be chosen by the community; however, government subsidies should be based on the cost of providing basic service with the community paying the added cost for high levels of service (para. 85). In setting subsidies government must determine the least cost alternative that provides basic service. For example, hand-dug and hand-drilled wells that provide year round service should be used wherever possible, as the construction cost of hand-dug wells and hand-drilled wells (about US$ 2,000) are much less than the current cost of machine drilled boreholes (US$ 8,000 to 10,000).

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[3] A local distributor of submersible pumps based in Accra provides installation and maintenance services for its products, with services promotion through television and other media. The firm has a contract with GWSC for maintenance services during the warranty period of its pumps and for backup to GWSC maintenance personnel.

22. Two hand-dug well designs are currently used in Ghana. The GWSC-PAMSCAD Project first excavates the well to depth and then lines the hole with prefabricated concrete rings; most NGOs first excavate to the water table, line in-situ, and then excavate below the water table within a perforated caisson (smaller diameter concrete rings that are placed one on top of the other). The advantage of the latter is that it makes it easier to excavate below the water table and to a greater depth, and the well can be deepened at a later time should the groundwater level drop. At present all wells are provided with a raised, un-reinforced slab with an opening in it to allow water to be drawn with a rope and bucket. While direct-action handpumps are rather new to Ghana they have proved to provide good service on hand-dug wells where the depth to static water level does not exceed 12-15 meters. They provide a level of protection commensurate with community use, where a large number of people share the same source.

23. Generally, boreholes are constructed with 4 inch PVC casings. Experience in the 3,000 Wells Project is showing that deformation of the casing over time makes it sometimes impossible to insert borehole rehabilitation equipment and may make it impossible to upgrade a system to one with an electric submersible pump. Six inch PVC casings would provide better functionality with little increase in cost.

Technology - Dams

24. In the Northern Region around Tamale, due to inadequate groundwater resources, dams, designed to collect and store surface runoff, have long been used for community water supplies. Recent installations have been fenced with treatment provided by infiltration galleries or in-situ sand filters. Water is then collected from covered dug wells connected by piping to the reservoir treatment unit.

Technology - Handpumps

25. Currently there are 2,250 Moyno, 4,250 standard India Mark II and 1,000 Monarch handpumps in Ghana. About 800 of the Moyno and all of the standard India Mark II pumps in the 3,000 Wells Project are being modified or replaced by Ghana-modified India Mark II pumps that have stainless steel downhole components. GWSC has adopted the India Mark II handpump as its standard pump and recommends it for all donor-assisted and NGO projects. However, the standard India Mark II is not suitable in over half of the well sites in the country because its galvanized iron pump rod and rising main are susceptible to corrosion in groundwater of pH 6.5 or less, and replacement with stainless steel is a very expensive alternative. The Modified India Mark II is lighter and easier to repair than the standard Mark II but its stainless steel rising mains are expensive. Handpumps meeting the VLOM requirement and with non corrodible below ground components, such as the direct-action Nira suitable for lifts up to 12 meters, and the Afridev suitable for lifts up to 45 meters, are currently being tested in the Upper East Region. The Nira pump, whose main features are its low price, durability, ease of repair, high water discharge, corrosion resistance and user satisfaction comes closest to the VLOM concept.

26. Most mechanical workshops in Ghana specialize in the repair and overhaul of engines or survive on jobbing. Only a few companies have metal fabrication workshops and possess the necessary skills and equipment needed to establish a successful handpump business. All steel for handpumps is currently imported and will have to continue to be for the near future; stainless steel will also have to be imported for the indefinite future as it is only made at a few specialized plants in the world. The technological level of the plastics industry in the country is also limited, although several companies are able to produce acceptable PVC pipe. It is likely that high density polyethylene pipe used for direct action handpumps can be successfully

produced as the extrusion process is simpler than with PVC. Injection molding facilities exist in the country but their technological level is well below that required for engineering plastic components used for handpumps. The raw material for plastic components will also have to be imported.

27. A comparison of prices between locally manufactured and imported handpumps currently in use in Ghana reveals that the India Mark II cannot be made locally at a competitive price due to the intense competition and rationalized large scale production of that pump in India. However, the Afridev and the Nira handpumps could be made locally at a price competitive with offshore suppliers. The cost of manufacturing the UST pump and the "Ghana modified India Mark II pump" cannot be compared to foreign sources as they are unique to Ghana. Because of the competitive nature of the world handpumps market, local manufacturers will have a difficult time competing against offshore suppliers, unless imported pumps are taxed at a similar level as imported raw materials. The key to limiting the number of different pumps brought into the country while maintaining price competition is the requirement that a community buys its own pump (para. 57 and 86). Information on the cost of local manufacture is provided in Annex 11 and in the manufacturing analysis prepared for this report (see the list of background reports, page iii).

Technology - Water Treatment

28. Surface water supplies are treated in 28 conventional water treatment plants and 66 package treatment plants. Treatment in both types of plants consists of coagulation with alum, rapid gravity sand filtration, pH correction with lime and chlorination with calcium hypochlorite. Most of the conventional water treatment plants in the country remain operational although in need of new control and chemical dosing equipment; whereas the package plants are beyond repair.

Technology - Latrines

29. The modern ventilated improved pit latrine was developed simultaneously in Ghana and Zimbabwe in the seventies. Since then the design has been diversified and adapted to make use of various local building materials. As a result there is now a wide range of designs including (i) the KVIP that is best suited for public latrines in rural communities, (ii) the Ghana-modified Mozambique VIP for rural households and (iii) trench latrine that was introduced in the southern part of the country in the 1950s. The KVIP uses alternating pits and, typically, concrete blocks for the pit lining and the superstructure; the Ghana-modified Mozambique VIP uses a single pit and an earth or thatch superstructure; and the trench latrine consists of an open trench as its name implies, however, provision of a concrete ring beam would provide for greater safety at minimal cost. The KVIP costs approximately 200,000 cedis (US$625) although this can be reduced by use of less expensive building materials for the superstructure; while the unlined version of the Ghana-modified Mozambique VIP costs about 8,000 cedis (US$25).

II. SECTOR INSTITUTIONS

A. Ministry of Works and Housing (MWH);
Ghana Water and Sewerage Corporation (GWSC)

30. MWH has primary responsibility for urban development, sets urban and housing policy, and oversees the activities of various parastatal agencies. Among these is GWSC, the lead agency in the water and sewerage sector, responsible for both urban and rural water supply and for piped sewerage and sewage disposal. On-site sanitation facilities are the responsibility of districts and municipalities, which obtain assistance of the Ministry of Health (MH).

31. Prior to the establishment of GWSC in 1965 most local authorities owned and operated their own rural water supplies which had been planned and constructed by the Department of Rural Water Development (DRWD) within the Ministry of Local Government. Urban supplies at that time were operated by the Water Supplies Division of MWH. The Water Supplies Division absorbed the DRWD prior to being converted to GWSC.

GWSC - Organizational Structure

32. GWSC has its head office in Accra, nine regional offices, one area office for Accra-Tema (ATMA), two central workshops in Tema and Kumasi, regional stores in Tema, Kumasi, Takoradi, Ho and Tamale, district maintenance centers, and a drilling unit based in Kumasi. A Corporate Planner, Chief Auditor, Legal Officer and two Deputy Managing Directors responsible for Operations and Finance & Administration report to the Managing Director. Directors for Operations and Maintenance, Planning and Development, Rural Water Development and each of the ten regional offices report to the Deputy Managing Director of Operations while the Finance, Administration and Commercial Directors report to the Deputy Managing Director of Finance and Administration (Annex 3). The Director of Rural Water Development is responsible for formulating RWS policies, planning and implementing new RWS projects, coordinating the activities of NGOs and ESAs, monitoring RWS services and supervising the Drilling Unit. The structure of GWSC at the regional level is essentially the same as at headquarters with Operations and Maintenance, Planning and Development and Rural Water Development (created in 1987) Units reporting to a Regional Engineer and Finance, Administration, and Commercial Units reporting to a Regional Finance Administrator. Maintenance of small piped systems and handpumps is carried out by district based staff under the supervision of a District Manager and supported by the Regional O&M Unit.

33. The planning, construction, operation and maintenance of rural water supplies is integrated into the Corporation at all levels. While the objective of this arrangement is to facilitate ease of management and administration, it does not allow for the substantial differences in the manner in which the rural and urban sectors must be handled. Financing, management and maintenance systems, tailored for urban operations have been applied to rural areas with minor adjustments yielding unsatisfactory results. The limited number of qualified professional staff within the organization have tended to be concentrated in the urban departments at the expense of the rural sector.

GWSC - Staffing

34. GWSC has a total staff of about 5,700.[4] A human resource utilization study carried out in 1986/87 estimates GWSC's actual staffing needs at about 4,500 persons although it also recognizes the shortage of professional staff. Only about 650 staff are classified by GWSC as management, technical professionals, administrative professionals and supervisory personnel. The remaining are unskilled and semi-skilled workers, many of whom do not have full time work. About 6% of GWSC's staff are located in the central office; more than 20% in the Greater Accra Region; and the remaining 74% are dispersed amongst the other regions. The low proportion of high and middle-level professional staff as well as skilled technicians, has acted as a hindrance to GWSC's performance. This situation is especially acute outside the major metropolitan areas of the country. Salary levels and benefit packages have not been sufficiently attractive to draw adequate numbers of the calibre of staff which the corporation requires. GWSC has recently initiated measures to reduce the number of non-professional employees and to recruit a greater number of technically and professionally qualified staff. At the same time it is aware of the need for training and retraining of its existing staff.

35. The overall staffing profile of the corporation reflects the strongly urban-biased nature of its operations. Personnel is dominated by a wide prevalence of engineers and technicians/operators as well as commercial and financial specialists. Community development specialists who are more particularly needed for the development and implementation of water services in rural areas are not employed by GWSC. Also, the difference in technical and managerial skills required for urban and rural water supply services as well as differences in cost recovery policies require separate agencies or at the very least separate departments. Precedents for this are available in many neighboring countries, most of which have been better able to improve the services in both urban and rural areas because of the split. Presently GWSC has a Rural Water Development Department at headquarters, but at the regional level, both rural and urban personnel report to the regional managers and budgeting and accounting are mixed at all levels. Whether kept within GWSC or moved to another agency, staff with requisite skills will have to be hired or transferred from other agencies and personnel at all levels will have to be trained to undertake their part of a National RWS/S Program.

GWSC - Drilling Unit

36. GWSC's Drilling Unit is hampered by: operation of old and obsolete drilling rigs that require constant repairs; inadequate and unreliable support equipment; lack of sound financial management as exhibited by poor accounting and record keeping; inability to arrange quick delivery of parts from overseas; and lack of a preventative maintenance program relying instead of periodic overhauls when new externally financed projects come along. In addition, the Drilling Unit is burdened with excessive staff and is unable to motivate working staff with appropriate bonuses, overtime and field allowances. Drilling Unit records show that revenues from the construction of boreholes have exceeded expenditures (not including depreciation) during the last two years, but no investments have been made to improve equipment. At the same time, the Drilling Unit is requesting donor support to rehabilitate two of its rigs as part of an upcoming project in the Eastern Region for which the Drilling Unit will operate under force account. Privatization of the Drilling Unit, or at least autonomous, self-financing operation would be good for the drilling unit and for the drilling industry. This would give the Unit the autonomy it needs to operate efficiently, and with more contracts let to the private sector,

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[4] This figure is high in relation to the total production capacity of GWSC. In neighboring Cote d'Ivoire, for example, SODECI, an Ivorian private water distributor runs a comparable operation with a staff of 1,500 and provides a service comparable to any well run water company in the world.

would increase competition and decrease well costs. Privatization of NGO owned drilling operations would further expand the local market and also contribute to the lowering of well costs.

GWSC - Ongoing and Planned RWS Projects

37. The following table gives a summary of ongoing and planned rural water supply projects that GWSC is executing. A listing of all rural water supply and sanitation projects in the country is given in Annex 4. Handpump rehabilitation is underway in the 3,000 Wells Project and is planned for the Water Utilization Project in the Upper Regions; several pilot projects for community management of small piped systems are underway; and about 2,000 of the 6,000 boreholes and 3,000 of the 10,000 hand dug wells requested at the 1987 donors' conference have been funded.

	Number of Systems	Location	Assistance Agency
A. Rehabilitation of Existing Systems			
Borehole Rehabilitation Project	500 HPs	4 Regions	UNICEF
Bolgatanga Rural Water Project	50 HPs	Upper East	WB/Canada
3000 Wells Maintenance Project	3200 HPs	7 Regions	Germany
Rehabilitation Project	33 piped	Eastern	Germany
CWS Maintenance Project	15 piped	Northern	Canada
(Planned Projects)			
Rehabilitation of piped systems	200	All Regions	WB/bilat.
Water Utilization Project	2600 HPs	Upper E/W	Canada
B. 6,000 Boreholes Program			
Rural Water Project, Phase I	159 HPs	Northern	Japan
NORRIP II Water Component	350 HPs	Northern	Canada
(Planned Projects)			
Rural Water Project Phase II	320 HPs	Western/BA	Japan
Rural WATSAN Project	200 HPs	Eastern	UNDP/Neth
Rural Water Project	900 HPs	Central	France
C. 10,000 Hand-dug Wells Program			
Small Communities WATSAN Project	560 HDW	All Regions	UNICEF
PAMSCAD Dug Wells & Latrine Project	2000 HDW	All Regions	Japan
Decentralized Management of RWS	200 HDW	Volta	UNDP

Note: HP = Handpump and HDW = Hand-dug well

B. Ministry of Local Government (MLG);
Department of Community Development (DCD);

Department of Rural Housing and Cottage Industries (DRHCI)

38. The Republic of Ghana is administered through 110 district assemblies, responsible for collecting taxes (base, property, business fees and licenses) and for planning and administering their own development programs, and ten Regional Coordinating Councils, made up of the Regional and District Secretaries. Local taxes are kept within the district and are supplemented by industrial taxes collected by the Internal Revenue Service. It is Government's intention that individual communities become the main actors in planning and implementing the development projects that they need and that they be assisted in this by district and regional staff (who report to and assist the district and regional secretaries). Ministries at the national level will be responsible only for policy, performance monitoring and personnel matters. With the recent creation of 45 new districts, most districts are understaffed and have minimal facilities.

39. The Ministry of Local Government (MLG) is responsible for policy formulation related to the Government's decentralization program as well as assisting with administration, financing and training in local district assemblies. While the assemblies are in the process of assuming responsibility for internal audit, the regional administrations will continue to provide payroll, budget and policy oversight functions. Its long term role vis-a-vis regional and national assemblies is not yet defined but MLG will undoubtedly continue to oversee the Departments of Community Development, Rural Housing and Cottage Industries and Town and Country Planning.

40. The Department of Community Development (DCD) primarily provides technical advice and assistance to minor self-help construction projects in rural communities, often through support to the projects of other Government agencies. The DCD is the only Government agency with staff below the district level, although the majority live in and work out of the district centers. Cost recovery and use of the private sector are not part of the Department's philosophy as it has traditionally provided Government financed infrastructure to rural communities. The DCD suffers from a chronic shortage of trained technical officers, inadequate transport and insufficient budget. This is due to the low Government budgetary input it receives and inadequate allowance for community support services requested by other agencies for their projects. DCD is currently supporting handpump caretaker training, dug-well and VIP latrine programs (Annex 4). It is expected that its district and regional based staff will have to be drawn on to provide extension services for a decentralized National RWS/S Program.

41. DRHCI originated in the construction unit of the Workers' Brigade Organization of the late 1950s. DRHCI has units in all the regions staffed by planners, industrial officers, engineering technicians and artisans working on cooperative housing projects and supervising latrine construction and various cottage industry projects. The units are however poorly staffed and equipped at the district level. In 1982, DRHCI was charged with the implementation of the national latrine program. With initial training from the University of Science and Technology (UST), it launched a 140 KVIP (Kumasi ventilated improved pit) public latrine program country-wide but only a few of these have been completed. The main problem had been the rapid escalation of construction costs coupled with inadequate mobilization techniques to meet the requirement for communities to pay their share of the cost. A few districts have undertaken sanitation projects with training and financial assistance provided by UNICEF and GOG. The relatively high cost of the KVIP has limited its spread in rural areas.

C. Ministry of Health (MH)

42. The Ministry of Health (MH) has three divisions that are involved in the water and sanitation sector: Environmental Health Services, Health Education Services and Epidemiology. Owing to scarcity of public health engineers, all sanitary engineering and planning has for many years been centralized at its headquarters in Accra.

43. The Environmental Health Services Division assists local authorities with organization and operation of refuse and night-soil collection and disposal and enforcement of public health regulations in homes, restaurants, markets and other public places. The Division is also involved in a number water supply and sanitation projects and the Global 2000 BCCI campaign towards the eradication of Guinea Worm, initially identifying endemic areas. While it does not execute sanitation projects, its health inspectors are trained in sanitation at the MH Schools of Hygiene before being seconded to the districts. Emphasis is being shifted from enforcement activities to the promotion of better sanitation practices. In order to implement a substantive sanitation component as part of the National RWS/S Program (section IV), Environmental Health Services officers will be needed, a number of whom have been trained through the Health Technology Diploma course at UST and are available.

44. The Health Education Division is responsible for the development of public health education programs, aimed at improving public knowledge and understanding of the causes of diseases to help bring about changes in attitudes and behavior with the objective of reducing illness. The Epidemiology Division is involved in the planning, execution and evaluation of control measures against communicable diseases of major public health importance e.g. malaria, measles, yaws, bilharzia and guinea worm. Regionally based staff organize periodic health education and immunization campaigns at community centers. However, these programs are not very effective due to financial, personnel and transport constraints.

D. Non-governmental Organizations (NGOs)

45. Amasachina, one of the most active indigenous NGO involved in the water and sanitation sector, is based in Tamale. This NGO has been active in the Northern region since 1966, promoting self-help activities in rural communities including assistance to communities to develop their own impoundments for water supply. After an initial request from a community, Amasachina assists the community leaders to approach the Irrigation Development Authority or a private contractor for the works. The group has helped over 50 communities to develop their water supplies. Since realizing the health hazards that such impoundments constitute, the NGO is developing improved sources of water supply with the assistance of Peace Corps Volunteers. The group has also attempted some VIP latrine construction.

