BASIC DESIGN STUDY REPORT

ON
THE PROJECT
FOR
THE RURAL WATER SUPPLY DEVELOPMENT
PHASE-III
IN
THE REPUBLIC OF ZAMBIA

APRIL, 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of the Republic of Zambia, the Government of Japan has decided to conduct a Basic Design Study on the Project for The Rural Water Supply Development Phase III and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the Republic of Zambia a study team headed by Mr. Osamu Ikeda, Deputy Director for International Cooperation, International Affairs Division, Minister's Secretariat, Ministry of Health and Welfare from November 11 to December 20, 1990.

The team exchanged views with the officials concerned of the Government of Zambia and conducted a field survey in the Project area. After the team returned to Japan, further studies were made. Then, a mission was sent to the Republic of Zambia in order to discuss the draft report and the present report was prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

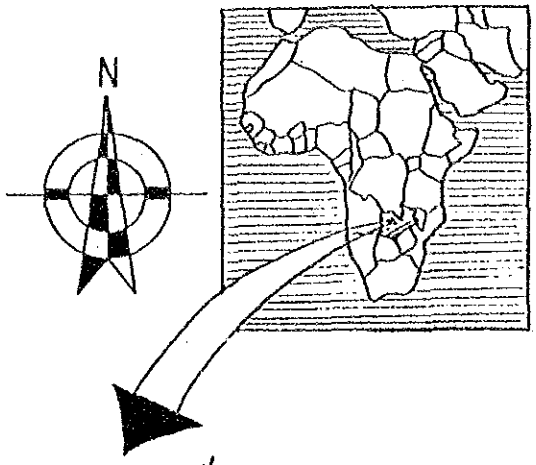
I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Zambia for the close cooperation they extended to the team.

April, 1991

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

LOCATION MAP OF PROJECT AREA



REPUBLIC OF ZAMBIA

TANZANIA

NORTHERN

ZAIRE

SOLWEZI

NORTH WESTERN

MALAWI

MOZANBIQUE

WESTERN

0 200 400 km

ANGOLA

NAMIBIA

ZINBABWE

PROJECT AREA

COPPERBELT

CENTRAL

LUSAKA

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LIST OF ABBREVIATIONS

BD	Building Department
CSO	Central Statistical Office
DD	Detailed Design
DWA	Department of Water Affairs
E/N	Exchange of Notes
FNDP	Fourth National Development Plan
GNP	Gross National Product
HI	Health Inspectorate
IDWSSD	International Drinking Water Supply and Sanitation Decade
JICA	Japan International Cooperation Agency
KFW	Kreditanstalt für Wiederaufbau
MAWD	Ministry of Agriculture and Water Development
MOD	Ministry of Decentralization
MOH	Ministry of Health
MWLNR	Ministry of Water, Land and Natural Resources
MWS	Ministry of Works and Supply
NAC	National Action Committee

NCDP	National Commission for Development Planning
RAs	Rural Area Water Supplies
RTs	Rural Townships Water Supplies
SUTs	Small Urban Townships Water Supplies
WDS	Water and Drainage Section

SUMMARY

SUMMARY

The Republic of Zambia is located in the south of Central Africa, covers an area of 752,614 km², and has an estimated population of about 7.8 million in 1989. The Zambian society is made up of as many as 73 tribal groups featuring diverse languages and traditions. Headed by President K. D. Kaunda since independence from a British protectorate in October 1964, it has been struggling to promote the unity and economic development of the country. The world's leading copper producer, having in addition massive export-oriented surplus of hydroelectric power, Zambia is viewed as a country endowed with affluent natural resources. Since the country's economy was hard hit by the slump of world copper prices which ensued during the 1970s, the Government has been striving to diversify the economic base away from copper export and to boost the agricultural production under the successive National Development Plans. Meanwhile, the rural water supply scheme has been promoted to improve the rural life and to encourage the settlement of the rural population for enhancing agricultural productivity and boosting food production through the supply of clean and safe drinking water. A long-range target under the ongoing Fourth National Development Plan (1989-1993) is to fulfil the supply of safe drinking water to the whole nation by the year 2000, and in line with the Plan of Action under the UN's International Drinking Water and Sanitation Decade, the Government is presently tackling its plan to extend the coverage of public water supplies to a full 100 percent for urban townships and to a level of 50 percent for rural areas by the year 1991.

The Department of Water Affairs (DWA) in the Ministry of Water, Land and Natural Resources (MWLNR) is an official institution directly concerned with the implementation of rural water supply schemes. Based upon Water Act 1964, it has mainly been in charge of investigation, planning, execution and management of the nationwide Rural Area Water Supplies (RAs) as well as administrative and technical support for water supplies for Small Urban Townships (SUTs) and Rural Townships (RTs). Its activities further involve a broad range of technical and engineering assistance at a national level to

the Government's planning for the development and conservation of national water resources including both groundwater and surface water.

In the past, Japan's assistance in this sector was extended to Zambia in two phases in 1985 and 1988 under the title of Groundwater Development Project in the Republic of Zambia phase I and II, in response to the requests of the Zambian Government for improving the deteriorated water environment of Southern Province after three consecutive years of drought since 1981. The successful performance of those projects was highly appreciated by the Government of Zambia, and has led to a renewed request for grant aid presented in 1990 to the Government of Japan for the purpose of installing boreholes with water facilities at two hundred sites in the three Provinces of Lusaka, Central and Copperbelt, where the coverage of water service still remains at an extremely low level of 24 percent despite their overriding position in the Government's policy for agricultural development.

The Government of Japan has responded to this request with a decision to conduct a basic design study, based upon which Japan International Cooperation Agency (JICA) sent to the Republic of Zambia a basic design study team from November 11 to December 20, 1990. The study team consulted on the Project with the officials concerned of the Government of Zambia and carried out the field survey concerning water practice, groundwater potential, equipment for borehole drilling, etc., in the Project area. This report was prepared after the team returned to Tokyo, based upon the results of the survey and their analysis at home, and has been completed through the process of the explanation of the draft report to the Government of Zambia from March 11 to 21, 1991.