46. The National Catholic Secretariat has had a long tradition of aiding parish communities solve water problems. Its most noteworthy recent interventions have been the Wenchi Village Water Project in the Brong Ahafo Region and the Bole Parish Water project in the Northern Region. The former is managed by an expatriate lay missionary and has a team of local staff and its own equipment including a drilling rig, compressors, vehicles and workshop facilities. During the past five years about 1,000 boreholes equipped with India Mark II handpumps have been installed all over the country by the Church. Apart from the Wenchi Parish, most dioceses employ one drilling contractor and occasionally call on the GWSC drilling unit. The approach adopted by the church's projects (notably Wenchi and Bole) begins with intensive dialogue with communities, during which the obligation of both parties are explained, an agreement reached and formally signed. A contribution of 60,000 cedis (US$180) per borehole for construction and the first year's estimated 15,000 cedis (US$45) maintenance fund must be

collected by the community before drilling commences. A local credit union (also organized by the Church) in the Sampa area is helping communities meet their financial obligations. Community handpump caretakers inspect the pumps, organize upkeep of the pump surrounds and report major faults to second-tier mechanics.

47. The Ghana unit of World Vision International (WVI) derives most of its support from its international affiliates, primarily in the United States. It is engaged in agriculture, pre-school education and primary health care of which its water and sanitation program is part. WVI has constructed about half of its planned 750 boreholes with complementary KVIP latrines in the Northern, Volta, Central, Greater Accra, Western and Eastern Regions. It too uses a community participatory approach and requires the community to assume responsibility for long term maintenance. Its first boreholes were drilled by a drilling contractor but it has since acquired its own drilling rig. Water Aid, a charitable organization based in the United Kingdom and associated with the water industry, supports a number of rural water projects in Ghana most of which are implemented by local NGOs. The Presbyterian Church, Evangelical Presby Church, Baptist Church, Anglican Church, Peace Corps and CUSO also support water and sanitation activities in the country (Annex 4). Much valuable experience related to community management of maintenance has been obtained by these NGOs.

E. External Support Agencies (ESAs) - Coordination of Activities

48. The RWS project in the Upper Regions financed by Canada and the 3,000 Wells Project in the south financed by the Federal Republic of Germany together have constructed about 6,000 boreholes providing water to about 1.5 million persons. Both began about 15 years ago as drilling projects, before the importance of community participation and handpump maintenance were appreciated; since then, both have evolved good maintenance systems, although revenues only cover a small part of the maintenance cost. Also, the Upper Regions Project has developed a large scale health education program. In the next phase of their support to the Upper and Northern Regions, Canada is planning to shift to community based management by installing VLOM pumps and training the communities to maintain them. The fate of the 3,000 Wells Project is less clear as the FRG may withdraw support before community management can be established. This will probably result in a failure of the system, as GWSC in unlikely to be able to raise sufficient revenues to buy spare parts and provide maintenance.

49. In the last few years, Japan has financed the construction of about 600 boreholes which GWSC is responsible for maintaining. Caisse Centrale de Cooperation Economique (CCCE) of France has recently completed planning the first phase of a two phase project to install 900 water points in the Central Region; their experience in community based management of maintenance in other countries will be very helpful in establishing it in Ghana. Switzerland has earmarked funds for the PAMSCAD hand-dug well program and Denmark is interested in contributing to the rural water and sanitation sector. UNDP is financing several RWS/S projects, one in the Volta Region and the other in the Eastern Region with co-financing by The Netherlands. UNICEF is supporting the construction of 560 hand-dug wells and the rehabilitation of 500 handpumps systems; it is also supporting a latrine program. A listing of ongoing latrine projects is given in Annex 4.

50. GWSC is primarily responsible for coordinating the activities of the ESAs working in the water sector. In recent years, UNDP has facilitated donor cooperation and investment, principally through its sponsorship of the 1987 National Water and Sanitation Conference, and a number of donors have worked together closely on an urban water rehabilitation project. Although ESAs have expressed willingness to coordinate their activities in rural water supply, the regionalization of projects and the lack of clear cut policies on the financing and

maintenance of RWS/S systems and on technology selection have led each donor to make its own decisions based on its particular procurement and scheduling constraints and the peculiarities in its project area. Other means of coordination include the UNDP financed Training Network Center for Water and Sanitation (TNC) at the University of Science and Technology that, a recent NGO meeting proposed should promote dialogue between donors by conducting periodic workshops to discuss issues that affect the sector. The TNC would also play a major role in developing training materials and training trainers for the National RWS/S Program (section IV). In addition the UNDP/World Bank Water and Sanitation Program is actively involved in Ghana and could promote dialogue between ESAs.

F. Communities

51. Community organization has always been an integral part of the tradition and culture of Ghana. The indigenous institution of chieftaincy and its descending chain of authority and responsibility from the chief and elders to the people constitute the basic social structure of a community. It is well established with easily recognizable groups which have specified responsibilities within the community. The system has provided a ready means of making communal decisions and undertaking communal activities. Religious organizations and establishments like the Asafo Groups[5] have provided other channels for community action. In recent times, district assemblies and organizations such as the Committees for the Defence of the Revolution (CDRs) and the 31st December Women's Movement have been formed. These organizations co-exist with the traditional leadership structures and together provide a wide representation of interests in administering community affairs.

52. In Ghana, women have always been significant contributors to to various sectors of the economy. In agriculture, apart from their considerable involvement in the production of cash crops, they are mainly responsible for the production of local food crops through subsistence farming, and the processing of other exportable products such as palm and coconut oil and shea butter. Women organize the transportation of harvested food crops and other agricultural products including fish, which they process, for marketing throughout the country. They are well experienced and are responsible for the greater part of the trade in consumer goods, including textiles and plastic products, some of which they import. The market women and traders are well organized.

53. Women have primary responsibility for building the family home; in some communities, they are responsible for its actual construction. The woman runs the home, and, therefore she has to assure adequate supply of water for drinking and domestic use and firewood for cooking. She is responsible for the storage of harvested food and the feeding of the livestock. Children are primarily the woman's responsibility to clothe, feed, keep healthy and nurture. None of these heavy responsibilities detract from the fact that women have a firm place in the decision making process and activities affecting the community. Unfortunately, the lack of basic domestic facilities for conveniently-placed reliable sources of water and the safe disposal of human waste have put a great strain on women. Very often much time and effort must be spent on the collection of water and firewood. Any decisions and activities towards the installation of water supply and waste disposal facilities should have extensive input from women.

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5 The Asafo Groups are the traditional warriors in a community charged with its protection. These days their activities center more on cultural events and community mobilization for projects that require quick action.

G. Private Sector

54. Ninety five percent of the boreholes in the last few years have been constructed by one contractor, two NGOs (the Catholic Church and World Vision) and two ESAs (Canada and Japan). Collectively they have 12 drilling rigs and construct about 600 boreholes per year (50 boreholes per rig with 15 staff per rig). In addition, the GWSC Base Drilling Unit in Kumasi has 3 rigs which are operational and constructs about 65 boreholes per year (20 boreholes per operational rig with 20 staff per rig) (Annex 5). The drilling operations of the Canadian and Japanese projects are managed by technical advisors provided by the projects and drilling rigs and crews are provided by GWSC's Drilling Unit.

55. Because there has been only one drilling company in the country, boreholes are expensive. With prices of about US$9,000 each, boreholes are roughly three times the cost in the United States and the United Kingdom, and are higher than what a well managed drilling company would have to charge to make a reasonable profit in Ghana. The lack of competition and resulting high prices have caused several NGOs to purchase their own drilling rigs. This, however, has not reduced their costs, as experience is showing that NGO costs are on the order of US$12,000 per borehole. With NGO and GWSC rigs constructing about 3/4 of the boreholes in Ghana, the market is too small to support a competitive private drilling industry.

56. Recently, GWSC has contracted the maintenance of about 200 submersible pumps in rural systems to a local private contractor. There is much potential for involvement of the private sector in the construction of hand-dug and hand-drilled wells as well as household and public latrines. The private sector can also play a much larger role in the maintenance of handpumps and small piped water supply systems, in the manufacture of handpumps and water appurtenances, and in distribution of pumps and spare parts through trading companies which operate throughout the country and have a well-developed distribution network.

57. Of particular concern in establishing local manufacture of handpumps and a private spare parts distribution system is the lack of a sufficiently large handpump market to achieve the economies of scale necessary to make these businesses viable. The primary reason for this being the continued fragmentation of the market within Ghana, with each project dictating the use of a different pump. It makes sense for Government to recommend pumps, not for the purpose of standardization, but rather to provide advice to consumers and potential local manufacturers, and to prevent the arbitrary introduction of a different pump with each new project. Both direct action and high lift pumps should be recommended, as good direct action pumps are clearly advantageous to the community (para. 23, 94-95) and high-lift pumps are a necessity in many locations. Nearly all pumps and spare parts are manufactured abroad, imported by external financing agencies and distributed by GWSC. Only limited handpump manufacturing is currently being undertaken in Ghana. This consists of the production of some component parts and the assembly of the Ghana Modified India Mark II as well as the production of a number of prototype handpumps by the University of Science and Technology in Kumasi. If there is a major nationwide shift to direct action pumps it is likely that there would be a large enough market to support local manufacture.

H. Training Institutions and Programs

58. The Universities of Ghana, Cape Coast and Science & Technology, the Ghana Institute of Management and Public Administration (GIMPA), DCD and GWSC Training Schools, the Schools of Hygiene, the Rural Training College at Kwaso, polytechnics and technical institutes offer various courses related to the water and sanitation sector. Collectively, they offer degrees in sanitary engineering and social science; diplomas in community

development, accounting, social administration, public health, environmental health, and hydrogeology; and certificates for national craftsmen and drillers.

59. At present the courses offered by these institutions are not tailored to the needs of the RWS/S sector. Knowledge of subjects such as community management, latrine design, project management and accounting are essential in establishing the proposed National RWS/S Program. Furthermore, appropriate training materials are hard to find and there is a lack of adequately trained staff. Many of these institutions are making efforts to improve the quality of their courses and keeping up with the changing needs within the sector. Some have formed links with training institutions outside the country and are sending instructors overseas for additional training where possible. A major objective of the recently formed Training Network Center for Low-cost Water Supply and Sanitation (TNC) located within the Civil Engineering Department of UST (a member of an international network on such training institutions) will be to assist trainers in these other institutions to improve the RWS/S course content by assisting them to tailor training materials to their needs and to demonstrate their use. As part of this effort, the TNC is taking the lead in preparing the HRD portion of this sector strategy and action plan. Implementation of the proposed National RWS/S Program would not be technically difficult, in fact, it would largely be a human resources development effort in which people at all levels must be trained: senior and middle level managers, trainers, project staff, artisans and community members. Existing training institutions are adequate to handle the training needs for the proposed National RWS/S Program if funds for this training are made available and if assistance is given in preparing suitable courses.

III. SECTOR FINANCES

A. Cost Recovery

Cost Recovery - Handpumps

60. The average annual maintenance costs of a borehole fitted with a handpump are estimated at 62,000 cedis (US$190) per year in the Upper East Region and 70,000 cedis (US$215) in the 3,000 Wells Project (Annex 6), excluding administrative costs for billing and collection. Throughout Ghana, a flat rate of 109 cedis per household per month is charged for the use of a borehole, except in the Upper East Region where a tariff of 18,200 cedis per pump per year is charged. One borehole can typically serve 40 to 60 households, providing a maximum annual revenue of 52,000 to 78,000 cedis ($US163 to 235). In 1989, revenues collected averaged 9,200 cedis per pump in the Upper East Region, 8,700 cedis in the 3,000 Wells Project and 4,400 cedis in the Wenchi project; these are between 8 and 15% of estimated annual maintenance costs. While the tariff structure appears adequate, only about 10% of GWSC's handpump maintenance costs are recovered through tariff payments. The basis of these costs is provided in Annex 6.

61. Revenue collection in rural communities is problematic because of the distances involved and because many people still believe that water is not a saleable commodity. Most boreholes were originally provided free of charge with no commitment made by the communities to maintain them, and the water tariff was later introduced abruptly without adequate information provided to the communities. If no repairs are necessary during the year or if GWSC's response is slow, the communities see no clear relationship between the cost of repairs and the tariffs and feel that they are being overcharged. Introduction of community based maintenance should avoid the almost impossible task of collecting revenue in

dispersed rural communities. However, extensive dialogue with the communities is necessary to successfully make the shift.

62. In addition to GWSC's own system of subvention, the Government allocates funds from the Public Investment Program (PIP) as counterpart funding to external aid programs in the rural sector. These funds are supposed to cover all the local costs of externally sponsored maintenance units such as units in the Upper East and West Regions and the regional maintenance units in the 3,000 Wells Project, and essentially cover all local salaries, supplies and materials. The ESAs also purchase spare parts for the RWS projects that they originally financed. The Federal Republic of Germany, however, is considering the withdraw of its support, and Canada is looking for a way to end it without jeopardizing the operational status of the pumps in the Upper Regions. When the external aid is eventually phased out, GWSC regional offices are expected to cover the full costs from their own resources.

Cost Recovery - Rural Piped Systems

63. Throughout Ghana, flat rates of 185 cedis/month and 560 cedis/month (US$0.56 and US$1.70) are charged to households using public standpipes and private connections; very few rural households have private connections. These flat rates correspond to a tariff of about 40 cedis/m3 (US$0.12/m3), to be compared to an estimated O&M cost of about 40 cedis/m3 and a total cost (O&M plus investment) of about 80 cedis/m3. Actual revenue collection, however, averages only 10 cedis/m3. Failure to charge at the water point and to meter water consumed is at the root of the problem, since most households living in larger rural communities would likely be able to afford the 10 cedis/day (US$0.03 per day, 300 cedis/month) that would be needed for full cost recovery. (Annex 6) Metering is now commonly perceived as the key to commercial and financial management by African water suppliers. While recovery is fair at private connections, it is usually very poor at public standpipes; as a result, standpipes account for about 70% of the total amount due to GWSC for rural communities.

64. Involvement of the communities at present is minimal, although regional managers of GWSC are attempting to establish better relations with local assemblymen, as for example in the Volta Region, where community groups operate water kiosks and retain a portion of the proceeds, with the assistance from a GTZ supported project. Based on the experience to date there is a good chance that small groundwater based systems could be managed by the community, if they contract operation, maintenance and/or revenue collection, as required, to GWSC's Urban Division or to a private firm. However, replacement of major equipment may require a continuing grants program.

Cost Recovery - Urban Water Supply

65. Up to 1986, between one and two-thirds of GWSC's operating expenses were regularly covered by Government subventions. At that time the Government withdrew its support requiring GWSC to assume full responsibility for meeting its day-to-day operational costs. Subsequently, tariffs were introduced for the first time in rural areas, and a five-fold increase in the existing urban tariff was implemented in 1986. These actions were followed by tariff increases of 25% in 1987 and 1988, and a further increase of 15% in 1989. As a result GWSC has succeeded in meeting all its operating costs without Government support. This is made possible by surplus revenues over and above day-to-day operational costs generated at the three major metropolitan areas of the country, namely Accra-Tema, Kumasi and Takoradi. In the remaining areas of the country, regional offices are cost recovery has only been sufficient to provide for about 65% of the regions' operational budgets with the result that they must be subsidized by surplus revenues generated by the three metropolitan areas.

66. However, GWSC is not collecting sufficient revenues to cover depreciation and interest on loans. The value of GWSC's assets in its balance sheet is grossly understated and the present provision for depreciation included in its operational budget is insufficient for GWSC to replace its assets at the end of their useful life. Also, with the depreciation of the cedi against the currencies in which the loans are denominated, GWSC is expected to encounter increasing difficulties in meeting its debt obligations and assuming responsibility for covering development costs hitherto provided for through allocations from the PIP. Also, increasing wages and the overall rising cost of living is raising day-to-day operational costs and eroding the excess of revenues that the metropolitan areas have been able to generate and the inability of GWSC to substantially improve the quality of its services, makes it difficult for the Government to approve an increase in tariffs.

67. To improve services and increase its water sales, GWSC is currently on line for a major rehabilitation loan amounting to US$125 million. The loan is being made available through contributions of several donors, chiefly IDA, the United Kingdom and Austria. The project is to include institutional development as well as rehabilitation and high priority expansion of existing urban water supply systems. While the project is expected to enable GWSC to eventually become fully viable as a commercial operation over a period of about eight years, its ability to achieve this objective will in large part be dependant on its capacity to ensure sufficient internal cash flow to contribute the required counterpart funds and to devote the staff time and expertise necessary for the successful implementation of the project. It is clear that if funds can not be diverted for the purposes of supporting the rural sector, this will significantly weaken the capacity of GWSC to meet its urban obligations, and the pressure GWSC is under to commercialize its urban operations will result in a serious neglect of the rural sector.

B. Rural Water Supply Sector Financing

68. Investments in the rural water supply sector have almost exclusively been financed by donor contributions; this has applied to new facilities as well as for major rehabilitation work and replacement of depreciated equipment. The Government's annual provisions from the PIP towards development costs have essentially been in the form of counterpart funds to external aid contributions and used to finance local costs such as salaries and local materials. External donor funds are channelled through GWSC which acts as implementing agency for most of the major external agencies operating in the sector. Support is also channelled through the regional development authorities VORADEP and NORRIP, MH and individual district administrations also acting as implementing agencies for RWS programs. In a number of cases where assistance is provided by NGOs, funds are channelled directly to communities. Contributions towards investment by communities is still extremely limited, though under one NGO financed scheme, communities have been mobilized to provide as much as 100,000 cedis (US$300) per household of initial capital costs, with consideration being given to increase this (para 45).

69. Investment in rural sanitation facilities has generally been very low, with the major source of funding provided by external donors channelling funds through MH, DCD or directly to District Administrations. District Administrations sometimes obtain support through limited PIP allocations for demonstration VIP latrines. Under some schemes such as PAMSCAD, communities have been encouraged to contribute towards at least 50% of the construction costs of pit latrines and this has met with some initial success. No systematic planning of rural sanitation exists, and investment tend to be donor driven with regions and districts taking advantage of funds as they are made available. O&M costs of properly constructed rural sanitation facilities are minimal; however, health education support and promotion of sound sanitary practices which are essential for their effective management are severely constrained

by the lack of funds on the part of the district authorities and the MH, responsible for implementing these programs.

70. The potential for generating a higher proportion of resources from communities themselves for the purpose of financing sector development would appear favorable, though it will vary amongst communities depending on income levels and effective demand for water and sanitation. Most communities, despite generally low income levels, have a strong tradition of fund-raising for community projects. Evidence suggests that they are prepared to contribute money for things which they need and want, or for a service properly rendered. If a community of 50 families (300 persons) having average annual household incomes of US$200 pays US$500 for its handpump and all maintenance costs, the initial cost of the handpump would be about 5% of a family's annual cash income and 2% thereafter for maintenance. Similar families living in larger communities with piped supplies would pay about 5% of their income for the operation, maintenance and depreciation of the facilities.

71. Commercial lending for the purposes of financing investment in rural water and sanitation is virtually non-existent; financial institutions in the rural sector are generally weak, operate from a very narrow capital base and suffer from illiquidity. Most do not have adequate numbers of qualified staff to properly appraise and supervise lending activities and defaults are consequently high. Interest rates are high (about 25%) and lending periods short (1 - 2 years). Most banks are prepared to provide loans for agricultural inputs or direct income-generating activities. However, water and sanitation projects are viewed as non-productive investments and thus risky. From the borrowers' perspective, they are reticent to take loans and the long term commitment that they require. While it is not now possible to finance community water supply facilities with commercial loans on a widespread basis, future upgrading of services will require this and lending experience should be obtained through pilot work. Also, communities should establish a credit record so that they will be eligible for loans at a future date.

IV. STRATEGY FOR IMPLEMENTING THE NATIONAL RURAL WATER SUPPLY AND SANITATION PROGRAM

A. Objectives of the National RWS/S Program

72. In Ghana, a rural community is currently defined as one which has a population of less than 5,000 persons. This criterion is also suitable for differentiating between rural and urban water supplies, where rural water supplies are managed by individual communities and urban water supplies by a public utility[6]. Community management means that the community is directly responsible for the planning, operation and maintenance of its water supply system and for the collection of revenues to pay operations and maintenance costs. Communities may choose to contract operations, maintenance and/or revenue collection functions to an outside entity.

73. The objective of the National RWS/S Program is the establishment of a self-sustaining RWS/S sector, including (i) the provision of reasonable access to safe water to all communities that are willing to contribute towards the capital cost and pay for all the operations and maintenance costs of an improved supply, (ii) the promotion of better health, especially through improved water use and sanitation practices, and (iii) the establishment within the private sector in all regions the capacity to construct low-cost latrines and hand dug wells and to maintain manual and mechanized pumps. To serve as many people as possible, Government would give priority to communities with populations greater than 100 and would only subsidize the cost of basic service; higher levels of service would be encouraged but communities would have to pay the added cost.

74. If all communities participate, service coverage in rural areas could reach 90% by the year 2010. This would require an additional 15,000 handpumps and 770 small piped systems for the remaining communities that have populations between 100 and 5,000. In addition, it will be necessary to rehabilitate or replace most of the existing 8,600 handpumps (most have now provided service for more than 10 years), converting them to types that can be repaired by local mechanics, and the existing 80 small piped systems must be rehabilitated. Such a National RWS/S Program would require an investment of about 50 billion cedis (US$165 million) or 5 billion cedis (US$16 million) per year over a 15 year implementation period with costs shared by the communities (10%), Government (15%) and ESAs (75%) (Annex 7).

75. In line with the Governments's decentralization program, the National RWS/S Program is designed to end full dependency on central Government and to reverse the traditional "top down" approach and make projects much more "demand driven". Individual communities are expected to take the lead in choosing, financing, implementing and managing development projects, including water supply and sanitation, based on their needs. Local government agencies, in particular the districts would provide direct support to the communities. Central Government agencies, in particular the one responsible for water supply and sanitation, would provide professional support to the districts. The private sector, expected to take the lead in the provision of goods and services, would have an increased role in the construction of water points and piped systems; the manufacturing, distribution and repair of handpumps; and the promotion and construction of simple sanitation facilities.

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[6] As communities become larger, management of services becomes more complex and at some point the services of a specialized agency become necessary. The question of whether a public utility or the community itself manages the operation, maintenance and revenue collection of a system is important in distinguishing between urban and rural water supplies and determining the specific responsibilities of GWSC's RWS Division. The practicality of using this definition of RWS should be carefully considered during the detailed design of the National RWS/S Program.

76. The best way to improve health and reduce mortality rates is through a combination of improved water supply, better water use and hygiene practices, proper disposal of human wastes, treatment of diarrhea by oral rehydration and immunization of children. Health education, promotion of latrines and immunization campaigns are activities that must go on over many years, while helping a community to plan and maintain a water supply is likely to require about a year. Because the time scales are different, it is not possible for a National RWS/S Program to be responsible for all these activities, besides they are more properly done by the Ministry of Health. Nonetheless, the National RWS/S Program can support the Ministry of Health's program in this area by carrying out well defined health education activities in the course of its work with communities, focusing on promotion of personal hygiene, excreta disposal, diarrhea control, nutrition, and promotion of immunization. Special consideration should be given to generating demand for improved water supply and sanitation in communities which do not appreciate the need for them or where unprotected water sources are used in the wet season. In addition, the National RWS/S Program should take responsibility for establishing at the district level private sector capacity to promote and construct a range of household and public latrines. Training artisans to construct latrines is similar to training of well sinkers or handpump mechanics, and can thus be undertaken at a marginal extra cost.

B. Institutional Arrangements

77. To implement the proposed RWS/S program, there are four essential elements: (i) local planning and extension services must be district responsibilities, (ii) a regionally based, multi-disciplinary group including specialists in planning, community development, sanitation, RWS technologies, and hydrogeology must provide technical and training support to district staff, (iii) a central team must manage the program, carry out national planning, and coordinate ESA and NGO activities and (iv) the institutional structure must be able to support sound and flexible financial management.

78. The single most important factor in the success of a national RWS/S program is Government's commitment to it and the executing agency. Assuming this commitment, Government should contract GWSC to coordinate the National RWS/S Program and provide budgetary allocations for this purpose. Substantial restructuring of GWSC, without jeopardizing GWSC's current or future obligations in the urban sector, is needed. It is recommended that a RWS/S Division, headed by a deputy managing director, be created within GWSC to implement the Program. The Division would be independent of GWSC's urban water supply operations, sharing only administrative functions, with administrative support staff assigned to each RWS Unit and separate urban and rural books maintained. The majority of the staff of the RWS/S Division could come from existing rural water supply personnel within GWSC, although external recruitment will be required for community development, sanitation and planning personnel. All would require specialized training to effectively carry out their responsibilities. Fixed term contracts with appropriate housing allowances should be used whenever possible. Financial incentives, directly linked to the delivery of the Program, could be envisaged for staff of the RWS/S Division. A structure for the Division is suggested in Annex 8.

79. The Ministry of Works and Housing will continue to play its role in policy adoption, regulation, resource mobilization and national program monitoring and coordination. The Ministry of Health through its staff at the district level would be responsible for promotion of improved health and sanitation. Similarly, the Ministry of Local Government, particularly the Department of Community Development, through its staff at the district level would continue its long-standing role in community mobilization and training. Both would provide specialist services within District and Regional RWS/S Units.

Role of the Communities

80. The acquisition of an improved water supply would start with the application for financial assistance filed by a community through its district. Before this assistance is granted, the community would be responsible for deciding the type of water supply system and its management. In this process, a water committee would be formed (or its functions included in an existing group), a specialized bank account would be opened and an initial contribution to the capital cost deposited, and other pre-project obligations would be met. During the planning, construction and follow-up period the community would participate in health education and training and would be responsible for improving environmental sanitation. Communities would also be fully and solely responsible for the operation and maintenance of their water supplies, including the collection of charges.[7]

Role of the District Assemblies

81. The district assemblies have a key role to play in the National RWS/S Program. They are responsible for guiding sector development and providing direct support to communities in their jurisdictions to plan their water supply systems. Whenever possible districts should form a RWS/S Unit consisting of community development, water supply, and sanitation specialists. Each district should work out an arrangement with GWSC's Regional RWS/S Unit for assistance in meeting its responsibilities; where district resources are minimal, the district may choose to have GWSC provide day to day management of its RWS/S program, based on an agreed upon work program. District based RWS/S Units would assist communities with a needs assessment and in planning their water supply systems; they would also help form and train water committees, promote good health practices and, after the systems have been built, provide support to the communities upon request; they would also provide information on technology choice and design, and coordinate the training of private area mechanics and local contractors for hand-dug/drilled wells and latrines. District RWS/S Units would prepare annual RWS/S workplans and budgets to be adopted by the assembly, and with the assistance of regional RWS/S staff, package contracts for hand-dug or hand-drilled wells. The Department of Community Development and the Ministry of Health would provide staff to the districts (many of whom are already in place) to help implement the Program. Operational costs of the district RWS/S Units including field allowances would come from the Government either directly or through the RWS/S Unit.

Role of Regional and Headquarters RWS/S Units

82. Regional RWS/S Units, whether within GWSC or the MLG, would be small multi-disciplinary teams consisting of specialists in planning, community development, sanitation, hydrogeology, RWS technologies and administration. They would be responsible for assisting district RWS/S Units to implement their community based RWS/S Program, training extension agents and assisting them to define their strategies and plan their activities. They would keep inventories of communities and RWS/S facilities, track program activities and progress and assist districts and regional secretaries to prepare an annual program and budget. They would be in charge of well siting, supervision and inspection of construction; training of local contractors to construct hand-dug and hand-drilled wells and suitable latrines; and preparation and packaging of well contracts. They would also be responsible for the planning and implementation of a latrine promotion program.

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7 A listing of community, district, GWSC RWS/S Division, and private sector responsibilities is given in Annex 9.

83. The Headquarters RWS/S Unit would be responsible for planning and coordinating the National RWS/S Program, preparing annual workplans and budgets, monitoring progress, and periodically evaluating and updating policies and setting standards and guidelines. The Headquarters RWS/S Unit would also be responsible for mobilizing national and international funding and support for the Program, liaising with other ministries and coordinating projects supported by NGOs and ESAs. It would also prepare designs and specifications for small piped systems (or contract this out to private firms) and inspect the construction, coordinate applied research to be done through appropriate agencies and maintain a water resources and water supply facilities data base. Finally, the Headquarters RWS/S Unit would be in charge of administrative functions, including overall supervision of the Program, budgeting, accounting, procurement, contracting, disbursement and personnel management.

84. The following table gives an estimate of the types and numbers of facilities that the District, Regional and Headquarters RWS/S Units must oversee to reach 90% coverage of the rural population. In each case community management must be established.

Water Supply Facility Requirements

Type of Facility	Total Number of systems	No./Region/yr (average)
Convert existing HPs to VLOM models	8,500	
Construct new hand-dug/drilled wells	7,500	85
Construct new machine drilled wells	7,500	85
Construct new piped systems	750	9
Rehabilitate existing piped systems	75	1

Assumptions: 10 year implementation.
All communities participate.
Handpumps installed on all hand-dug wells.

Role of the Private Sector

85. The private sector will undertake all construction and maintenance work as well as make and distribute all water supply equipment. As far as possible this will be done by local private contractors, manufacturers and distributors, with financing and technical assistance provided to facilitate this. Of particular importance will be the establishment of the local capacity to construct hand-dug and hand-drilled wells and latrines, to distribute spare parts, and to establish the local manufacture of a direct action pump. In addition, efforts will be made to increase the number of local machine drilled well contractors; primarily through sale of GWSC's drilling equipment and the use of bidding procedures that favor small local contractors. Also, special attention must be paid to borehole rehabilitation to ensure that such services are available to communities at a reasonable price. Special investigations must be made (i) to determine the best way to train and support GWSC mechanics during their transition to private mechanics, (ii) to train and finance hand dug/drilled well contractors and latrine artisans, (iii) to make best use of GWSC's drilling equipment to promote local competition and (iv) to establish the capacity to rehabilitate boreholes within the private sector.

C. Financing the National RWS/S Program - Cost Sharing

86. The Government would finance the operational costs (technical assistance provided to the communities) of the district, regional and headquarters based RWS/S Units. A substantial

part of the construction costs (about 160,000 cedis or US$500 per community) would be borne by the community. The remainder would be subsidized by the Government with the assistance of ESAs, since it usually exceeds the financial resources of most rural communities and there is no practical way to recover capital costs from the beneficiaries over a long period. Also, the banking industry does not have the capacity to finance the sector and experiences with long term loan repayments have been discouraging. To serve as many communities as possible, Government would only subsidize the cost of basic service; higher levels of service would be encouraged but communities would pay the added cost. In addition, communities would pay all operations, maintenance and replacement costs (para 87).

87. Preliminary surveys of willingness to pay for improved water supply by rural communities in Ghana, show that an initial contribution of 160,000 (US$500) for a community of 300 is feasible. This represents 50 to 100% of the cost of handpump (depending on its type), purchased at a private regional outlet, that is including all normal commercialization costs. A number of benefits would be realized if communities make a substantive contribution to the capital cost of their improved water supply, particularly if they purchase their handpump:

(a) sector development becomes "demand driven", and Government subsidies would focus on communities that most want improved services;

(b) communities would sufficiently value the system to maintain it, since they become its owner; and

(c) a market for pumps and spare parts would be created with pumps selected on the basis of cost, performance and availability rather than on criteria imposed by the funding agency.[8]

88. Centralized maintenance with collection of water tariffs from rural communities has not worked in any country in the region, including Ghana. Rural communities would take responsibility for managing their water supply systems. For systems to be sustained, it would be essential that communities pay the full O&M cost, as Government and ESAs financing cannot be guaranteed for the long term, and would be better applied to extending coverage to more communities without basic services.

89. For handpump-based systems, each community would be fully and solely responsible for the maintenance of the pump, including the collection of charges, the recording and saving of funds deposited and used, and the repair of the pump, either by a trained member of the community or by a private mechanic hired for that purpose. The community would also be responsible for the eventual replacement of equipment; handpumps are made up of different components that wear at different rates, requiring replacement at different times rather than a single lump sum payment for the entire pump. This spreads costs out over time and makes them more manageable.

90. For small piped systems, each community could contract GWSC's Urban Division or a private firm to operate, maintain and/or collect revenues for their system, depending on the community's needs. For example, collection of charges could be done either by GWSC personnel, a private individual or a women's group, at the standpipe, each time water is

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[8] Once a community must pay for its pump, residents will be quick to learn about the performance of their neighbors' pumps and the adequacy of support provided by the distributor, weighing these factors against the cost of the pumps and their spare parts. Those pumps that provide the best service at the least cost will capture the market.

collected, or at private connections. It is important that revenue collection stops being a conflict between GWSC and the community and therefore that payment be based on actual consumption and for services actually rendered. Depending upon the type of contract the community and GWSC entered, replacement costs would have to be financed either by GWSC or by savings of the community.

D. Financing the National RWS/S Program - Channeling of External Funds

91. The cost of planning and constructing rural water supplies would be shared by the communities (10%), Government (15%) and external financing agencies (75%), with community and ESAs paying the capital costs and the Government paying the operational costs of the RWS/S Units. From the communities' perspective the process would begin with them submitting a formal request for financial assistance to their district secretary. The district RWS/S staff, assisted by the Regional RWS/S Unit, would then prepare and annually update a construction grants list (prioritized listing of communities) and an annual workplan for approval by the district assembly that would identify the communities that would receive a construction grant in the following year and would serve as an agreement with the Regional RWS/S Unit for its assistance. Based on demand and the numbers of new facilities successfully constructed in each district and region, the cost sharing formula between districts and regions would be periodically updated by the Regional Coordinating Councils (para. 38) and the Ministry of Finance and Economic Planning, with the advice of GWSC's RWS/S Division.

92. Financing approved by the central Government would flow back to the communities from the PIP, through the district assemblies; however for practical reasons, funds would be managed by the RWS/S Headquarter's and Regional Units. The Regional RWS/S Unit would therefore sign the construction contracts, and disburse funds against actually realized construction through an imprest account managed by the Regional RWS/S Unit Manager; although special arrangements could be made wherein contracts for hand dug wells would be let by district administrations. In the case of cost sharing with a community (for a piped system for example), the Regional RWS/S Unit would also have to ensure that additional disbursements had been authorized by the community. RWS/S funds would be audited annually. This disbursement procedure would also apply to funds earmarked by an ESA for a specific RWS/S project, even if disbursement applications have to be countersigned by an independent consultant. The procedure also allows an ESA to assist with specific project components such as financing hand-dug/drilled well contractors, establishment of a national spare parts distribution system, or development of training methods and materials needed for the National Program.

E. Technology Selection

Technology Selection - Water Wells

93. Compared with surface water, groundwater has obvious advantages and should be used whenever available and of good quality. In line with the policy of subsidizing basic services only, drilling methods should be based on the lowest cost facility that provides good service. Thus, hand-dug and hand-drilled wells should be constructed whenever possible as they are much less expensive than machine drilled wells. A map showing the likelihood of constructing a successful hand-dug well is given in Annex 1; it appears that hand-dug wells may be suitable in about half the country (7,500 wells) that are needed to meet the 90% coverage objective set in para. 71. When machine drilled boreholes are required, success rates reaching 80% can be attained if geophysical siting techniques are used. Six inch casings should become standard as they provide better functionality at little increase in cost. This will

ensure that submersible pumps for well rehabilitation and service level upgrades can later be installed.

Technology Selection - Pumping Equipment

94. Electric pumps are a proven technology to be used, whenever a community is served by an electric grid that is not subject to frequent power outages. Diesel pumps, consisting either of a diesel/generator set with an electric submersible pump or, for lifts of less than seven meters, surface mounted gas or diesel powered centrifugal pumps are more problematic because of their complexity and cost; also, communities may encounter difficulty in keeping fuel on hand. Solar and wind pumps are not dependent on external fuel supplies and can be less expensive; wind pumps, however, should have limited application because winds of sufficient speed and reliability to make them economical occur in few locations. Handpumps can provide basic service to small communities for pumping lifts of up to about 45 meters.