The coverage of nationwide public water supplies was augmented from 46 percent to 58 percent during the period from 1980 to 1985, and yet that for rural areas is still hovering around 41 percent. Therefore, the DWA is now striving to improve that rate by means of deploying two drill rigs to the respective provinces for installing boreholes which hardly run dry even during dry seasons. At present, however, there are no workable machines available for the seven districts of the three provinces under this project, where groundwater development has been limited and, despite their proximity to large cities, the coverage of rural supplies remains at a remarkably low

24 percent in comparison to the national level of 41 percent on average. During the dry seasons, which make a sharp contrast with the wet ones in this area, a greater part of hand dug wells drain up, leaving the rural people deprived of any immediate sources of water. Furthermore, the economic crunch in the wake of the Gulf Crisis (as is illustrated by a soaring fuel cost which has jumped to more than five times that of a prewar price) has squeezed the DWA's program to execute its own rural water supplies .

In view of this situation, this Project is aimed at urgently enhancing the coverage of rural water supplies and improving the degenerated water environment through the construction of new boreholes at 200 sites and the rehabilitation of existing ones at 100 sites. It is also intended to provide technology transfer through the execution of the Project to counterpart staffs of the DWA regarding hydrogeological survey, drilling work, and operation and maintenance of water facilities, so that they could promote their own rural water supply program after the completion of the Project, employing the procured equipment and materials. The Project further encourages the inhabitants to directly participate in the operation and maintenance of the completed facilities and provides them training to improve their perception of health and sanitation.

The Project benefits the rural population of about 119,000 through the construction of 200 boreholes and about 44,000 through the rehabilitation of 100 existing ones (163,000 in total), roughly corresponding to about 19 percent of 851,000 as a whole in the seven districts of the three provinces. Although the DWA targets to serve 30 liters per capita per day as its standard for rural supplies, the Project plans to swiftly distribute one single borehole to each of the Project sites so that it can assure inhabitants of at least an essential supply of 5 liters per capita per day even during the hardest seasons of the year, thereby relieving the acute shortage of drinking water sweeping the whole area like a scourge. To achieve that purpose, the Project is operated over a broad area of about 20 percent of the whole Zambia (roughly corresponding to 40 percent of Japan), carrying out hydrogeological survey, drilling work and installation of water facilities. Such a type of operation necessitates a base station for the storage and maintenance of the equipment and materials procured under the Project, preferably in Kabwe City, which is suitably located for the efficient mobilization and operation of task

forces. Yet, since Kabwe City at present has no appropriate facilities for such purpose, it is necessary to plan to install a depot there under this Project.

The outline of the Project is summarized in the following four points:

1.	Construction of Boreholes (200 sites)
2.	Rehabilitation Works of Existing Boreholes (100 sites)
3.	Procurement of Equipment and Materials for Groundwater Development: 1) Drilling rigs, tools and accessories 2) Materials for construction of boreholes 3) Survey equipment 4) Hand pumps 5) Vehicles supporting operations 6) Equipment/tools for repair and maintenance of supplied equipment, with spare parts
4.	Installation of a depot for storage and sustained maintenance of supplied equipment

The Project sites, and the numbers of borehole construction and rehabilitation are listed as follows:

	Province	District	Construction of boreholes	Rehabilitation of boreholes
1.	Lusaka	Lusaka Rural	45 sites	70 sites
		Luangwa	10 sites	10 sites
2.	Central	Kabwe Rural	30 sites	To be handled by Germany Project
		Mkushi	30 sites	
		Mumbwa	20 sites	
		Serenje	15 sites	
3.	Copperbelt	Ndola Rural	50 sites	20 sites
Total	3 Provinces	7 Districts	200 sites	100 sites

Regarding the implementation schedule, the most appropriate framework is judged to split the whole work into five (5) stages, taking into account the period for the procurement of the equipment and materials and difficulty with inland transportation arising out of Zambia's landlocked position as well as constraints in filed work during wet seasons.

In such a prolonged implementation schedule, the technical and economic evaluation of Project performance would become indispensable; preferably at the end of the third stage. The fourth stage of the Project should be resumed in accordance with a revised program likely to result from such a review, which studies variation in the Project cost due to price escalation as well as feasibility of further continuation of the Project and the style of assistance. In such division of the Project into the stages, due consideration should be paid to achieve the self-completeness of the work in each stage and possible arrangements must be made to shorten the actual working periods, since the rainy season continue for five to six months in a year, heavily straining the execution of field works.

STAGE	DESCRIPTION OF MAIN WORKS
1st Stage	1) Procurement of equipment and materials for groundwater development 2) Construction of boreholes with water facilities (20 sites) 3) Rehabilitation of existing boreholes (1 site) 4) Construction of a depot for storage and maintenance of equipment/materials
2nd Stage	1) Construction of boreholes with water facilities (59 sites) 2) Rehabilitation of existing boreholes (55 sites) 3) Procurement of equipment and materials for construction/rehabilitation of boreholes 4) Construction of a depot (Continued from the 1st stage)
3rd Stage	1) Construction of boreholes with water facilities (40 sites) 2) Rehabilitation of existing boreholes (37 sites) 3) Procurement equipment and materials for operation & maintenance of the Project
Intermediate Evaluation	1) Review of the framework and progress of the Project as well as the style of assistance 2) Review of the Project cost
4th Stage	1) Construction of boreholes with water facilities (40 sites) 2) Rehabilitation of existing boreholes (7 sites) 3) Procurement equipment and materials for operation & maintenance of the Project
5th Stage	1) Construction of boreholes with water facilities (41 sites) 2) Procurement of equipment and materials for operation & maintenance of the Project

The direct benefits to be derived from the execution of this Project are that rural inhabitants in the Republic of Zambia can receive stable and sustained service of safe drinking water, leading to the improvement of health in rural areas. This situation is expected to be reflected in a sharp decrease in the incidence of a variety of waterborne and intestinal diseases, contributing vastly to public health improvement and upgrading the quality of rural life. On the other hand, the installation of water supply facilities within the premises of the respective communities can have an effect to remarkably shorten the distance between homes and water sources, thereby alleviating the painstaking labor of women and children for bringing water home. They can use their energy for other activities, possibly agricultural production. All in all, the improvement of rural infrastructure created by the implementation of the Project will eventually lead to the settlement and rise of the agricultural labor force in the region, prompting the development of the regional agricultural sector. It could make an impressive contribution to one of the major goals of the Fourth National Development Plan (1989-1993).

The population benefitted by the Project is expected to reach about 163,000, about 19 percent of the total estimated population of 851,000 in the Project area in 1989. Among the total beneficiaries, the population newly served through the construction of 200 boreholes is about 119,000 (roughly 14 percent of the whole population in the area), raising the present service level of 24 percent to a remarkably improved rate of 38 percent. Furthermore, technology transfer to the DWA through the Project implementation will strengthen expertise in groundwater resources development and will bolster the execution of its own borehole construction program. This technical contribution will have no small effect.

In view of these benefits and effects, this Project is concluded to be feasible as a grant aid project extended by the Government of Japan to the Government of the Republic of Zambia.

CHAPTER I

INTRODUCTION

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INTRODUCTION

The Republic of Zambia is located in the middle south of the African Continent, occupying an area of 752,614 km² with an estimated population of 7,800,000 (1989). Due to its longstanding heavy dependence upon copper industry, the country's economy has tended to be crucially affected by the fluctuation of the global economy, and the Government has been concentrating its efforts on the diversification of the industry, particularly the boost of agricultural production to overcome the vulnerability of the economic sturucture. One of the major policies of the Government for that purpose has been to encourage the settlement of the rural population through the improvement and upgrading of rural life by means of expanded service of clean and safe drinking water across the country's rural areas. The rural water supply scheme, therefore, is given the highest priority among the Government's strategies to attain the goals of the ongoing Fourth National Development Plan (1989 - 1993) following the Third one (1979 - 1983), in line with the Plan of Action for the UN's International Drinking Water Supply and Sanitation Decade (IDWSSD, 1981 - 1990), and has been promoted with a target of covering 50 percent of the country's rural population by the year 1991.

In Southern Province of Zambia where rainfall usually is at the lowest level of 700 mm per anum in the country, the drought having ensued for the three consecutive years since 1981 had drained up a greater part of water wells and surface waters. The Government of Zambia, therefore, sent the Government of Japan a request for grant aid for its plan of Groundwater Development Project in Southern Province comprising the construction of boreholes. In response to this request, the Government of Japan dispatched a basic design study team in 1985, and implemented a grant aid project. Following the successful completion of this project, Zambia officially asked

for continued assistance, and was responded to by the Government of Japan, as it again sent a basic design study team in 1988, eventually resulting in the grant aid project of Phase II in this sector for the construction of 120 boreholes and rehabilitation of 100 existing boreholes in the same province. Through the successful results of those two grant aid projects, the coverage of rural water service in Southern Province has been augmented from 32 percent to 41 percent.

The technical soundness and swiftness of implementation displayed in those two projects were acknowledged by the Zambian side, and has prompted its renewed request for the project for the Rural Water Supply Development Phase III mainly intended for the construction of boreholes at 200 sites and rehabilitation of 100 existing boreholes in the three provinces of Lusaka, Central and Copperbelt. In the rural areas of those three provinces live 850,000 people (roughly 22 percent of the country's entire rural population), of which only 204,000 (corresponding to about 24 percent) are now being served with drinking water through 1,270 boreholes, the remaining of 76 percent having been left without any stable water sources. A degenerated water environment is widespread there, with the great majority of inhabitants being forced to take water from contaminated dug wells or fetch water from afar, occasionally from streams 5 or 7 km away.

In view of these circumstances, the Government of Japan decided to carry out the basic design study for the project under the current request from the Government of Zambia, and Japan International Cooperation Agency (JICA) sent a basic design study team headed by Mr. Osamu Ikeda, Deputy Director for International Cooperation, International Affairs Division, Minister's Secretariat, Ministry of Health and Welfare from November 11 to December 20, 1990. Through the consultation with the officials of the Government of Zambia as well as the field survey on the background, objectives, planned details and anticipated effects of the request, the study team has been able to confirm the framework of the Project feasible for grant aid. On November 23, 1990, the minutes on basic agreement for the Project were signed by the representatives from the Ministry of Water, Land and Natural Resources, serving as the executing agency, the National Commission for Development Planning, serving as the Government agency receiving foreign aid, and the basic design study team.

This report on the basic design study for the Project has been completed, based upon the outcome of the field survey and its analysis at home, after the explanation of the draft report to the Government of Zambia from March 11 to 21, 1991 by the mission headed by Mr. Toru Maeda, Grant Aid Division, Economic Assistance Department, Ministry of Foreign Affairs. It describes the feasibility, framework, details of works and procurement, implementation schedule, operation and maintenance program of the Project, along with the recommendations. A collection of data such as the minutes, itinerary of the survey, members of the study team, list of the interviewees, etc. is referred to at the end of this report.

CHAPTER II

BACKGROUND OF THE PROJECT

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BACKGROUND OF THE PROJECT

2.1 OVERVIEW OF THE REPUBLIC OF ZAMBIA

The Republic of Zambia is located in the middle south of the African Continent in the southern hemisphere. It covers an area of 752,614 km², about twice that of Japan, and is divided into nine provinces comprised of fifty-seven subdivisions of districts. The nation derived its name from the Zambezi River flowing through the northwestern part of this typically inland country with no seacoasts, bordering with seven countries of Zaire, Tanzania, Malawi, Mozambique, Zimbabwe, Namibia and Angola. Most of its land is comprised of high plateau ranging from 1,000 m to 1,300 m in elevation, where a plateau-savanna climate is predominant, with rain of a comparatively sparse 700 mm annually in the south and an increasing rate of 1,500 mm to the north. Southern and Central Provinces have endured dry spells during the past five years. The country's capital Lusaka, with an estimated population of 800,000 in 1989, lies on a plateau of 1,300 m in height with average temperatures ranging from 21.1° C in January to 16.1° C in July and a mean annual rainfall of 836 mm.