95. Where water use is about 20 liters/capita/day and a machine drilled borehole cost more than US$5,000, handpumps will provide water at least cost for communities with populations under about 1,000, solar for populations between 1,000 and 2,500, and diesel for populations above 2,500. Where less expensive hand-dug or hand-drilled wells can be constructed, handpumps can serve virtually any sized community. In general, where water consumption and well costs are low, handpumps will tend to be the most appropriate technology and where water use and well costs are high, solar and then diesel pumps will be better. An analysis of technology choice is provided in Annex 10.

Technology Selection - Handpumps

96. Much progress has been achieved in the last decade in designing "user friendly" pumps. They can be repaired in a few minutes by a man or woman in a community using low cost spare parts; they are also corrosion resistent, thus eliminating one of the biggest source of user dissatisfaction caused by highly corrosive groundwater and galvanized iron down hole components (the iron released into the water causes bad taste and discolors food and clothing).

97. For pumping lifts up to 12 to 15 meters, direct-action pumps have proved highly successful. Without a lever-handle or bearings, they are characterized by their simplicity, low-cost and ease of repair, and are ideal pumps for village based maintenance. The Nira AF85 pump has proved very successful in many countries and should become the standard for low-lift applications. In Ghana up to two-thirds of all pumps, i.e. a market of about 13,000 pumps, could be direct-action. Use of these pumps on hand-dug wells would also ensure high quality water, at a price that is competitive with drawing water with ropes and buckets.

98. For pumping lifts up to 45 meters, easy to repair, corrosion resistent high-lift pumps are now available. The Government should recommend both a direct action pump and a high lift pump for use in Ghana, not for the purposes of standardization but rather to prevent arbitrary introduction of a new type of pump with each new project and to create a sufficiently large market to warrant local manufacture and private sector distribution of pumps and spare parts (para 83). A comparison of handpumps now used in the country is given in Annex 11.

Technology Selection - Solar Pumps

99. Solar energy is potentially well suited to Ghana because of the high and consistent solar radiation received throughout the year; as the cost of photovoltaic panels decreases and as confidence in their reliability increases, solar pumps are expected to play an increasingly important role in the National RWS/S Program. Over 300 solar pumping systems are currently operating in West Africa (of which 140 are in Mali) and their reliability has been excellent with breakdowns occurring only once in 10 years of operation. A program of 1,000 solar pumps in West Africa, financed by the European Community, is also underway. A typical solar pumping system is composed of a photovoltaic panel, invertor, submersible electric pump, water tank and accessories such as the rising main, water level controls, flow meter and wiring. Both the pump and the photovoltaic array are now very reliable with a life expectancy of 8 years for the pump and at least 20 years for the array. The few breakdowns that occur are generally due to wiring or invertor problems.

Technology Selection - Water treatment

100. Protected surface water sources (springs and upland streams) can provide a reliable service if water can be conveyed by gravity and it is available throughout the year. Treated water from rivers and lakes also provide good service if reliable operators, spare parts and uninterrupted supplies of fuel and chemicals are available. However, even temporary failure of the treatment system can result in serious outbreak of water-borne disease.

101. Designers of water treatment plants for small and medium sized communities are now returning to tried and tested methods of water treatment, particularly slow sand filtration preceded by roughing filters, and are minimizing the electro-mechanical equipment, preferring to use hydraulic processes. The result is considerable cost savings and improved reliability, with typical 95% solids removals and 10,000 fold reductions in pathogenic organisms without the use of chemicals. Nonetheless, chlorination is recommended, although a major outbreak of disease is unlikely even if chemicals should run short. Infiltration galleries can provide even better and more reliable treatment at lower costs and should be used whenever technically feasible.

Technology Selection - Latrines

102. The Kumasi VIP (KVIP) latrine, that is best suited to urban sites and the Ghana-modified Mozambique VIP latrine that is likely to be better suited for rural areas, are now well known in the country. The generation of a demand for latrines has in the past been a problem because of the high cost; it is therefore important that a range of different cost designs for improved sanitation (from a simple trench to various types of VIP and pour flush latrines) be promoted through the National RWS/S Program both for household and public use (Annex 12).

F. Construction

103. All construction should be awarded through competitive bidding, with local contractors given a fair chance to compete; this should be translated in domestic preferences acceptable to ESAs. In general, smaller contracts should be let that are sized to fit the district/regional capacity to plan, construct and manage. International competitive bidding should be the rule for contracts over 300 million cedis (US$1 million);

104. Construction of hand-dug wells and hand-drilled boreholes should be done by local contractors and artisans. Because of the importance of hand-dug and hand-drilled wells in meeting the goals of the National RWS/S Program, it is essential to train local contractors to

construct them according to standard specifications, and to provide these contractors with the financial assistance they may need to purchase equipment or finance their working capital. Lease/purchase or similar arrangements may be appropriate.

105. The absence of a local drilling industry has its cause in the lack of competition, ESAs use GWSC's drilling rigs to construct boreholes under force account and NGOs resort to procuring and operating their own drilling rigs. GWSC's Drilling Unit is hampered by operation of old equipment, lack of sound financial management, excessive staff who cannot be motivated with appropriate bonuses, overtime and field allowances. Acquisition of spare parts and drilling materials is also problematic, largely unavoidable due to controls on procurement and operations needed for a large corporation. As GWSC should rapidly move away from its current role of "provider of service" to the one of a "promoter", there is no justification to maintain the Drilling Unit as part of its operations. It is therefore recommended that the GWSC Drilling Unit be closed down, and its equipment sold to local private contractors. Steps should be taken to assess the value of the existing equipment, to identify possible buyers who could effectively manage a drilling company, and to secure financing for one or two new drilling companies. Privatization of GWSC's Drilling Unit would increase competition and help reduce drilling costs in the country.

106. Handpump installation would be contracted out to private area mechanics after proper training; construction of facilities and installation of equipment for small piped systems would be done by private regular civil works contractors.

107. Similar to hand-dug and hand-drilled boreholes, latrine construction would be done by local artisans and small private contractors. In many cases their services will be limited to supervision and masonry work, as costs can be minimized if individual households dig the pit and construct the superstructure themselves. Artisans and contractors should also have an entrepreneurial spirit and be able to sell their product to households. Their training would include both the technical and promotional aspects of the latrine business.

G. Local Manufacture and Distribution

108. Based on the projected number of new and rehabilitated water points in the country (para 82) demands for new handpumps could be as high as 22,000 pumps during the next 15 years or about 1,500 pumps per year, 2/3 of which could be low-lift pumps. If locally manufactured, and provided that they are not more penalized by import duties on raw materials than an imported pump would be, low-lift, direct-actions pumps could be sold by regional private retailers at a price comparable to what a community is willing to pay for improved water supply (150,000 cedis or US$500).

109. Rather than standardizing on selected handpumps, each community should purchase its own pump, paying half its cost, based on local availability and the one that they believe gives the best performance at the least price. This would establish a market for locally made handpumps and spare parts; encourage serious manufacturers, both national and international, to distribute their products at regional outlets and local shops; and eventually limit the number of different pumps on the basis of the seriousness of manufacturers and/or distributors rather than the number of projects in the country. Both technical and financial assistance must be given to local manufacturers and distributors to initiate spare parts distribution.

H. Human Resources Development

110. The success of the National RWS Program will depend on the motivation and the capability of the personnel responsible for implementing it. To a large extent it could be characterized as a training program, for all participants: communities, project personnel and their supervisors, trainers, and private contractors and mechanics. In addition, administrators and other decision makers at the district, regional and national levels need to be informed and involved. While most of the financing will go towards capital expenditures for new water supply facilities, most of the effort will go towards training. In all some 120 RWS/S Division staff, 200 community development agents, 50 to 100 sanitation specialists, 16,000 community water committees, 250 pump mechanics, 20 hand-dug well contractors employing 200 artisans, and 400 latrine artisans must be trained.

111. Project personnel need to (i) learn new communications skills that encourage dialogue and participation rather than rely on directives, (ii) learn effective work planning skills including monitoring, evaluation and problem resolution, (iii) gain a thorough knowledge of the policies and the technical details of the Program, and (iv) become experienced in the process of establishing community management. The Training Network Center for Water Supply and Sanitation and the proposed GWSC training center at Owabi will play important roles in this effort; and because of the practical nature of the training and the need for experience, training should be linked to field activities in regional projects.

V. PREPARATION OF THE NATIONAL RWS/S PROGRAM

A. INTRODUCTION

112. Overall guidance of the preparatory work for the National RWS/S Program will be provided by a RWS/S Advisory Committee formed for that purpose by the Ministry of Works and Housing. Members include GWSC, MFEP, MLG, MOH, the Water and Sanitation Training Network Center, ESAs, NGOs, and the UNDP/WB Regional Water and Sanitation Group in West Africa. Program preparation will be the responsibility of a Working Group appointed by the Advisory Committee with GWSC playing a key role, selected consultants, and the Water and Sanitation Training Network Center. The UNDP/WB Water and Sanitation Group in West Africa will act as secretariat for the Advisory Committee and Working Group. The operational division of the World Bank will work closely with GWSC in determining the management structure of the RWS Division.

113. The strategy for preparing and initiating the program consists of a five components (i) program design, (ii) formation of GWSC's RWS Division, (iii) investment and finance planning, (iv) training materials/methods development, and (v) implementation of selected regional projects. Active participation of all agencies involved in the sector is essential if a common strategy that can be implemented across all regions is to be developed. The level of collaboration and flexibility needed to develop the National RWS/S Program will certainly test the concept of inter-agency cooperation.

114. Elements of the National RWS/S Program that will require external financing include the following.

(a) Vehicles and equipment for RWS Division and District RWS/S Units.
(b) Technical assistance in managing the RWS/S Program.
(c) Conversion to VLOM handpumps at existing sites.
(d) Construction of machine drilled wells.

(e) Construction of hand-dug and hand-drilled wells.
(f) Construction of piped water supplies.
(g) Equipment for local hand-dug and hand-drilled well contractors.
(h) Equipment for local machine drilling contractors.
(i) Equipment for local borehole rehabilitation contractors.
(j) Technical assistance, equipment and materials for local handpump manufacturer.
(k) Stock for spare parts distributors.

B. PROGRAM DESIGN

115. RWS/S Policy: RWS policy statements on a number of important issues need to be adopted by government in order to guide sector development. During program preparation the specific wording of policy statements on each of the following should be drafted by the Working Group, approved by the Advisory Committee, and tested in the regional projects: objectives of the National RWS/S Program; definition of RWS; cost sharing between government and communities; and recommended water supply equipment.

116. Institutional Responsibilities: The responsibilities of the district assemblies, GWSC, DCD, MOH and the private sector in implementing the National RWS/S Program specified in this report should be finalized, approved by the Advisory Committee, and tested and refined through regional projects.

117. Staffing Requirements: The specific staffing requirements of district, regional and headquarters RWS units, including responsibilities, specializations, civil service levels, and numbers of persons should be determined.

118. Construction Grants Program: Guidelines for the proposed construction grants program should be developed, including:

(a) Decision making: Community management means that communities are directly responsible for and must make all decisions regarding the planning, operation, maintenance, and collection of revenues to pay recurrent and replacement costs of their water supply facilities. Communities may choose to contract operations, maintenance and/or revenue collection functions to an outside entity. Options for each of these responsibilities need to be developed and tested both for communities with handpumps and communities with small piped systems. The decision making process that communities must go through in applying for and planning a new or improved water supply system, and the planning assistance and training program that is to be offered by district and regional RWS Units also need to be developed in detail and refined through regional projects.

(b) Construction grants list: Selection of communities that are to receive improved water supply facilities is a sensitive issue and one which requires a defined and transparent methodology. Procedures for preparing and maintaining district and regional construction grants lists should be prepared and the specific mechanisms by which construction grants are allocated between regions and districts must be worked out in detail, with the roles of the district assemblies, district secretaries, Regional Coordinating Councils, MLG, MFEP, and GWSC Regional and HQ RWS/S Units clearly delineated.

(c) Financing mechanisms: Procedures for channeling government construction funds to beneficiary communities and procedures for communities to pay their share must be developed. Certain flexibility in this is required in order to meet the needs of the various support agencies.

(d) Construction management: Guidelines for managing construction contracts including prequalification, preparation of bidding documents, advertising and awarding contracts, construction supervision, and payment should be prepared, and procedures for supervising the construction of boreholes and hand dug wells by RWS/S Unit personnel and private firms should be developed and tested through regional projects.

119. Health Promotion: A component of the National RWS/S Program that supports the Ministry of Health's program in this area by carrying out well defined health education activities in the course of RWS/S Units' work with communities that focuses on promotion of personal hygiene, excreta disposal, diarrhea control, nutrition, and promotion of immunization should be prepared. Special consideration should be given to generating demand for improved water supply and sanitation in communities which do not appreciate the need for them or where unprotected water sources are used in the wet season. In addition, the National RWS/S Program should take responsibility for establishing at the district level private sector capacity to promote and construct a range of household and public latrines. A strategy for identifying and training local artisans to promote and construct latrines should be developed with instruction to include not only technical aspects of construction but also promotional and business aspects, as artisans will need to generate work for themselves through personal contacts with individual households in their area.

120. RWS Survey Methodology: A RWS survey methodology should be developed that can be used by district and regional staff (i) to familiarize themselves with the communities in their area including their size, location, existing water supply facilities, prevalence of water related diseases, and need for improved services, and (ii) to prepare a construction grants list. The following types of information should be collected and used as the basis for selection criteria to prioritize communities: ■ Population, ■ Community type (scattered, nucleated), ■ Guinea worm (extent), ■ Main water source: type, distance to it, and water quality (dry season and wet season), ■ Geology, ■ Hand dug wells (presence and suitability for upgrading), ■ Possible new water supply installations, ■ Comments including indications of need, ■ Location map.

121. Hand Dug Well Program: A program should be developed to reorient the PAMSCAD Hand Dug Well Programme to one that is based on private contractors, including procedures for identifying, training, financing and supervising viable local contractors and providing work for them. Provision should also be made for community self-help labor. Whenever possible regional projects should include a hand dug well component in their programs.

122. Equipment and Spare Parts Distribution: A program to promote the distribution of water supply equipment and spare parts through private retail outlets should be designed and implemented through the regional projects. Equipment should include pumps (manual, solar, diesel and electric), piping, storage tanks, and valves; and services might include installation by a representative of the retailer and a limited warranty.

123. Assistance to Local Manufacturers: Assistance should be given to local manufacturers of handpumps and possibly other water supply equipment, including technical advice on design, fabrication, and establishment of in-house quality control. Third party quality control should also be established.

124. Privatized Maintenance System: A strategy and schedule for converting to privatized maintenance for handpumps and small piped systems, utilizing existing staff to the extent possible and ensuring uninterrupted operation of existing facilities, should be prepared. Many regions already have trained handpump mechanics who are employed by GWSC; a specific support program, including both training and financial assistance, to help current GWSC staff to make the transition to privatized maintenance is essential. Instruction on repairing new types of pumps and, more importantly, learning to operate a private business should be planned.

125. Borehole Rehabilitation: Long term sustainability of the RWS sector will require that boreholes be rehabilitated perhaps once every ten years. A program to provide borehole rehabilitation services through the private sector should be developed, possibly linking it to the hand dug well program, as contractors will require compressors in both instances.

126. Technical Guidelines: Practical technical guidelines, designed for field use, are needed to ensure a consistent, high quality program. Detailed materials for the following are required:

(a) Guidelines for siting hand dug and machine drilled wells and supervising their construction.

(b) Standard drawings and specifications, indicative installed costs, sample bidding documents, construction inspection guidelines, and O&M manuals for hand dug wells, machine drilled boreholes, handpumps, small piped systems (solar, diesel and electric pumps, storage tanks, piping, outlets), surface water treatment facilities, and latrines (household and public). The demand for latrines in the past has been limited by their high cost; it is therefore important that a range of different cost designs for improved sanitation (from a simple trench to various types of VIP and pour flush latrines) be available.

C. FORMATION OF GWSC RWS DIVISION

127. A comprehensive strategy for establishing a RWS Division within GWSC must be prepared. Activities are to include:

(a) Existing Organization and Resources: Review the organization of existing RWS operations and inventory staff (numbers and skills), facilities, and equipment by region.

(b) Organization of RWS Division: Propose an organizational structure for the RWS Division (management, administration, planning, technical services, training, and regional units), including line relationships.

(c) Staffing and Facilities Plan: Prepare a staffing and facilities plan for GWSC's regional and headquarters units, utilizing existing staff, facilities and equipment to the extent possible. Include an operational budget for the first five years and one for a full scale national program. Also, recommend an incentive program for RWS/S Unit personnel to encourage installation of new or rehabilitation of existing water supply facilities and their proper management, linking remuneration to actual achievements (e.g. annual bonuses).

(d) Operations and Personnel Manuals: Prepare operations and personnel manuals for the RWS Division. The operations manual should contain procedures for (a) budgeting, accounting and disbursal, (b) procurement, (c)

inventory control, and (d) contract management including prequalification, preparation of bidding documents, advertising and awarding contracts, construction supervision, and payment. The personnel manual should be based on GWSC's existing manual but should be tailored to the needs of the RWS Division.

(e) Contract for National RWS/S Program: Draft a contract under which GWSC would implement the National RWS/S Program on behalf of the Government.

(f) GWSC Drilling Unit: Develop a management plan for GWSC's Drilling Unit, including its organization, staffing, and financing. The Unit should be autonomous and self-financing, and should be structured with a view toward privatization; consideration should be given to at least partial privatization now.

D. INVESTMENT AND FINANCE PLANNING

128. Investment Program: Prepare an investment program for the National RWS/S Program.

(a) Demand for RWS facilities: Estimate (i) the number of small piped systems and point sources (handpumps and open wells) in each region that exist; (ii) the number of new and rehabilitated systems that will be needed to serve the target population, and (iii) the demand for improved supplies (i.e. the number of communities that will be prepared to request a grant and pay their portion of the costs).

(b) Planned investments: Review the planned investments going into each region.

(c) Investment plan: Prepare an investment plan for each region and for GWSC's overall RWS operations, including physical works, facilities and equipment, staffing and operations, training, and technical assistance. The implementation schedule should be based on reasonable assumptions for funds availability, absorptive capacity and necessary community promotion and involvement.