Zambian society is made up of as many as 73 tribal groups featuring different languages, traditions, etc., and the Government aims to achieve the unity of the nation through integration of those tribes under the motto "One Zambia One Nation". Headed by President K.D. Kaunda since the independence in 1964, it has embraced socialism based upon humanism as the nation's philosophy and has promoted economic development and national unity. The estimated total population of the Republic in 1989 was 7,800,000, with urban residents accounting for a larger portion of 50.2 percent, many of them having migrated into the country's ten largest cities in particular and hiked the respective populations there to a level intensively straining their

infrastructures. On the other hand, the rural population is the remaining 49.8 percent, most of them living in small rural communities scattered across the country. According to the statistics in 1989, the average population density was 10.4 persons per square kilometer, with a wide range of regional diversity caused by specific features of localities such as industrialization, as illustrated by the figures of 3.2 persons per square kilometer in Northeastern Province and 54.1 persons in Copperbelt Province. The national population has steadily been increasing by an average rate of 3.3 percent per annum during 1980 and 1990, while the infant mortality rate is reportedly 105 persons among 1,000 persons. In addition, the country has constantly been hit by epidemics, particularly waterborne diseases such as cholera, which took over 500 victims out of more than 5,000 patients during 1990 - 1991.

As the world's biggest producer of copper and cobalt, Zambia has heavily been dependent for its economy upon the mining industry, mostly copper which accounts for nearly 92 percent of the country's exports. Acutely aware of the vulnerable structure of their economy, which was hard hit with the slowdown of the global economy in the past, the Government has been striving to diversify the nation's industry into two sectors, mining and agriculture, these twenty years. The gross national product (GNP) in 1989 was 42,283 million Kwacha (3,042 million U.S. dollars), which brought the figure of GNP per head to 390 U.S. dollars. The foreign trade in 1989 brought export earnings in 11,915 million Kwacha (857 million U.S. dollars) against imports in 10,818 million Kwacha(778 million U.S. dollars), thus producing a balance of trade earnings of 1,097 million Kwacha(79 million U.S. dollars). The overall account balance, however, has continuously been registering the deficit because of non-trade and capital balance deficits stemming from mining's heavy dependence on expatriates, inflated transport costs due to its standing as a landlocked country, etc. Japan, as a trading partner, has been highly contributing to the Zambian economy , as indicated in the 1988 statistics, when Japan imported copper metal and others in an amount of 50.1 billion yen(334 million U.S. dollars) despite its exports to Zambia of 8.7 billion yen (58 million U.S. dollars). A variety of other social and economic indices of Zambia are collected in Appendices to this report.

2.2 NATIONAL DEVELOPMENT PLANNING

The country is the world's leading copper producer, and is in possession of a huge surplus of hydroelectric power, a potential for trading, thanks to affluent river flows. Thus, Zambia is viewed as a country endowed with rich natural resources, compared to other African neighbors. Constraints, however, come from the transport sector, due to the country's landlocked position, which is suspected to be a chief culprit in prompting domestic inflation since the prices of all imported goods are pushed up because of trading having no choice but to use foreign ports as well as subsequent inland transportation by railroad and/or truck through foreign countries. Such a situation has been aggravated by political turmoil in the neighboring countries such as South Africa and Angola. In the meantime, since the country's economy suffered from the slump of copper prices, which had ensued during the 1970s, the Government has been struggling to diversify industry away from mining and promote agriculture for boosting food production. Abrupt expansion of the manufacturing sector in the wake of this policy, however, has prompted such a large-scale migration of the rural population into urban areas that the resultant sharp decline in agricultural population has squeezed the production and triggered food shortages in urban areas. The promotion of the rural water supply scheme, therefore, has been positioned as one of the highest priority strategies in the National Development Plans for the purpose of improving rural life, decreasing gaps between urban and rural areas and reactivating women labor.

Since independence in 1964, the nation implemented the Tentative Development Plan (1964-1966), the First to the Third National Development Plans (1966-1984) and the subsequent New Economic Recovery Programme (1987-1988), and is now undergoing the Fourth National Development Plan (1989-1993). The goals of this plan are to diversify the economy, to reduce the regional disparities, to develop human resources, to accelerate the rate of Zambianization in the economy and to increase employment opportunities, etc., with a target of reducing the high inflation rate of 45 percent in 1989 to less than 20 percent in 1993, the final year of the Plan (Table 2 - 1).

Table 2 - 1 NATIONAL DEVELOPMENT PLANNING (1964-1993)

NO.	PLAN TITLE	SUMMARY OF PLAN'S TARGETS & STRATEGIES	REAL GDP GROWTH RATE
1.	TENTATIVE DEVELOPMENT PLAN (1964-1966)	1) to promote the transport, education and health sectors	---
2.	FIRST NATIONAL DEVELOPMENT PLAN (1966-1970)	1) to diversify the country's economic base; 2) to decrease gaps between urban and rural areas; 3) and to develop human resources.	10.6%
3.	SECOND NATIONAL DEVELOPMENT PLAN (1972-1976)	1) to diversify the economic base; 2) to decrease gaps between urban and rural areas; 3) and to develop human resources.	3.4%
4.	THIRD NATIONAL DEVELOPMENT PLAN (1980-1984)	1) to boost agricultural production 2) to alleviate poverty among the economically disadvantaged and vulnerable groups; 3) and to restructure and reactivate mineral and mining sectors.	0.2%
5.	NEW ECONOMIC RECOVERY PLAN (1987-1988)	1) to expand and diversify the country's export base by encouraging non-Copprer exports; 2) to increase employment opportunities; 3) to stabilize the economy by controlling inflation; 4) to increase profitability and reinvestment of profits in enterprises utilizing local raw materials; 5) and to reduce Government budget deficit;	2.5%
6.	FOURTH NATIONAL DEVELOPMENT PLAN (1989-1993)	1) to reativate the economiy on the basis of maximising the use of own resources 2) to reduce the high rate of growth of the nation's population; 3) to reduce inflation; 4) to reduce the overall Government budget deficit; 5) to accelerate the rate of Zambianisation in the economy; 6) to increase formal sector employment; 7) and to accord high priority to the development of agriculture and to diversify the country's export base.	ongoing

FNDP, 1990

Under this ongoing Plan, the rural water supply scheme has successively been promoted, since it could play a major role in attaining the Plan's goals such as alleviating gaps between urban and rural areas through boosting agriculture production, reactivating women labor and achieving self-sufficiency of the economy, not to mention its significant role in connection with the UN's International Drinking Water Supply and Sanitation Decade (IDWSSD, 1981-1990). (Refer to Table 2-2.)

One of the main objectives of the Fourth National Development Plan in the development of national water resources is to ensure permanent supplies of water of acceptable quality and adequate quantity to as many users as possible in line with the IDWSSD Plan of Action for Zambia. The strategy of the said Plan of Action considers four levels of water supply as follows:

(1) Provision of safe water supply to at least 100 percent of all urban and rural populations by the year 1991;

(2) Provision of safe water supply to 80 to 90 percent of the total population by 1991 comprising 100 percent of all large and small urban areas and about 50 percent of all rural population;

(3) Provision of safe water supply to 100 percent of the total population in Zambia by the year 2000, and

(4) Similar coverage as for (2) except that the target date is the year 2000.

In the field of the water sector funded under the Plan, therefore, the DWA is tackling the targets to provide safe water supply to all the population by the year 2000 as a long-term goal and to serve 100 percent of the population in small urban centers and 50 percent of the rural population by the year 1991 - both categories of supplies directly under the responsibilities of this Department - in response to the IDWSSD. The national budget of the Republic of Zambia inflated from 8,300 million Kwacha (830 million U.S. dollars) in 1988 to 29,900 million Kwacha (750 million U.S. dollars) in 1990 due to the sharp

inflation trend continuing for the latest three years, although its value against the U.S. dollar has sharply declined in substance. Under the ongoing Plan, the DWA's water development planning is allotted with about 700 million Kwacha (about 17.7 million U.S. dollars), among which the share of foreign assistance is about 400 million Kwacha (10 million U.S. dollars), accounting for 56.6 percent of the total fund. The remaining 43.4 percent of is planned to be financed by local funding. The yearly allocations during the Plan's five years are 120 million Kwacha (about 3 million U.S. dollars) to 160 million (4 million U.S. dollars). Among DWA's activities, the greatest emphasis is laid on Rural Area Water Supplies (38.7 %) and those for Small Urban Townships (28 %), followed by National Water Master Plan (3.7 %), River Basin Conservation (2.5 %) and Drilling Operations (2.1 %). Foreign aid in those activities stands at a high level of 56.5 percent as a whole, with prominent shares anticipated for the National Water Master Plan (95 %), Drilling Operations (91 %) and the Hydrological Branch (81 %). A remarkable situation has lately arisen, however, that as a result of the devaluation of Kwacha in 1990 from 10 Kwacha against one dollar to 40 Kwacha, more than 80 percent of the DWA's planning as a whole has now been dependent upon foreign assistance (Table 2 - 2).

TABLE 2 - 2 FINANCIAL PROGRAM OF DWA FOR NATIONAL WATER RESOURCES DEVELOPMENT UNDER THE FOURTH NATIONAL DEVELOPMENT PLAN

UNITS: THOUSAND KWACHA

CATEGORY	FOURTH NATIONAL PLAN (TOTAL)		ALLOCATION PER ANNUM					FOREIGN COMPONENT		DOMESTIC COMPONENT	
	TOTAL	%	1989	1990	1991	1992	1993	SUB-TOTAL	%	SUB-TOTAL	%
1.SMALL TOWNSHIPS WATER SUPPLY	198,481	28.0	45,123	43,123	46,254	41,687	22,348	132,982	67.0	65,490	33.0
2.RURAL AREA WATER SUPPLY	274,190	38.7	55,642	54,642	54,642	54,642	54,642	153,546	56.0	120,644	44.0
3.NATIONAL WATER MASTER PLAN	25,900	3.7	6,475	6,475	-	-	-	24,605	95.0	1,295	5.0
4.HYDROLOGICAL BRANCH	1,120	0.1	224	224	224	224	224	907	81.0	216	19.0
5.HYDROGEOLOGICAL BRANCH	3,570	0.2	714	714	714	714	714	1,821	51.0	1,749	49.0
6.DRILLING OPERATIONS	15,051	2.1	5,268	1,505	1,505	1,505	1,505	13,696	91.0	1,335	9.0
7.RIVER BASIN CONSERVATION	17,780	2.5	4,900	4,900	2,600	2,600	2,600	7,289	41.0	10,490	59.0
8.CANAL DREDGING/ CONSTRUCTION	12,880	1.8	3,220	2,415	2,415	2,415	2,415	7,728	60.0	5,152	40.0
9.SUPPORT PROGRAMS	159,670	22.5	33,670	31,500	31,500	31,500	31,500	57,481	36.0	102,189	54.0
TOTAL	708,642	100.0	155,162	155,736	146,389	135,347	116,008	400,056	56.5	308,586	43.5

2.3 WATER ADMINISTRATION AND PRACTICE

2.3.1 WATER ADMINISTRATION

Water administration in Zambia is managed to be centralized by the National Commission for Development Planning (NCDP). The Government institutions in the water supply, environment and health sectors are currently comprised of five; the said NCDP, the Ministry of Water, Land Natural Resources (MWLNR), the Ministry of Decentralization (MOD), the Ministry of Works and Supply (MWS) and the Ministry of Health (Table 2 - 3). The administration in the water sector is governed by the Water Act (1964) and the Local Decentralization Act (1980).