129. Financing Plan: Prepare a financing plan for each region and for components which cut across regions. The types and approximate numbers of facilities that are needed to reach 90% coverage of the rural population are as follows: convert existing handpumps to VLOM models (8,500), construct new hand dug wells (7,500), construct new machine drilled wells (7,500), construct new piped systems (750), and rehabilitate existing piped systems (75). In each case community management must be established.

E. TRAINING

130. Implementation of the National RWS/S Program will require a concerted human resources development effort. All GWSC and district RWS/S Unit personnel, Training Network Center staff, members of each community, and decision makers (community, district, regional and national levels) must be trained. In preparing for the National RWS/S Program the following work is required: (i) develop and refine the training materials and training methods needed to implement the National RWS/S Program, (ii) train district, regional and headquarter staff, and (iii) develop and strengthen RWS/S curricula at the GWSC, DCD and MOH training centers.

131. Key areas in which sector personnel need to be skilled include (i) participatory communications techniques, (ii) work planning, monitoring and evaluation, and (iii) strategy for establishing community management. The training materials to be prepared will be grouped into training packages and will be tailored to the different groups that will be using them. Trainers of personnel at each of the different levels will also need, in addition to the training package for that group, trainers' guides containing additional information on the subject and on the training methodologies to be used. The particular types of training materials and training techniques that are used will vary. Materials may be written reports or manuals, slides, video, flip charts, posters, etc, and didactic and participatory techniques should be used as well as practical and theoretical methods.

132. Participatory communications techniques: Participatory communication techniques are essential for the establishment of community management, for water supply facilities will be sustained only if communities decide the type of systems that they want and how they will manage them. All project personnel must be trained to communicate effectively with their clients in the communities in a way that ensures that they understand the issues and options, that draws out their thinking on these, and that leaves decision making to them. Participatory communications techniques are also effective in project management, particularly in projects such as RWS/S that require a multi-disciplinary approach which is tailored to and evolves with the needs of each community. Techniques and materials must be developed that can be used to improve project personnel's ability to communicate effectively with communities and to conduct planning meetings that are participatory in nature. Participatory training techniques for (i) conducting community meetings, (ii) conducting water committee meetings, (iii) training WATSAN committee members, (iv) training and supervision of district personnel, and (v) day to day work planning of Regional RWS/S Units should be prepared and field tested.

133. Work Planning, Monitoring and Evaluation: Work planning, monitoring and evaluation are interrelated and essential to successful implementation of the National RWS/S Program. Specific materials on the following elements should be prepared and field tested.

(a) Work planning: In working with individual communities problems are likely to arise because of unique social or physical conditions, consequently community support activities must be tailored to the needs of each community and workplans need to be updated from visit-to-visit. District and regional project staff will need to strategize together to tailor their support to each community and to overcome problems that may arise. Guidelines for preparing annual workplans for districts and regions need to be prepared, as does a record keeping system through which district and regional staff can track the progress of individual communities and design and schedule upcoming activities.

(b) Monitoring and evaluating sustainability: The main purpose of monitoring and evaluation is to assess the sustainability of water and sanitation facilities and to find ways of improving policies and implementation strategies. Guidelines should be prepared for regional staff to measure the level of community involvement/support for their water supply facilities as well as the performance of district personnel. Techniques that require the active participation of the beneficiary communities and that promote inter-staff communications should be employed. At the national level, the TNC should set up a monitoring system to evaluate the sustainability of the water supply facilities including the management capability of WATSAN committees. Research will be directed at identifying constraints to the establishment of community management and ways of refining implementation strategies and training materials to better effect

sustainable water supply facilities. Also, procedures for identifying the training needs RWS/S Unit personnel should be developed.

(c) Monitoring of service coverage and water resources: Procedures for monitoring service coverage and water resources (surface and groundwater occurrence and quality) should be developed, including water quality sampling procedures and record keeping. An appropriate database should be established and maintained at GWSC headquarters with the information provided to the Water Resources Institute on a regular basis .

134. Establishment of Community Management: Establishment of community management requires training materials that are tailored to implementing each step of the process. Manuals and training procedures for each of the subject areas listed below should be prepared. In general, for each category there will be (i) manuals for sector specialists so that they will have the detailed information they need to carry out their work, (ii) training aids for communities to help them plan and manage their water supply facilities, and (iii) basic information for personnel specializing in other areas of the program so that they can reinforce components for which they are not directly responsible.

(a) Program information: Overviews of all aspects of the National RWS/S Program are required so that (i) all staff are conversant with all aspects of the National RWS/S Program, not just their areas of specialization; and (ii) decision makers, private artisans, contractors, and the general public can have access to the information they need to interact with the Program. Subjects should include basic RWS/S policies; construction grants program (RWS survey methods, selection criteria for communities, processing procedures, contract management and construction process); roles and responsibilities of communities, private sector and government agencies; community decision making process and training program; participatory communications techniques; design and siting of water supply and sanitation facilities; maintenance procedures (fault detection and repair of handpumps, spare parts distribution, and private repair services); and promotion of health and sanitation.

(b) RWS surveys: Guidelines and materials for conducting RWS surveys should be prepared and field tested.

(c) Grants lists: Procedures for preparing and up-dating construction grants lists should be prepared and field tested.

(d) Community support: Materials for assisting communities to plan and manage their water supply systems should be prepared and field tested, including:

(i) Training WATSAN committee members
(ii) Revenue collection, accounting, savings, and record keeping
(iii) Operations and maintenance
(iv) Health and hygiene education
(v) Monitoring and evaluation (follow-up - problem resolution)
(vi) Promotion of hygiene and sanitation
Environmental quality in communities: general sanitation and drainage at water points.
Collection, storage and use of household water.
General health promotion (diarrhea control, immunizations, nutrition)

135. Training assistance for GWSC Regional RWS/S Units: In the process of developing and field testing the training materials and training methods, the TNC will need to work closely with GWSC's regional RWS/S Units. Training should be provided both through collaboration on the preparation of training materials and on field testing them through training of Regional and District RWS/S personnel and community members. Thus a day to day working relationship between TNC and Regional RWS/S Personnel is essential.

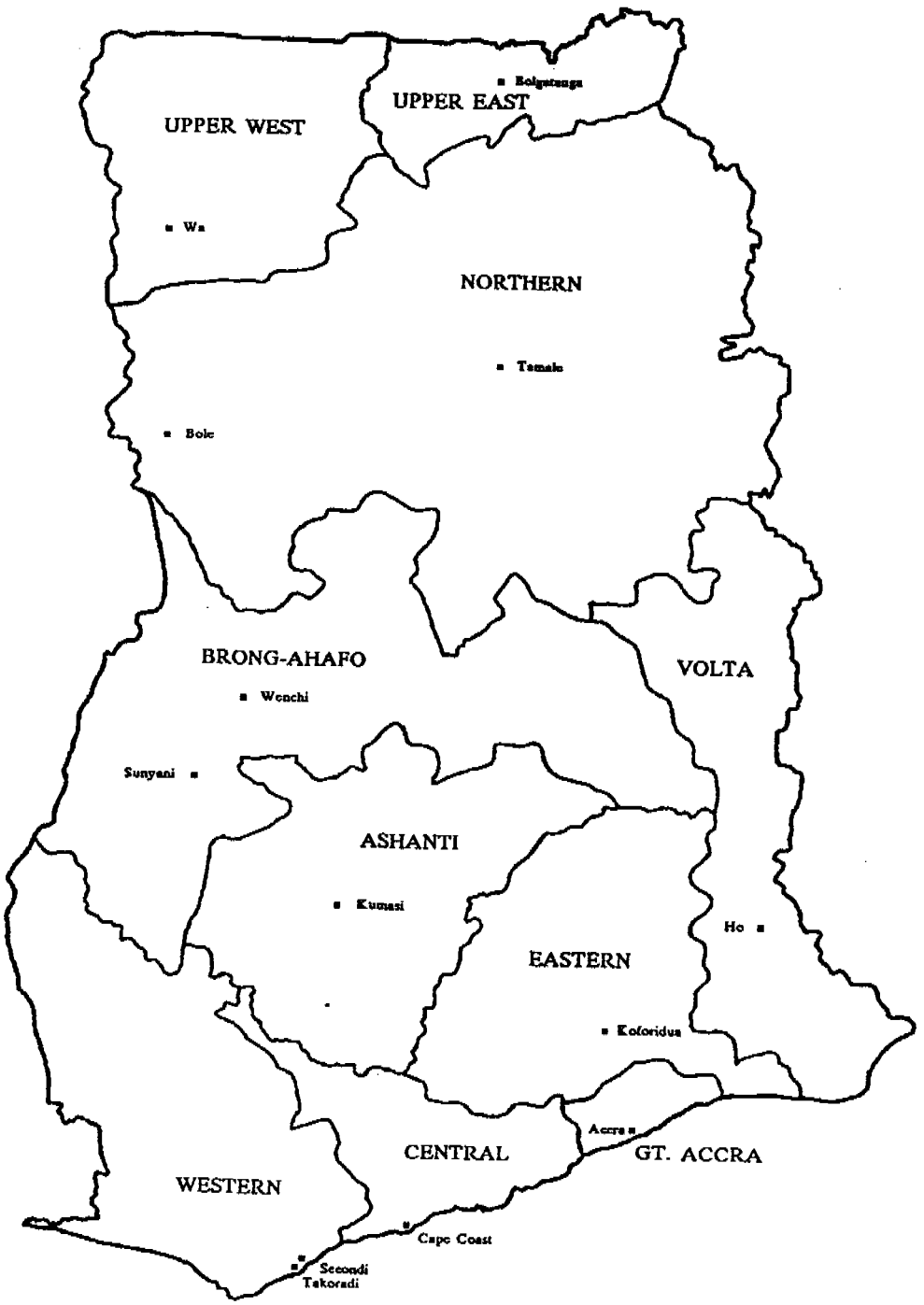
136. RWS/S curricula at the GWSC, DCD and MOH training centers: It has been proposed that a RWS/S Training Center be established at GWSC's existing training school in Owabi. The TNC, working with future key staff of the RWS/S training school should prepare the training program to be used in the expanded National Program. In addition they should assist the DCD and MOH training centers to strengthened their RWS/S Programs, making them consistent with the implementation strategy being used in the National RWS/S Program.

F. INITIAL REGIONAL PROJECTS

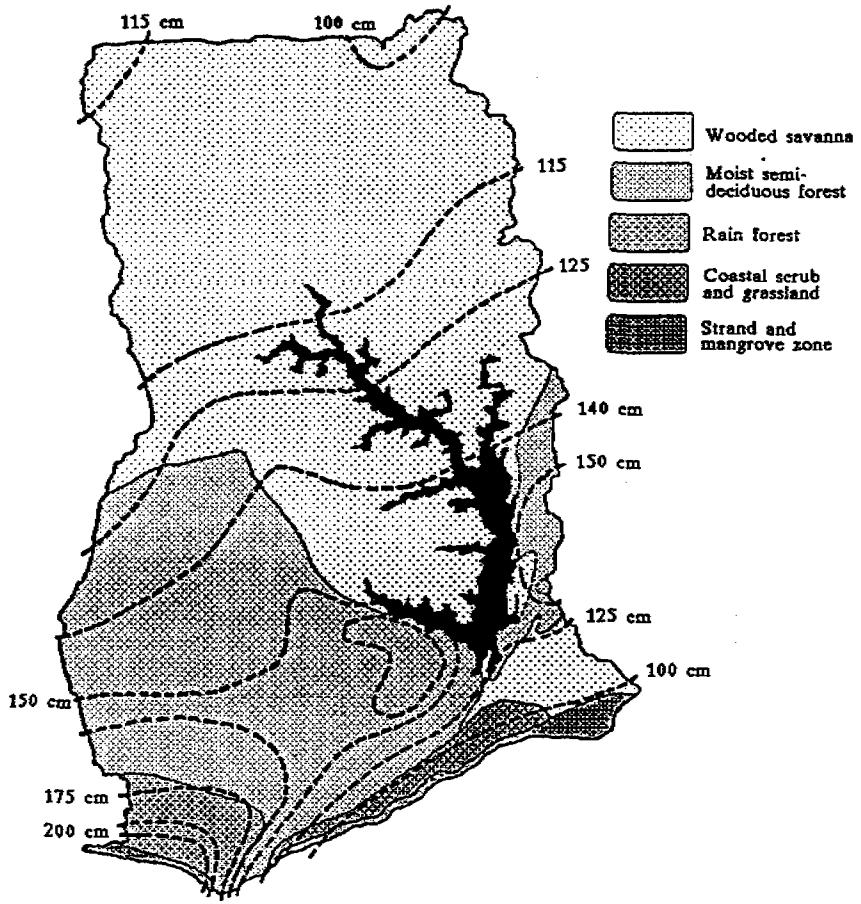
137. Initial Regional Projects: The National RWS/S Program be first initiated in selected regions. Based on geographic coverage and expected donor financing, these may include the Upper East Region (Canada), Volta Region (UNDP), Central Region (France), Eastern Region (UNDP/Netherlands), and Ashanti Region (Germany). To the extent possible these projects should conform to the policies and institutional arrangements that are outlined in this sector strategy and that will be developed further through preparation of the National Program. Important components of all regional projects include:

(a) Multi-disciplinary RWS/S Units at the central, regional and district levels.
(b) Program of support for private mechanics, hand dug well contractors and latrine artisans.
(c) Equipment and spare parts distribution through local retail outlets with the community paying a substantial part of the cost.
(d) Health promotion component.

138. In the process of implementing these regional projects (i) the implementation strategy will be refined, (ii) training methods and materials will be developed, (iii) detailed arrangements for involving the private sector in project execution will be worked out, and (iv) core RWS/S Unit staff and trainers in related institutions will get the experience they need to expand the program into other areas. These Regions would later become the centers at which staff from other districts and adjoining regions could obtain the field experience they need to implement the program in their areas.

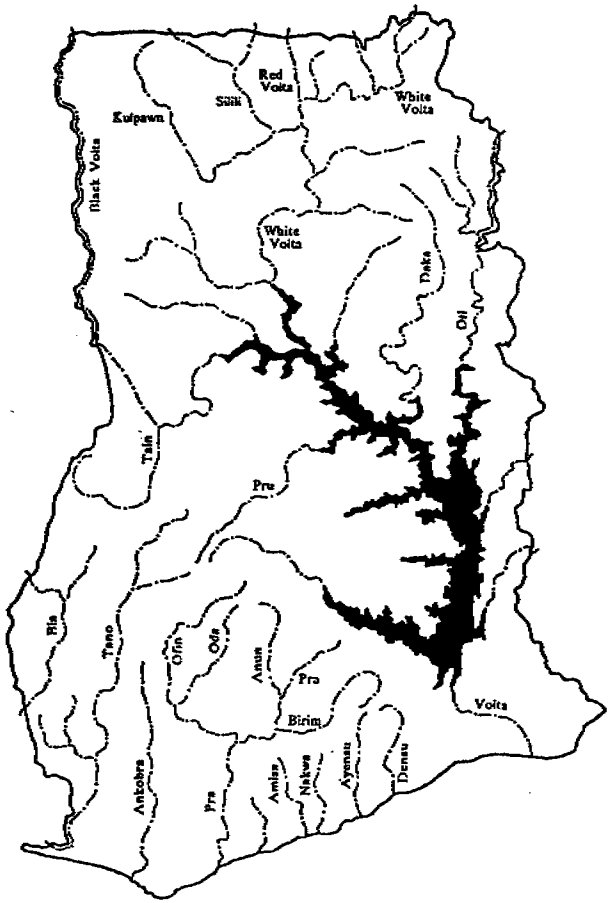

Bolgatanga
UPPER EAST
UPPER WEST
Wa
NORTHERN
Tamale
Bole
BRONG-AHAFO
Wenchi
VOLTA
Sunyani
ASHANTI
Kumasi
Ho
EASTERN
Koforidua
Accra
CENTRAL
GT. ACCRA
WESTERN
Cape Coast
Secondi
Takoradi

REGIONS

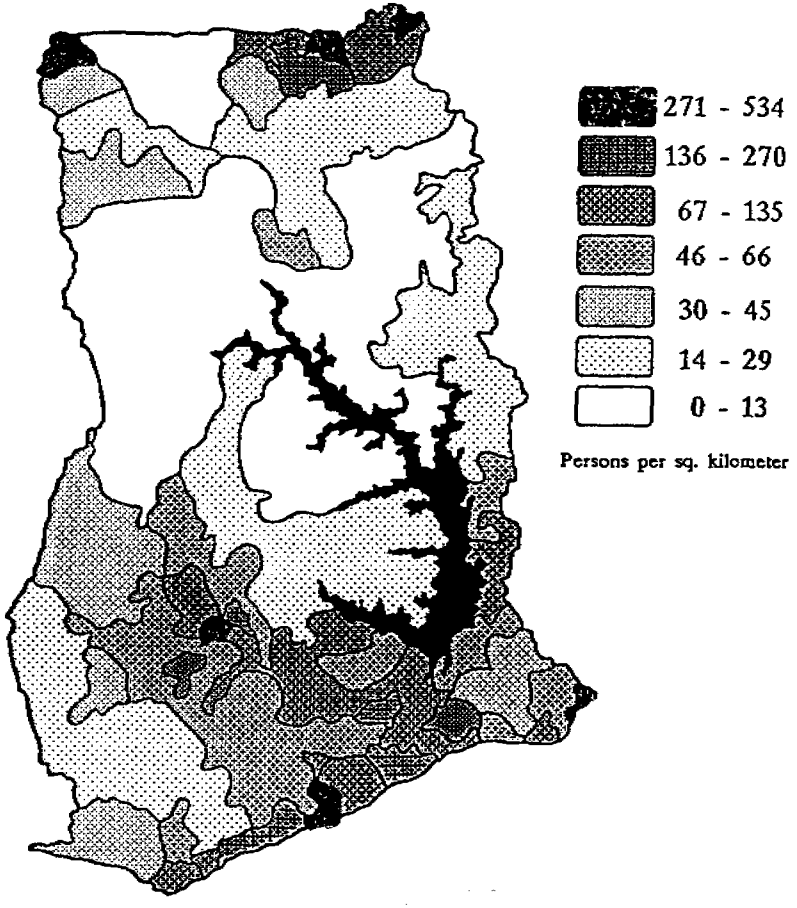


RAINFALL AND VEGETATION

New Geography of Ghana, Longman (1970)

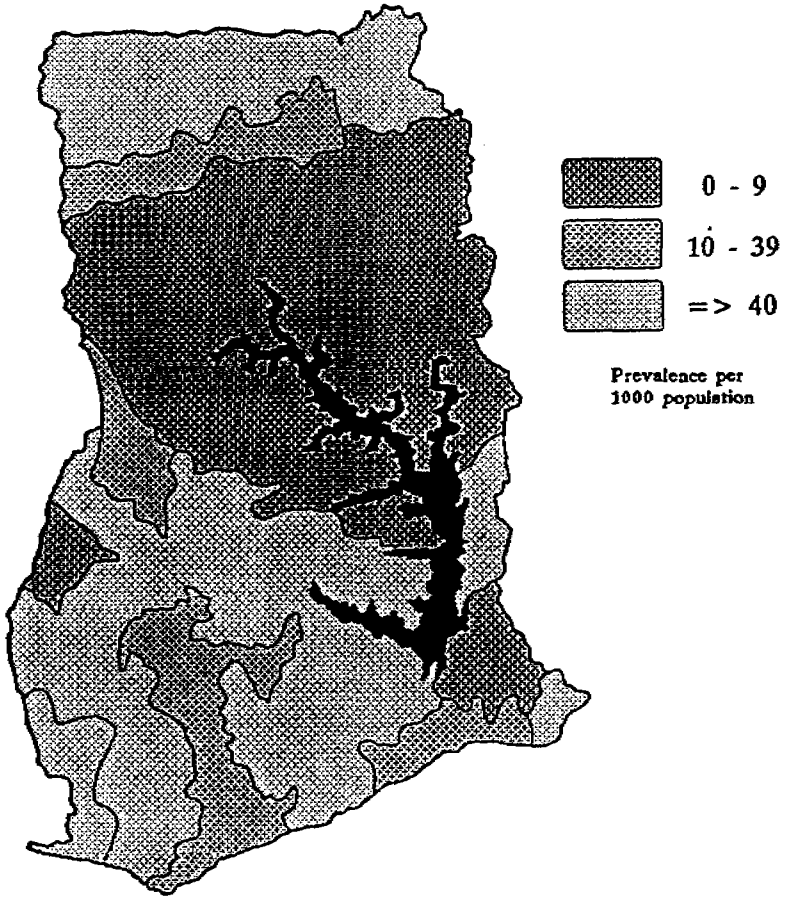


RIVERS



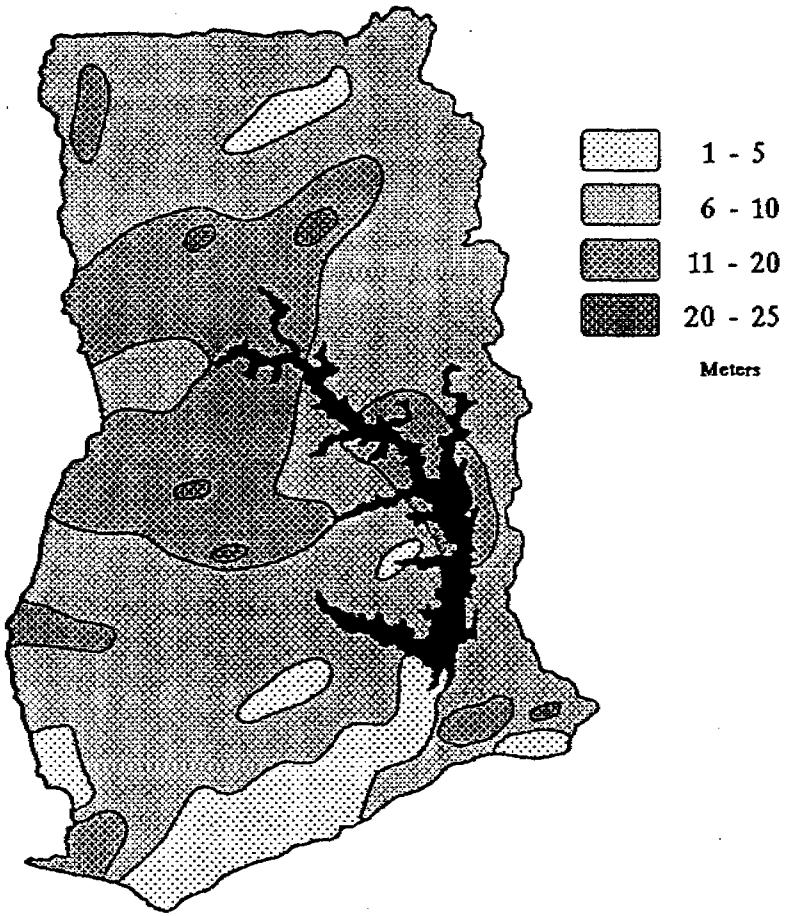
RURAL POPULATION DENSITIES

Atlas Project of Ghana (CSIR)



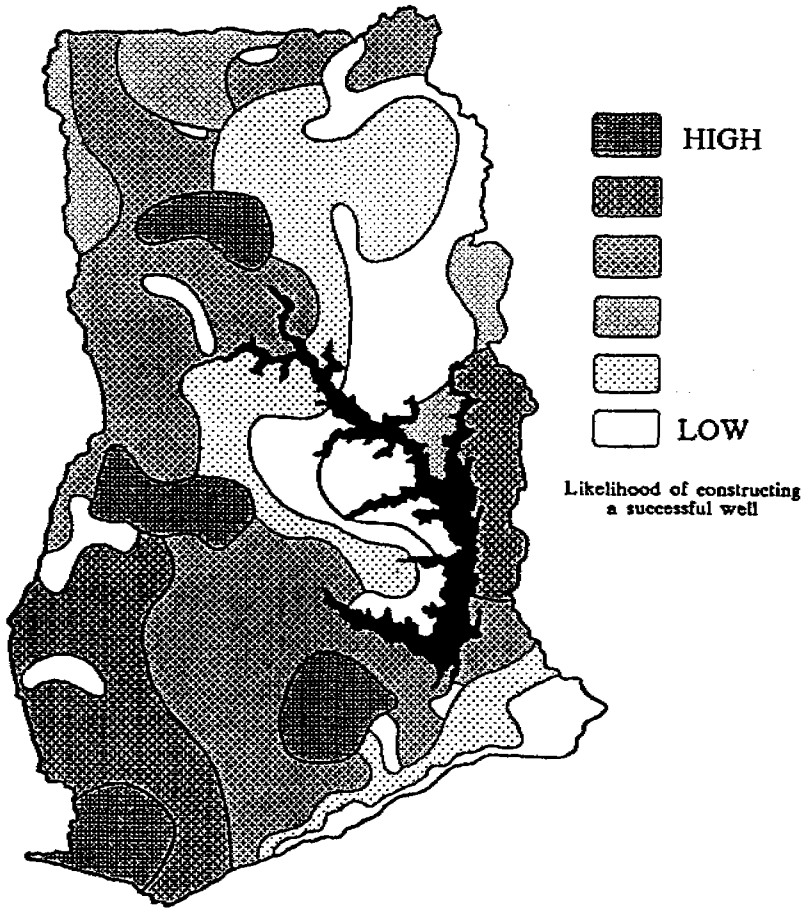
GUINEA WORM PREVALENCE

Global 2000 Program



STATIC WATER LEVELS

Atlas Project of Ghana (CSIR)



HAND DUG WELL POTENTIAL

Bannerman, 1990

RURAL WATER SERVICE COVERAGE

Number of People

Community Size	< 100	100-200	200-500	500-1500	1500-5000	Total	No. Served (1) With Water (percent)
ASHANTI	189,000	108,000	250,000	573,000	525,000	1,645,000	21
B/AHAFO	186,000	95,000	172,000	281,000	299,000	1,033,000	25
CENTRAL	122,000	67,000	157,000	315,000	288,000	949,000	19
EASTERN	129,000	155,000	347,000	389,000	385,000	1,405,000	21
GT. ACCRA	26,000	28,000	58,000	83,000	87,000	282,000	4
NORTHERN	81,000	162,000	307,000	292,000	175,000	1,017,000	24
UPPER EAST	27,000	90,000	310,000	312,000	46,000	785,000	64
UPPER WEST	18,000	51,000	151,000	155,000	81,000	456,000	91
VOLTA	157,000	143,000	228,000	309,000	287,000	1,124,000	28
WESTERN	164,000	98,000	181,000	304,000	297,000	1,044,000	28
TOTAL	1,099,000	997,000	2,161,000	3,013,000	2,470,000	9,740,000	29
	0.11	0.10	0.22	0.31	0.25	1.00	

Number of Communities

Community Size	< 100	100-200	200-500	500-1500	Handpump Requirements (2) (100 to 1,500) Total	Existing	Needed	Piped System Requirement (1,500 to 5,000) Total	Existing	Neede
ASHANTI	9,980	640	660	560	3,178	1100	2,078	180	4	17
B/AHAFO	7,850	590	480	280	2,054	700	1,354	100	13	8
CENTRAL	4,750	400	430	330	1,949	550	1,399	100	5	9
EASTERN	3,140	940	940	400	3,362	840	2,522	130	12	11
GT. ACCRA	710	180	160	80	628	40	588	30	0	3
NORTHERN	1,340	960	850	340	3,085	740	2,345	70	7	6
UPPER EAST	410	520	840	380	2,752	1570	1,182	20	9	1
UPPER WEST	290	290	410	160	1,303	1340	(37)	30	4	2
VOLTA	4,190	880	620	330	2,676	850	1,826	100	16	8
WESTERN	7,420	600	490	310	2,167	870	1,297	90	10	8
TOTAL	40,080	6,000	5,880	3,170	23,154	8,600	14,554	850	80	77
						0.37	0.63		0.09	0.9

Notes:

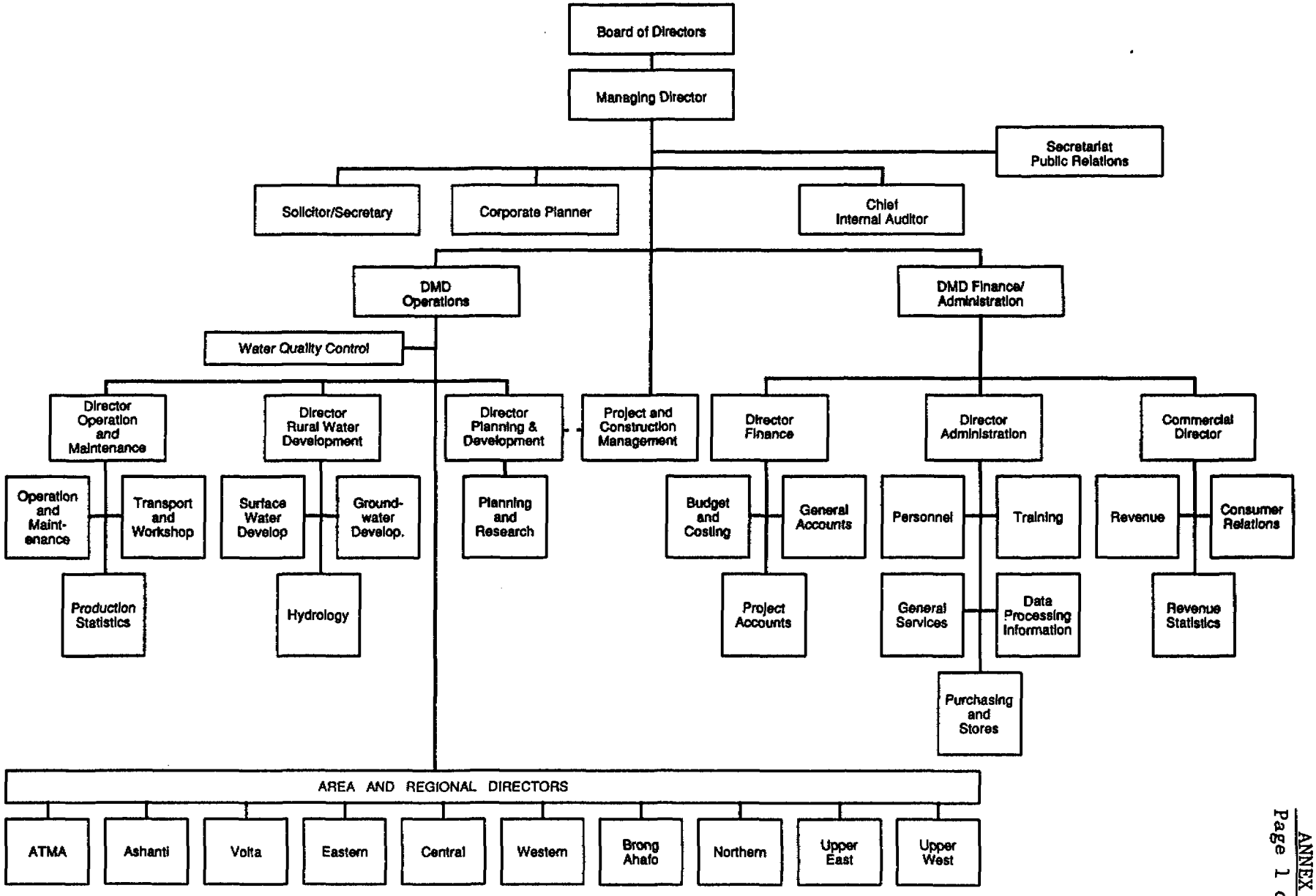
(1) Assumes 300 persons per handpump and 3,500 per piped system.
With 70% of systems operational, 20% of rural population has safe water.
Ghana Living Standards also estimates that 20% of rural population has access to safe water.

(2) Handpump requirements are based on serving all communitiers with populations of 100 to 1,500 (90% of total rural population).
Communities with populations between 200 and 500 on average assumed to require 1.3 handpumps.
Communities with populations between 500 and 1,500 on average assumed to require 3 handpumps.
On average new systems will serve 300 persons per handpump.

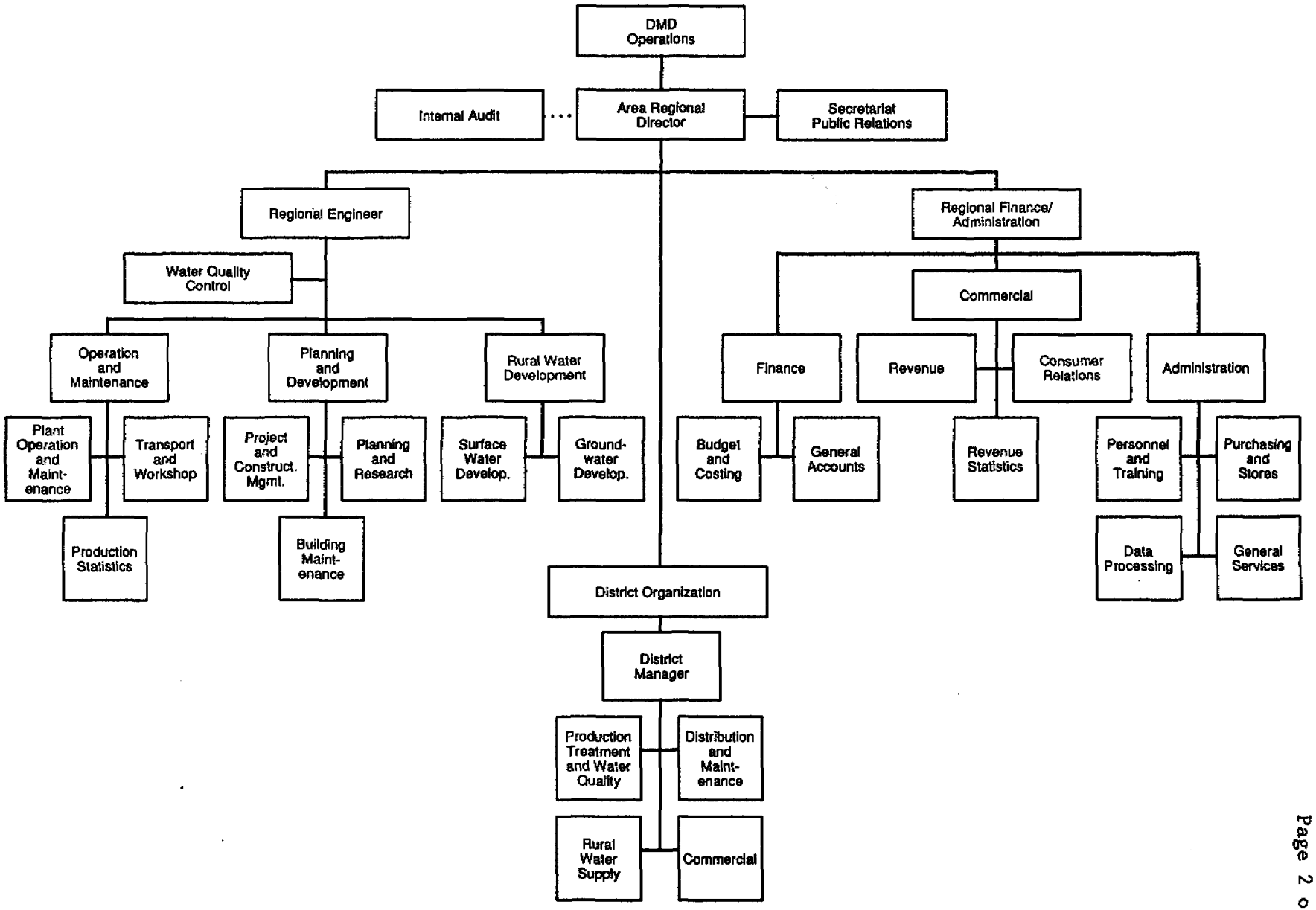
(3) 1990 statistics.

(4) The rural population may increase by 25% by the year 2000, but the number of communities is not likely to change. Because of the uncertainty in rural population growth and actual demand for improved services, current population figures are used.