1) National Commission for Development and Planning (NCDP) is in a ruling position to control national policies for water resources development in line with National Development Planning, UN's International Drinking Water Supply and Sanitation Decade (IDWSSD) and other major programs. It also assumes chairmanship at the National Action Committee for the IDWSSD.

2) The Department of Water Affairs (DWA) in the Ministry of Water, Land and Natural Resources (MWLNR) directly manages all rural water supplies, is responsible for nationwide water resources planning, development and conservation, and also handles the country's 42 small urban townships water supply and 7 rural townships water supply systems.

3) The Ministry of Decentralization (MOD) provides financial aid to water supply systems run by local authorities, and directs and supervises their foreign aid projects in respect of administrative matters.

4) The Water and Drainage Section (WDS) of the Buildings Department (BD) in the Ministry of Works and Supply (MWS) is responsible for planning, designing and supervising the construction of water and sanitary facilities to public institutions such as schools, police, hospitals, prisons, etc.

TABLE 2 - 3 WATER SUPPLY SECTOR ORGANIZATION & INSTITUTIONS

No	Institutions	Major Functions
1.	Department of Water Affairs (DWA); Ministry of Water, Land and Natural Resources (MWLNR):	1) to be responsible for nationwide water resources planning, development and conservation; 2) to be responsible for advising Govern-on all issues related water resources development; 3) to handle the country's 66 urban townships water supply systems; 4) to handle all rural water supplies.
2.	National Commission for Development Planning; Ministry of Finance and Development Planning:	1) to formulate national policy and strategy for social and economic development, including water and health sectors, in charge of census, statistics, research, etc. 2) to be in charge of foreign economic and technical assistance, representing the Government; 3) to assume chairmanship at National Action Committee for UN International Drinking Water Supply and Sanitation Decade (IDWSSD)
3.	Ministry of Decentralization (MOD): (Formerly Provincial & Local Government Administration Division of the Office of the Prime Minister)	1) to provide financial aid to local authorities from Central Government, including the water and health sectors; 2) to direct and control local authorities, reviewing and approving their budgets and auditing. (Note: This office has no technical and engineering department.)
4.	Water and Drainage Section(WDS) of Buildings Department (BD); Ministry of Works and Supply (MWS):	1) to be responsible for planning, design and supervision of construction of water-borne sanitation to public institutions such as schools, police, hospitals, prisons, etc)
5.	Health Inspectorate (HI); Ministry of Health (MOH):	1) to be responsible (within the framework of IDWSSD) for health education 2) to promote environmental health and sanitation of rural areas

5) The Health Inspectorate (HI) in the Ministry of Health (MOH) is responsible for the improvement of environmental health and sanitation of rural areas and offers them health education.

2.3.2 CURRENT SITUATION OF WATER SUPPLIES

Zambia's water supplies are divided into two categories; one for heavily populated urban townships and the other for rural areas. Rural water supplies are planned and executed by the DWA in the MWLNR, based upon the Water Act 1964, while urban townships supplies are basically handled by the district councils under the supervision of the Ministry of Decentralization, ruled by the Decentralization Act 1980. The latter, however, is presently managed not only by the district councils but by the DWA, reflecting a complex aspect of this group of water supplies connected with urban administration.

The whole country of Zambia is divided into 9 provinces with 57 subdivisions of districts, which are comprised of 10 urban districts and 47 rural districts. The water services for 10 urban districts, including the capital of Lusaka having populations of more than 50,000, are classified as Large Urban Area water supplies (LUAs). They are based upon an autonomous system, apparently being run in technically and economically sound conditions. In the 47 rural districts, either townships water supplies or Rural Area water supplies (RAs) are serving the population, with the latter entirely under the direct management of the DWA. On the other hand, the former is being run by various institutions such as district councils, mining companies, railways and the DWA. This group is divided into two categories; one is 75 Small Urban Townships water supplies (SUTs) and the other, 17 Rural Townships water supplies (RTs). (Refer to Table 2-4.)

In the early 1980s, water service of the Republic covered 45 percent of the whole population. The ratio rose to 56 percent in 1985, but the rural water supplies remained yet to be improved, hovering around 41 percent. In urban areas involving densely-populated LUAs and SUTs, surface water is frequently served after it is treated through

TABLE 2 - 4 CATEGORY OF WATER SUPPLY SCHEMES AND RESPONSIBLE INSTITUTIONS

ADMINISTRATIVE UNIT	NO. OF UNITS	CATEGORY	EXECUTIVE AGENCY		
URBAN DISTRICT	10	LARGE URBAN AREA SUPPLY	DISTRICT COUNCILS	10	
RURAL DISTRICT	47	SMALL URBAN TOWNSHIPS WATER SUPPLY	DWA	42	75
			DISTRICT COUNCILS	25	
			MINES & RARASTATALS	8	
		RURAL TOWNSHIPS WATER SUPPLY	DWA	7	17
			DISTRICT COUNCILS	10	
TOTAL	57	RURAL AREA WATER SUPPLY	DWA	ALL RURAL AREA	

DWA, 1990

the process of sedimentation, filtration and chlorination. Service by house connections, however, still remains at a low level, 48 percent in LUAs and 27 percent in SUTs. In RTs and RAs, the utilization of surface water is limited to only 22 percent and all the remaining 72 percent is dependent upon groundwater either from dug wells (36 %) or boreholes (42%). Since the standard equipment for RAs's water supplies with wells or boreholes is a hand pump, inhabitants must bother to daily cover a distance of no less than 100 m to sometimes as many as several kilometers to bring clean water home. Table 2-5 shows the current situation of the water supply coverage by various categories of schemes.

2.4 DEVELOPMENT ASSISTANCE

Bilateral aid, mainly from Japan, West Germany, Norway and Italy, has been playing a significantly important role in the entire development assistance to Zambia. During the years from 1983 to 1988, the total assistance per annum doubled from 2.18 million U.S. dollars to 5.06 million, in which grant aid accounted for a high ratio of 60 to 73 percent. Table 2-6 enumerates the trend of development assistance in recent years.