REPUBLIC OF GHANA
WATER SECTOR REHABILITATION PROJECT
Ghana Water and Sewerage Corporation
Head Office Organization



REPUBLIC OF GHANA
WATER SECTOR REHABILITATION PROJECT
Ghana Water and Sewerage Corporation
Regional & District Organization



RURAL WATER SUPPLY PROJECTS IN GHANA

Project Name	Implementing Agency	Support Agency	Region	Type of System	Systems Total	Systems Installed
Borehole Drilling Project	EP Church		Volta	HP	40	40
Mamprusi District RWS Project	Baptist Church	Baptist Ch.	Northern	HP	300	50
NORRIP II - Water	GWSC	Canada	Northern	HP	356	50
Water Utilization Project	GWSC	Canada	Upper Regions	HP	2,600	2,600
CWS Maintenance Project	GWSC	Canada	Northern	U/R Piped	15	
Wa Dug Wells Project	Catholic Church	Catholic Ch.	Upper West	HDW		
Tamale Drilling Project	Catholic Church	Catholic Ch.	Northern	HP	175	175
Bole RWS Project	Catholic Church	Catholic Ch.	Northern	HP	140	140
Sunyani Drilling Project	Catholic Church	Catholic Ch.	Brong-Ahafo	HP	110	110
Wa Drilling	Catholic Church	Catholic Ch.	Upper West	HP	220	220
Wenchi Water Project	Catholic Church	Catholic Ch.	Brong-Ahafo	HP	320	320
Accra Drilling	Catholic Church	Catholic Ch.	Eastern	HP	30	30
Cape Coast Dug Wells	Catholic Church	Catholic Ch.	Central	HDW	20	20
Keta-Ho Drilling Project	Catholic Church	Catholic Ch.	Volta	HP	50	50
Village Water Resources Proj.	Cath. Church/SAWA	CEBEMO	Northern	Dam/HDW	33/125	9/33
Well Digging Program	Cath. Church/SAWA	Village WRP	Northern	HDW	130	30
HDW Project	Christian Council	Ch. World Ser.	Northern	HDW	100	20
RWS Project	GWSC	France	Central	HP	900	
3000 Wells Project	GWSC	Germany	7 Regions	HP	3,200	3,200
Rehabilitation Project	GWSC	Germany	Eastern	U/R Piped	33	
RWS Project Phase II	GWSC	Japan	BA/Western	HP	320	
RWS Project Phase I	GWSC	Japan	Northern	HP	200	200
PAMSCAD	GWSC/DCD	Japan	All Regions	HDW	2,000	
Ground Catchments	Amasachina	Peace Corps	Northern	Catch.	10	
Dug Wells Project	Dist	Peace Corps	Upper East	HDW	100	
Contract Drilling	WRRI	Private	Gt. Accra			
Ground Catchments	ADRA	SAWA	Northern/UW		10	
District RWS/S Project	GWSC	UNDP	Volta	HDW	200	
RWS/S Project	GWSC	UNDP/Neth.	Eastern	HP	200	
Borehole Rehab Project	GWSC	UNICEF	4 Regions	HP Rehab.	500	500
CWS/S Project	GWSC/DCD	UNICEF	5 Regions	HP/HDW	600	
HDW Project	Akwapim Ridge Fnd	Water Aid	Eastern	HDW	30	
Afram Plains HDW Project	Presby Church	Water Aid	Eastern	HP/HDW	30	15
Wa HDW Project	Wa Catholic Parish	Water Aid	Upper West	HDW		
Bolga HDW Project	Wa Catholic Parish	Water Aid	Upper East	HDW	100	100
Kwahu and Kaoga HDWs	Water Aid	Water Aid	Eastern	HDW	570	30
RWS Project	VORADEP	WB	Volta	HP	227	230
Rehabilitation Project	GWSC	WB/ADP	7 Regions	U/R Piped	200	
CWS/S, HP Testing	GWSC	WB/CIDA	Upper East	HP Rehab.	50	
Large Scale CWS/S Project	World Vision	World Vision	6 Regions	HP	750	500
					15,000	8,600

RURAL SANITATION PROJECTS IN GHANA

Project Name	Implementing Agency	Support Agency	Region
Public Latrine Management	CDRs	City/dist	All Regions
Rural Sanitation Project	DCD	UNICEF	All Regions
Public KVIP Project	Dist	UNICEF	Brong-Ahafo
Public KVIP Project	Dist	UNICEF/AGCM	Ashanti
Sanitation Project	Dist	GTZ	Gt. Accra
Public KVIP Project	Dist/UST	GOG	Ashanti
Pan Latrine Conversions	DRH&CI	GOG	Gt. Accra
National KVIP Project	DRH&CI	GOG	All Regions
Mobil Clinic Latrine Project	Presby Church		Upper East
PAMSCAD	GWSC/DCD		All Regions

PRODUCTION RATES OF WELL DRILLING ORGANIZATIONS

Organization	No of Rigs	No of Staff	No Wells per year	No Wells per rig·yr	No Staff per Rig	No Wells per staff·yr
1. GWSC DU Base	3	60	65	22	20	1.1
2. WRRI	2	25	8	4	12	0.3
3. GWSC (JICA)	3	65	160	53	22	2.4
4. GWSC (CIDA)	3	53	80	27	26	1.0
5. DWM	1	8	63	63	8	7.9
6. WVI	2	20	138	69	10	6.9
7. Prakla-Seismos	3	60	160	53	20	2.6
Average (Nos. 3 to 7)				50	15	4.0

WRRI - Water Resources Research Institute
DWM - Divine Word Missionaries
WVI - World Vision International

COMPARISON OF THE ESTIMATED COST OF WATER TO BILLING AND ACTUAL COLLECTION

HANDPUMP BASED SYSTEMS

	UPPER EAST REGION	3,000 WELLS PROJECT	WENCHI	COMMUNITY MANAGED
1. Total number of pumps	1648	3200	289	
2. Maintenance cost, Cedis/pump/yr				
Fuel	1,500	1,600	1,300	
Vehicle maintenance	2,500	4,500	2,600	
Vehicle depreciation	5,800	9,600	6,800	
Well maintenance	13,200	13,200	13,200	13,200
Salaries and food	3,500	5,500	2,400	3,000
Overhead	3,300	3,000	200	
Subtotal	29,800	37,400	26,500	16,200
3. Spare parts cost, Cedis/pump/yr				
Spare parts	26,000	26,200	23,800	26,000
Delivery of spares	13,000	13,000	13,000	13,000
Subtotal	39,000	39,200	36,800	39,000
4. Costs versus revenues, Cedis/pump/yr				
Total maintenance cost	68,800	76,600	63,300	55,200
Total revenues	9,200	8,700	4,400	
Deficit	59,600	67,900	58,900	55,200
5. Ratio of revenues to costs	0.13	0.11	0.07	
Costs versus revenues, US$/pump/yr				
Total maintenance cost	208	232	192	167
Total revenues	28	26	13	
Deficit	181	206	158	

Note: Total cost of community managed pumps is about 0.5 cedis per bucket for a community of 300 persons.

COMPARISON OF THE ESTIMATED COST OF WATER TO BILLING AND ACTUAL COLLECTION

SMALL PIPED SYSTEMS

	JUABEN	EFFIDUASI-ASSOKORI	ASAMANG	AGONA	KONA
Population	10,000	11,000	4,000	8,000	5,000
Daily production, m3	80	150	45	320	80
Water consumption, liters/capita/day	8	14	11	40	16
1. Cost of O&M, cedis/m3					
Operation	34	41	26	19	30
Maintenance	4	3	6	6	13
Total	38	44	32	24	43
2. Cost of investment, cedis/m3 (1)	135	75	125	30	84
3. Total cost, cedis/m3	173	118	157	54	127
4. Billing, cedis/m3	35	30	16	10	7
5. Actual collection, cedis/m3	22	14	10	4	5
6. Ratio of billing to O&M	0.93	0.69	0.49	0.41	0.17
Ratio of collection to O&M	0.59	0.31	0.33	0.15	0.12
Annual deficit for O&M, cedis	443,840	1,642,500	351,495	2,417,760	1,095,000
7. Ratio of billing to total cost	0.20	0.25	0.10	0.18	0.06
Ratio of collection to total cost	0.13	0.11	0.07	0.07	0.04
Total annual deficit, cedis	4,385,840	5,737,800	2,410,095	5,921,760	3,558,750

(1) Based on estimated cost of system with 30 lpcd capacity adjusted for actual production. At full capacity the investment cost is about 40 cedis per m3.

8. Cost of investment, cedis/m3 (at 30 lpcd)	36.0	34.0	47.0	40.0	45.0

Calculation in #2 based on costs in #8 adjusted for daily production in each community.

POTENTIAL REVENUE COLLECTION

Public standpipes

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20 lpcd
6 persons per household
120 liters per household per day
3650 liters per household per month
185 cedis per household per month at standpipes
51 cedis per m3 billable, = US $ 0.15 with 100% accounted for water
41 cedis per m3 billable, = US $ 0.12 with 80% accounted for water

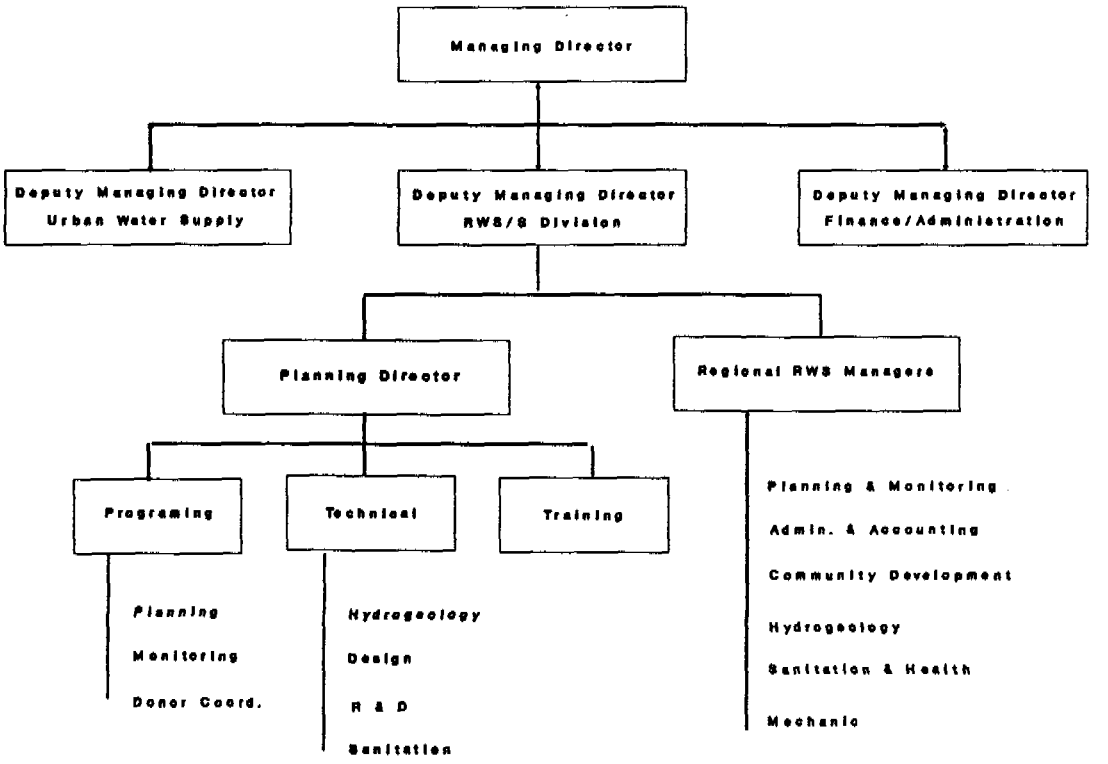
Note: 60 lpcd for private connections and 560 cedis per household per day results in the same revenues.

ESTIMATED BUDGET FOR NATIONAL RWS/S PROGRAM

	Quantity	Unit Cost (Cedis 1000s)	Unit Cost (US $)	Total Cost (Cedis millions)	Total Cost (US$ 1000s)	
CONSTRUCTION COSTS						
Machine drilled boreholes	7,500	2,240	7,000	16,800	52,500	
Hand dug/drilled wells	7,500	640	2,000	4,800	15,000	
Low-lift handpumps	15,000	384	1,200	5,760	18,000	
High-lift handpumps	8,000	224	700	1,792	5,600	
Piped systems (new)	770	19,200	60,000	14,784	46,200	
Piped systems (rehabilitated)	80	6,400	20,000	512	1,600	
Subtotal				44,448	138,900	
Annual cost (10 years)				4,445	13,890	
OPERATIONAL COSTS						
GWSC RWS Division						
Salaries and benefits						
Professional staff	92	1,120	3,500	103	322	
Support staff	50	480	1,500	24	75	
Vehicles	44					
Depreciation		1,056	3,300	46	145	
Maintenance		640	2,000	28	88	
Operation		320	1,000	14	44	
Miscellaneous		88,000	275,000	88	275	
Subtotal				304	949	
District personnel						
Salaries and benefits						
Professional staff	250	640	2,000	160	500	
Support staff	50	320	1,000	16	50	
Motorbikes	250					
Depreciation (1)		99	310	25	78	
Maintenance		640	2,000	160	500	
Operation		320	1,000	80	250	
Miscellaneous		48,000	150,000	48	150	
Subtotal				489	1,528	
Total annual costs				5,237	16,367	
Total costs				52,373	163,667	
Community contribution				5,237	16,667	10%
Government contribution				7,856	24,550	15%
ESA contribution				39,280	122,750	75%
				52,373	163,667	

Notes:
(1) District staff pay half the cost of their motorbike, financed by government.
(2) Community contributes 500 cedis/person for new systems and 200 for rehabilitated systems. Also, in-kind labor equals 25% of hand dug wells and 7.5% of piped systems.
(3) Government pays all operational costs.
(4) ESAs finance the balance of construction costs.
(2) Exchange rate (Cedis/US$) 320

ORGANIZATIONAL CHART
GWSC RURAL WATER SUPPLY AND SANITATION DIVISION



INSTITUTIONAL RESPONSIBILITIES

Community

- Apply to district for obtaining National RWS grant and planning assistance.
- Plan their water supply, deciding on type of system and its management.
- Form a water committee or include its functions in an existing group.
- Meet pre-project contractual obligations (organizational and financial).
- Meet construction agreements (e.g. site preparation and labor).
- Participate in health education training
- Improve environmental sanitation, including construction of household and community latrines if affordable.

For handpumps:

- Manage maintenance of handpump. (Collect and save water fund, keep records of accounts and decisions.)
- Repair pump or hire private mechanic.

For small piped systems:

- Contract GWSC Urban Division to operate, maintain and/or collect revenues.
- Manage functions not contracted to GWSC.

District

Planning:

- Plan and monitor district RWS/S Program.
- Prepare annual workplan and budget for RWS and update priority listings for new facilities to be adopted by the assembly.
- Keep records of service coverage.

Community Development:

- Assist community with needs assessment.
- Assist community to plan its water supply system.
- Assist with formation of water committees.
- Train water committees.
- Collect and save WS Fund, record keeping and pump repair.
- Promote good health practices and latrines.
- Provide continuing support to communities.

Technical:

- Provide information to community on technology choice and design.
- Train private mechanics.
- Coordinate training of contractors (wells, latrines, ...).

Sanitation:

- Coordinate training of latrine artisans.
- Train community health workers.

Regional

Manager:
- Plan and supervise Regional RWS/S program.
- Coordinate district and regional authorities.
- Manage personnel.
- Approve disbursal and contract payments.

Planning Coordinator:
- Keep inventory of communities and RWS/S facilities.
- Track program activities and progress.
- Prepare annual program and budget.
- Monitor and evaluate progress and condition of systems.
- Package contracts for wells

Administrative Officer:
- Keep accounts
- Prepare bidding documents and contracts.
- Disburse operational expenditures.

Community Development:
- Supervise and train extension agents.
- Assist extension agents to introduce project to communities and resolve problems.
- Adapt training materials for use locally.

Sanitation specialist:
- Train artisans/contractors in latrine construction. Plan and implement latrine promotion campaign.

Hydrogeologist:
- Site wells
- Inspect construction.
- Train local contractors to construct hand dug wells.
- Prepare bidding documents inspect well construction and approve payments to contractors.

Mechanic:
- Train private mechanics and extension agents.
- Inspect new water supply facilities.

National

Planning:

- Plan National RWS/S program.
- Prepare annual program and budget.
- Monitor and evaluate progress and condition of systems.
- Update national RWS/S plan and policies periodically.
- Set national standards, specifications and guidelines.
- Conduct limited applied research.
- Maintain water resources and water supply facilities data base.
- Design, prepare contract documents and inspect small piped water supply systems.

Management and administration:

- Supervise National RWS/S program.
- Train RWS/S Division personnel.
- Coordinate with other ministries.
- Coordinate with NGOs and ESAs.
- Mobilize national and international funding and support.
- Manage budgets, accounts and disbursals.
- Manage personnel.

Private Sector

- Construct hand dug, hand drilled and machine drilled wells with community assistance.

- Construct latrines with household assistance.
- Distribute pumps and spare parts.
- Repair manual and mechanized pumps.
- Operate and/or maintain small piped systems if communities so choose.
- Rehabilitate boreholes.
- Manufacture handpumps and spare parts

RURAL WATER SUPPLY TECHNOLOGY CHOICE

1. The technology chosen should give the community the highest service level that it is willing and able to pay for, will benefit from and has the. institutional capacity to sustain. The decision must be the community' s since they must assume responsibility for the operation and maintenance of its system. Information similar to that presented here should be available to community members so that they can make an informed decision.

2. In order to compare the costs of different pumping technologies, a set of base conditions for a "prototype community" have been defined. Individual parameters are then varied to observe their effect on the cost of water. Table 1 lists the base conditions and Table 2 gives a breakdown of total capital costs by major component for the main water pumping technologies (manual, electric, diesel, solar, and wind).