Among the donors, Japan is one of the main contributors, as it views Zambia as one of the priority countries, based upon the facts that Zambia is in a position to play a leading role among the frontline countries consisting of Angola, Zambia, Zimbabwe, Tanzania, Botswana and Mozambique, and that Japan is willing to keep close economic ties with Zambia represented by imports of copper from the latter, which amounted in 1988 to about 36.1 percent of the former's total imports of that metal. Thus, in 1985, Japan caught up with the U.S. and stood first among all the DAC countries in bilateral assistance to Zambia.

Japan's assistance program includes development cooperation for the food and agricultural sector with the objectives of boosting production and establishing self-reliance in food supply in response to the government's longstanding policy to diversify the country's economic base away from copper mining, as well as that for the water

TABLE 2 - 5 COVERAGE AND LEVEL OF WATER SUPPLY IN ZAMBIA

UNITS:TEN THOUSAND

DESCRIPTION	SERVED POPULATION			
	1980	1983	1985	1989
A TOTAL POPULATION C+D	566	627	672	780
B TOTAL PUBLIC WATER SUPPLY RATIO (E+F+G)/A	256 (45.2%)	295 (47.0%)	376 (56.0%)	
C URBAN POPULATION	226 (39.9%)	253 (40.4%)	289 (43.0%)	392 (50.2%)
D RURAL POPULATION	340 (60.1%)	374 (59.6%)	383 (57.0%)	388 (49.8%)
E URBAN AREA: HOUSE CONNECTIONS E/C	111 (49.0%)	124 (49.0%)	127 (44.0%)	
F URBAN AREA: PUBLIC STANDPOSTS F/C	36 (13.5%)	40 (15.8%)	92 (32.0%)	
G RURAL WATER SUPPLIES G/C	109 (32.0%)	131 (35.0%)	157 (41.0%)	

IDWSSD, 1987
DWA

TABLE 2 - 6 FOREIGN AID IN RECENT YEARS TO THE REPUBLIC OF ZAMBIA

UNITS: $ MILLION U.S.

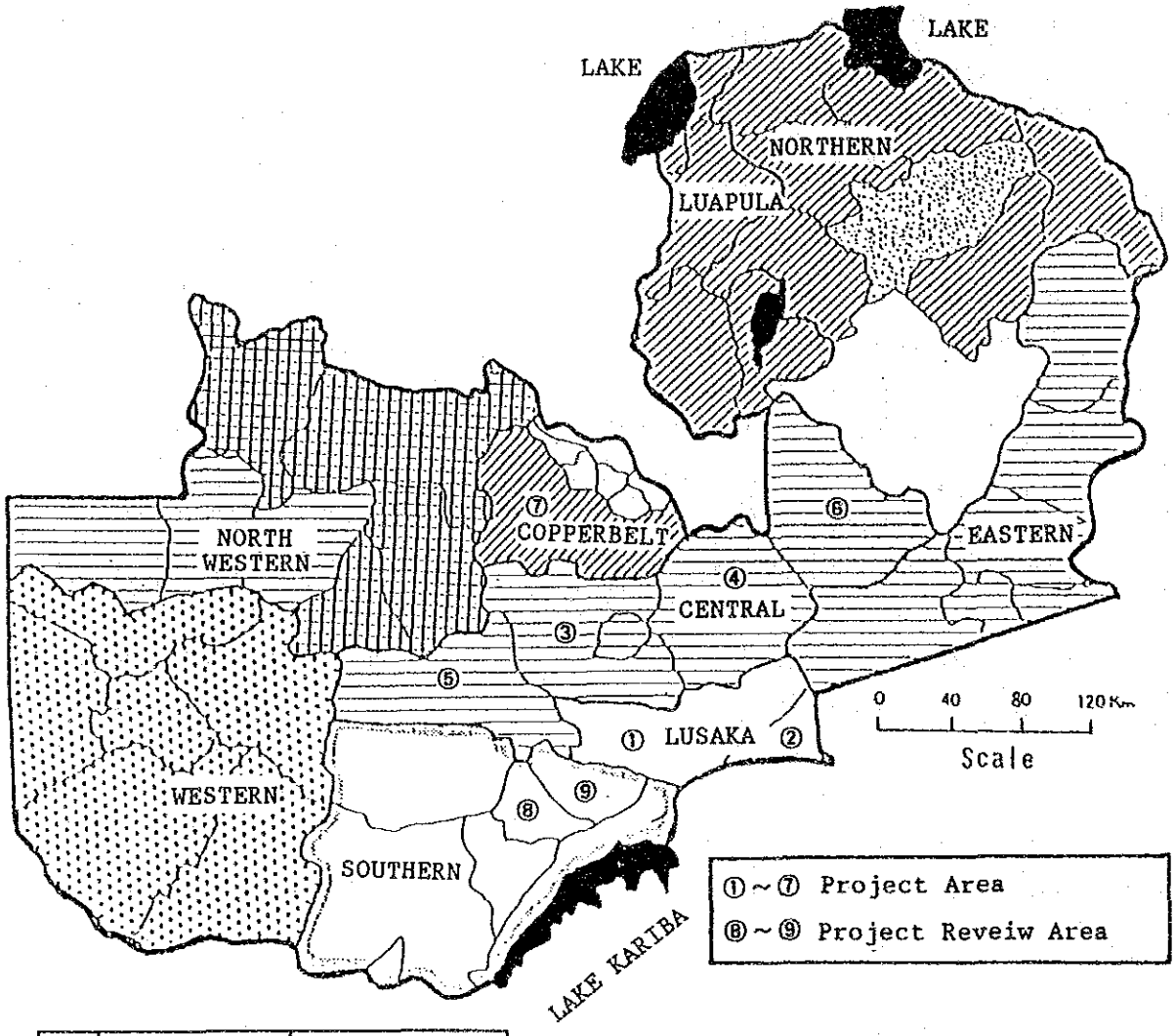
	1983	1984	1985	1986	1987	1988
A. BILATERAL AID	184.4	183.1	218.0	363.4	347.9	435.1
1. JAPAN	19.3	5.0	42.1	55.9	41.7	114.2
2. U.S.A	23.0	40.0	36.0	38.0	34.0	-
3. UNITED KINGDOM	20.4	19.5	22.8	44.0	38.5	-
4. WEST GERMANY	25.0	19.2	19.3	34.9	37.2	52.0
5. NETHERLAND	12.1	19.6	15.7	47.5	29.6	-
6. NORWAY	16.1	16.0	16.7	28.7	31.9	40.2
7. SWEDEN	29.4	20.6	22.9	44.4	25.4	-
8. ITALY	0.7	3.5	1.3	13.6	36.1	39.5
B. AID FROM INTERNATIONAL AGENCIES	33.4	57.8	113.7	115.4	84.7	71.2
1. EUROPIAN COMMUNITY	8.4	23.9	29.1	16.3	20.0	34.9
2. AFIRIKAN DEVELOPMRNT BANK	4.5	2.4	5.9	8.8	3.9	10.1
3. WORLD BANK	8.2	15.5	66.0	74.0	40.4	5.0
TOTAL AMOUNT (A+B)	217.9	240.9	331.7	478.9	432.7	506.4
AMOUNT OF GRANT IN TOTAL ASSISTANCE	149.3	159.2	197.3	292.2	316.0	362.5
SHARE OF GRANT IN TOTAL (%)	68.5%	66.1%	59.5%	61.0%	73.0%	71.6%