3. Service Level The community perception of an improved water supply will largely be determined by the service level provided. This perception will be critical in convincing the community to pay for the costs of the system. The service level provided by a new or improved water supply involves a combination of factors, including the quantity and quality of the water, the amount of time needed to collect water and the reliability of the system. If water quality and reliability are similar for different systems, then service levels fall into two groups, point sources from which households must carry water home and yard taps which deliver water to the home. Handpumps and standpipes provide roughly the same level of service while yard tap systems potentially offer better service if they are reliable. As shown in Figure 1 the cost of water increases substantially when the service level shifts from point sources (about $4 per person per year) to yard taps (about $12 per person per year). The increased cost Of yard taps is due to higher water consumption and piping costs.

4. Type of Pump Electric pumps are a proven technology that can reliably provide large quantities of water. Whenever a community is served by an electric grid that is not subject to frequent power outages, electric pumps are likely to be the technology of choice.

5. Diesel pumps, usually consisting of a diesel/generator set with electrical submersible pump, are more problematic because of their complexity and cost. For lifts of less than 7 meters, surface mounted gas or diesel powered pumps are a good alternative, and for higher lifts jet pumps with typical capacities of m3 at lOm and m3 at 20m can be used in small communities. In any case communities may encounter difficulty in keeping fuel on hand, when it can be diverted to other buyers or delivery trucks either breakdown or are prevented from reaching their delivery points because of bad road conditions. In the prototype community diesel at 50 cents per liter results in a fuel cost of 35 cents per person per year, which is about 15% of O&M costs and 5% of total costs. Thus it is a relatively unimportant factor.

6. Manual, solar and wind pumps have an advantage over diesel in that they are not dependent on external fuel supplies. Solar energy is potentially well suited to equatorial countries because of the high and consistent solar radiation they receive throughout the year. As the cost of photovoltaic panels decreases and as confidence in their reliability increases, solar pumps will play an increasingly important role in rural water supply. Wind pumps, however, will continue to have limited application because winds of sufficient speed and,reliability to make them economical occur in few locations. Handpumps provide basic

service to households for pumping lifts of up to about 45 meters. Above this, manual pumps require more energy than people can comfortably generate.

7. The curves in Figure 2 show the annualized pumping cost of water ($/capita/year) for manual, electric, diesel, solar, and wind pumps as a function of community population. Because handpumps have a limited capacity (about 5 m3/day), additional wells must be added to keep the service level constant, in this case at 250 persons per handpump, so on a per capita basis the cost of manual pumping does not vary with population. Other types of pumps are not limited by the rate of energy a person can produce and so require only a single well (assuming well capacity is sufficient) and exhibit significant economies of scale. Diesel pumps have the greatest economies of scale because the engine is expensive and its price varies little with capacity in the output ranges required for a small community water supply. Wind and solar pumps on the other hand can be sized in proportion to the power that is required so exhibit somewhat less economies of scale.

8. As a result, at 20 LPCD water consumption and a 20 meter pumping lift, handpumps provide water at least cost for populations under about 1000, solar do so between 1000 and 2500, while diesel do so above 2500. Even for larger communities there is little difference in cost between solar and diesel pumps if water consumption is low. However, as water consumption increases, as for example with yard taps, diesel pumps will become significantly less expensive. Electric pumps provide water at least cost in all but the smallest communities if no extension of the electricity grid is required.

9. Well Cost Well cost can vary from as little as $200 per well in Bangladesh, where artisans use the sludger method to drill as deep as 50 meters in alluvial soils, to more than $15,000 in some places in West Africa. Well costs are largely dependent on external factors such as construction management efficiency, type of well drilling rig, competition between drillers, number of wells constructed per year, promptness of payment and amount of expatriate involvement. Where these factors are favorable such as in India well costs in the range of $2,000 to $3,000 are possible. Pricing under $5,000 is a realistic target in Africa. Efforts must be made to reduce the costs of wells, as coverage could be increased by a factor of two or three for the same investment.

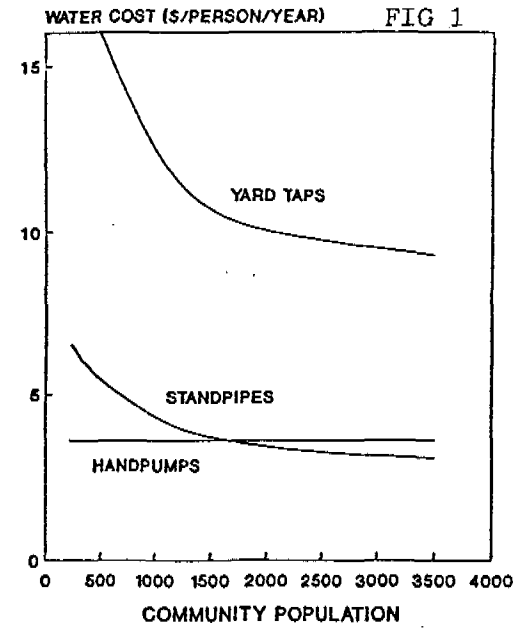
10. Potential well yields can also affect the choice of pumping technology. This is particularly true in the basement rocks of Africa and India where it can be difficult to site wells even to draw the minimum acceptable flow for a handpump (about 12 liters per minute), and very large drawdowns can be expected if motorized pumps are used. As a result, the cost of a well suitable for motorized pumping can increase markedly because wells may have to be deeper and the number of successful boreholes will decrease. In such cases use of trained hydrogeologists in well siting can increase success rates and lower the average cost per successful well.

Technology Choice Based on Cost

11. Well cost, population, water use and pumping lift each affect the price of water. The combined impact of these on system choice, based only on price, is shown in Figures 3 and 4 where low water use, pumping lifts and well costs favor handpumps and high water use, pumping lifts and well costs favor diesel pumps. Between these solar pumps have a niche in

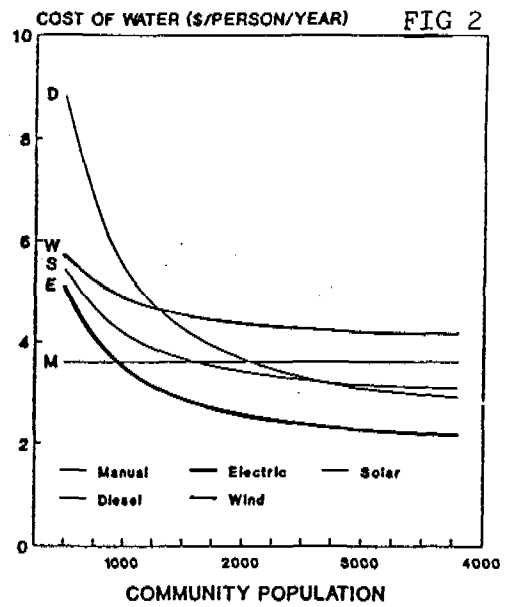
communities between 1,000 and 2,500 persons, although as exhibited in Figure 3, solar pumps cost very little more than diesel pumps in larger communities as long as water consumption remains at about the 20 LPCD level typical of standpipes. If grid power is available in the community, electric pumps can provide water at least cost in most communities, particularly if water consumption is high. It should be remembered, however, that whatever technology is employed, spare parts must be available and local mechanics must be capable of making all repairs or at least replacing individual components.

SERVICE LEVEL



Pumping Lift 20 meters

TECHNOLOGY CHOICE



Water Use 20 lpcd
Pumping Lift 20 meters

BASE CONDITIONS FOR COMMUNITY WATER SUPPLY SYSTEM

Demographic Characteristics	
Total population	1000
Number of households	125
Housing density (households/hectare)	15
Economic Conditions	
Discount rate (%)	10
Useful life mech. equip.	10
Useful life non-mech. equip.	20
Annual O&M/mech. eq. (% cap cost)	10
Annual O&M/non-mech. eq. (% cap cost)	1
Electric Power Cost ($/KWHR)	0.10
Diesel fuel Cost ($/liter)	0.50
Solar Insulation (KWHR/M^2/Day)	5
Average Wind Speed (meters/second)	3

Water Supply System	HPs	SPs	YTs
Distance to new source (m)	75	75	-
Collection time (min/trip)	20	5	-
Water use (liters/cap/day)	20	20	75
Number of wells	4	1	1
Number of water points	4	4	125
Cost per well($)	5000	5000	5000
Pumping & storage lift (m)	20	30	30
Storage volume (V/Q)	-	1	1

TABLE 2

THE COST OF WATER SUPPLY SYSTEMS FOR THE PROTOTYPE COMMUNITY

CAPITAL COST ($)

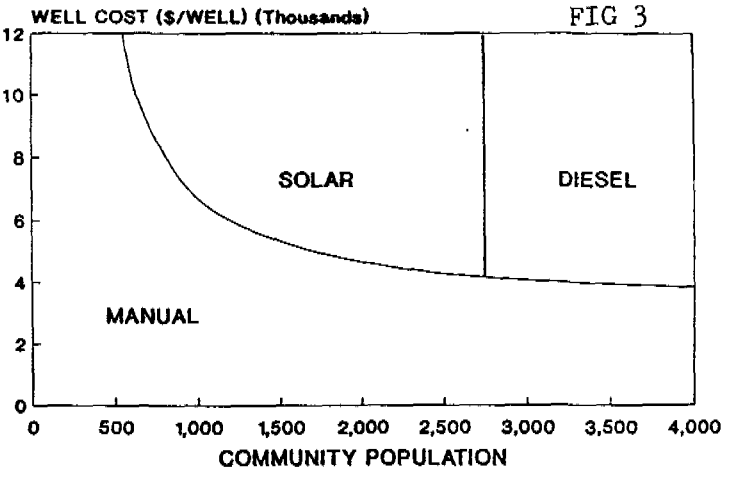
	Point Sources					Yard Taps	
Component	Manual	Elect	Diesel	Solar	Wind	Diesel	Solar
Wells	20,000	5,000	5,000	5,000	5,000	5,000	5,000
Pump	3,600	3,400	8,400	11,000	12,500	9,500	36,000
Storage	-	4,500	4,500	4,500	4,500	8,700	8,700
Piping	-	6,500	6,500	6,500	6,500	27,000	27,000
Total	23,600	19,400	24,400	29,000	28,500	50,200	76,000

ANNUALIZED PER CAPITA COST ($/capita/year)

Component	Manual	Elect	Diesel	Solar	Wind	Diesel	Solar
Capital	2.95	2.50	3.35	3.40	4.00	7.40	10.25
O&M	0.65	0.80	2.10	0.75	0.85	3.15	2.45
Elec/Dsl	-	0.15	0.35	-	-	1.30	-
Total	3.60	3.45	5.80	4.15	4.85	11.85	12.70

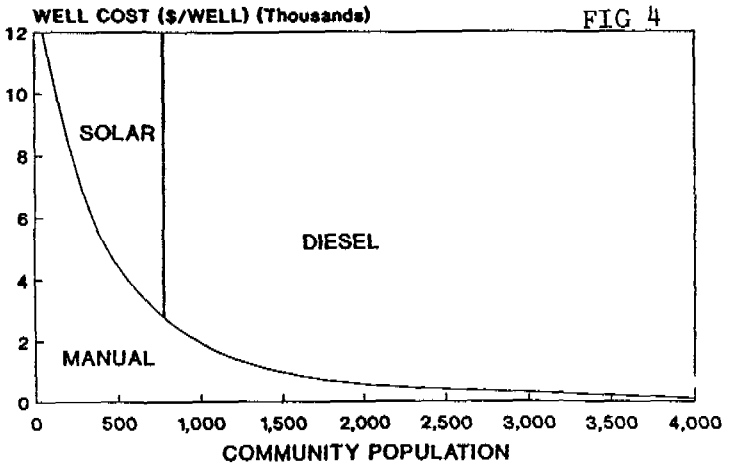
TECHNOLOGY CHOICE

FIG 3



Water Use 20 lpcd
Pumping Lift 20 meters

FIG 4



Water Use 40 lpcd
Pumping Lift 40 meters

COMPARISON OF HANDPUMPS CURRENTLY USED IN GHANA

1. A brief description of the important criteria by which a handpump should be evaluated are given below. Each pump used in Ghana is then rated on the basis of these criteria with a brief note stating the reason for the rating.

2. International Specification

There are several benefits to using pumps that have international specifications and are manufactuered by a number of manufacturers in different countries, particularly for user communities. First of all it ensures that spare parts will continue to be available and second the resulting competition between manufacturers prevents a sole supplier from charging excessive prices.

3. Ease of Installation

The concrete platform is more or less the same for all pumps; in West Africa pumps are fitted to the baseplate. The criteria serves to assess differences in installing the pump on the flange. Pumps that can be installed quickly with a minimum of tools are advantageous. The need for lifting tackle and heavy equipment make installation more difficult and take it outside the reach of small private contractors.

4. Ease of Repair

The simplicity of making the most common repairs (replacing seals, fulcrum bearings, handle bearings, pistons, and footvalves) affects the ease of repair. A small number of low cost tools enables village mechanics or communities to perform the necessary repairs themselves. Heavy and complex tooling makes motorized central maintenance teams necessary. This affects the cost of repairs and the time that the pump is out of service.

5. VLOM Potential

The pump has to be suitable for community management of operation and maintenance. VLOM means:

- The community accepts responsibility for the pump.
- The community can make repairs themselves or hire local private mechanic.
- The community finances repairs and eventually replacement of the pump.
- The pump can be manufactured in the country to ensure availability of spares.
- The pump is robust and reliable under field conditions.

6. Reliability

Reliability of mechanical equipment is commonly measured in "mean time before failure". In rural water supply, however, "mean down time" is equally as important. This means that a pump that must be repaired by a central maintenance team is likely to be out of service for some time before the team
can be mobilized, whereas a pump that can be repaired at the village level might be back in service within days.

7. Corrosion Resistance

The water quality in Ghana makes it imperative to use only fully corrosion resistent pumps. All rural water supply projects using India Mark II or Moyno pumps are faced with serious corrosion problems, rising mains and rods have to be frequently replaced and corrosion of down hole components results in unacceptable drinking water quality because of the high iron content.

8. Suitability for Local Manufacture

Pumps that require less sophisticated production processes and have generally bigger engineering tolerances are more suitable for local production.

9. Price of the Pump and Spare Parts

The price of the pump and especially its spare parts should be as low as possible. This will allow communities to raise enough money to purchase the necessary spares without dificulty.

TABLE 1 COMPARISON OF HANDPUMPS

CRITERIA / PUMP	INDIA MARK II	GHANA MODIFIED MARK II	AFRID EV	NIRA AF85	UST
International Specifications	+++	++	+++	++	-
Ease of Installation	+	+	++	+++	+
Ease of Repair	-	-	+++	+++	-
VLOM	-	-	+++	+++	+
Reliability	+	++	++	+++	-
Corrosion Resistance	-	+++	+++	+++	-
Pumping Lift	+++	+++	+++	+	+
Suitability for local manufacture	++	+	+	++	++ +
Cost of Pump and Spares	+++	-	+	+	++

Key: (-) = inadequate; (+) = adequate; (++) = good; (+++) = very good
Ratings are based on experience in Ghana as well as other countries.

TABLE 2 COMPARISON OF HANDPUMPS

CRITERIA	INDIA MARK II	GHANA MODIFIED MKII	AFRIDEV	NIRA AF85	UST
International Specifications	Pump produced in many countries to Indian Standards. Specifications in public domain.	Pump available to local manufacturers.	Pump specified through International Standard. Specs. in public domain. Produced in many countries.	Pump designed by private company, but available to local manufacturers. Made in Finland and Tanzania.	Indigenous design. Not extensively tested.
Ease of Installation	Needs 24 different tools for repairs, 10 of which are special ones.	Large number of tools required for repair, many of which are special.	8 tools are needed for installation. Need to make solvent cement joints in the field could be problem.	Pump can be installed with few tools. All components are lightweight.	Needs solvent cementing in field and heat forming of PVC pipe to connect rising main and pumphead.
Ease of Repair	Community cannot repair pump. Tripod needed, rising main and rod disassembly needed to withdraw cylinder parts.	Communities cannot repair pump. Tripod needed, rising main and rod disassembly needed to withdraw cylinder parts.	All routine repairs can be done by community with a spanner and a fishing tool.	All repairs can be done by community with 3 simple tools.	Repairs can only be made by trained mechanics. The rising main needs to be cut to repair the footvalve.
VLOM	Community mechanics cannot repair pump. Special tools are not readily available.	Community mechanics cannot repair pump. Tools not readily available.	Community mechanic can maintain pump with minimum support from area mechanic.	Community mechanic can maintain pump with minimum help from area mechanic.	Pump not suited for community maintenance due to non-extractable footvalve.
Reliability	Pump is reliable with few breakdowns. Can have long down times because of dependency on central crews.	Pump is reliable with few breakdowns. Can have long down times because of dependency on central crews or area mechanics.	Few breakdowns, which can be repaired by community mechanic.	Pump has few breakdowns and can be quickly repaired by community mechanic.	Few pumps installed break down often, weak point is footvalve which cannot be extracted.
Corrosion Resistance	Galvanized rising mains and piston rods are not corrosion resistant in West Africa groundwaters.	The use of stainless steel down hole components make it suitable for use in corrosive water.	All below ground parts are corrosion resistant.	All below ground parts are highly corrosion resistant.	Uses painted mild steel piston rod which is not corrosion resistant.
Pumping Lift	Pump can be used up to 45m.	Pump can be used up to 45m.	Pump can be used up to 45m.	Pumping lift is a maximum of 15m. Application of pump is to shallow wells.	Designed pumping lift is 30m. Rising main pumphead link is too weak for greater depths.
Suitability for local manufacture	Pump is manufactured in several Asian and African countries. High investment for tooling.	High working capital needed. Pump head can be made locally, rising main and rods need to be imported.	Pumphead can be manufactured locally, plastic components need special skill and extensive tooling.	The pumphead can be easily produced. If local HDPE pipes are available, whole pump can be made locally.	Pump can be manufactured locally.
Cost of Pump and Spares	Prices of pump and spares are low due to good competition.	Use of stainless steel makes pump most expensive of group under review.	Initial pump cost is high, spares are inexpensive and operational costs low.	Initial cost of pump is moderate. Spares are inexpensive.	Initial cost of pump is low. Need for frequent repairs make operational costs high.
Price, US$ (1) Offshore mfg. Local mfg.	 $250 $350	 - $1,300	 $750 $580	 $600 $320	 - $250

(1) Pump prices do not include markups for local distributors or profit for local manufacturers.