sector to meet the constantly growing water demand caused by overwhelming population growth. Another significant form of assistance has been directed to the health and medical sector, mainly to relieve an urgent problem stemming from scarcity of health manpower strength. The improvement of infrastructure concerning the transport and traffic sector is also among forms of assistance for helping the weakened economy pick up.

Fig. 2-1 indicates the current situation of development cooperation for rural water supply schemes handled by the DWA, relying on bilateral aid and assistance from international agencies during the 1980s. Those projects mainly consisted of construction and rehabilitation of boreholes and dug wells, and the number of facilities resulting from the execution of the respective projects are shown in the same diagram. Japan joined in this sector twice in 1985 and 1988 for the area of Southern Province, where 222 boreholes were newly installed and 100 existing boreholes underwent rehabilitation works under the two projects. Compared to other projects, those of Japan have distinguished features: Japanese efforts were focused on installation of new boreholes to depths of 40 m to 70 m which can hardly dry up even during the dry seasons; equipment of the latest design for drilling boreholes was supplied and essential technology for borehole construction was transferred to the Zambian partner, enabling it to continue works after the completion of the Japanese projects.

Furthermore, "Master Plan Study on Hydrologic Observation Systems of the Major River Basins in Zambia" (1989-1992) has now been ongoing since 1988 under technical cooperation from Japan, to provide the data base for nationwide water resources development and conservation, including water balance of the respective units of catchment areas.

FIG. 2 - 1 DIAGRAM SHOWING TREND IN DEVELOPMENT COOPERATION IN COUNTRY'S RURAL WATER SUPPIES



	Province	District
①	Lusaka	Lusaka Rural
②	Lusaka	Luangwa
③	Central	Kabwe Rural
④	Central	Mkushi
⑤	Cenrtal	Mumbwa
⑥	Central	Serenje
⑦	Copperbelt	Ndola Rural
⑧	Southern	Monze
⑨	Southern	Mazabuka

Development Cooperation

- Netherlands 171 Wells (1984-1989)
- Germany 349 Wells (1985-1990)
- Norway 5,020 Wells (1980-1989)
- World Bank 620 Wells (1984-1987)
- Ireland 151 Wells (1983-1990)
- Japan 322 Wells (1985-1990)
- Provincial Boundary
- District Boundary

J I C A, 1988

2.5 EXECUTING AGENCY

The executing agency of this Project is the Department of Water Affairs (DWA) in the Ministry of Water, Land and Natural Resources (MWLNR), which is in charge of investigation, planning, execution and management regarding rural water supply schemes at a national level, and undertakes implementation of Small Urban Townships Water Supplies (SUTs), Rural Townships Water Supplies (RTs), Rural Area Water Supplies (RAs), drilling operations, etc., through the setup consisting of the headquarters in Lusaka, Provincial Water Engineer Offices in the respective Provinces and District offices in various Districts. The whole organization of the DWA has a staff of about 2,000, stationed in the Headquarters and the respective Provincial Water Engineer Offices and District Offices. In Lusaka, Central and Copperbelt Provinces under this Project, the setup of the offices is of the same structure, having respectively the Provincial Offices staffed with about 120 to 150 employees and the District Offices with 20 to 50 for the execution of water supply schemes for SUTs, RTs and RAs. The organization chart of this Department is shown in Fig. 2-2. The implementation of this Project is to be headed by the Director of the DWA, involving the office of Data and Planning as well as the Hydrogeological Section, from which engineers and technicians will be dispatched for participating in the hydrogeological study and drilling operations during the implementation of the Project, thus enhancing the effect of technology transfer aimed under the Project.

The national budgets and those for the MWLNR and the DWA during the latest three years (1988-1990) are tabulated in Table 2 - 7. The national budget is seen to have increasingly swelled due to inflation from 8,303 million Kwacha in 1988 to 29,926 million Kwacha in 1990. The fund allocated to the DWA in 1990 was about 200 million Kwacha, accounting for more than 58 percent of the whole budget in the same year of the MWLNR, indicating the significantly important position of this Department within the Ministry. Among the DWA's total budget, the share of development planning corresponds nearly to 77 percent. Foreign assistance in this development planning is remarkably high, occupying roughly 87 percent.

Fig. 2 - 2 ORGANIZATION CHART OF DEPARTMENT OF WATER AFFAIRS (DWA), THE MINISTRY OF WATER, LAND AND NATURAL RESOURCES

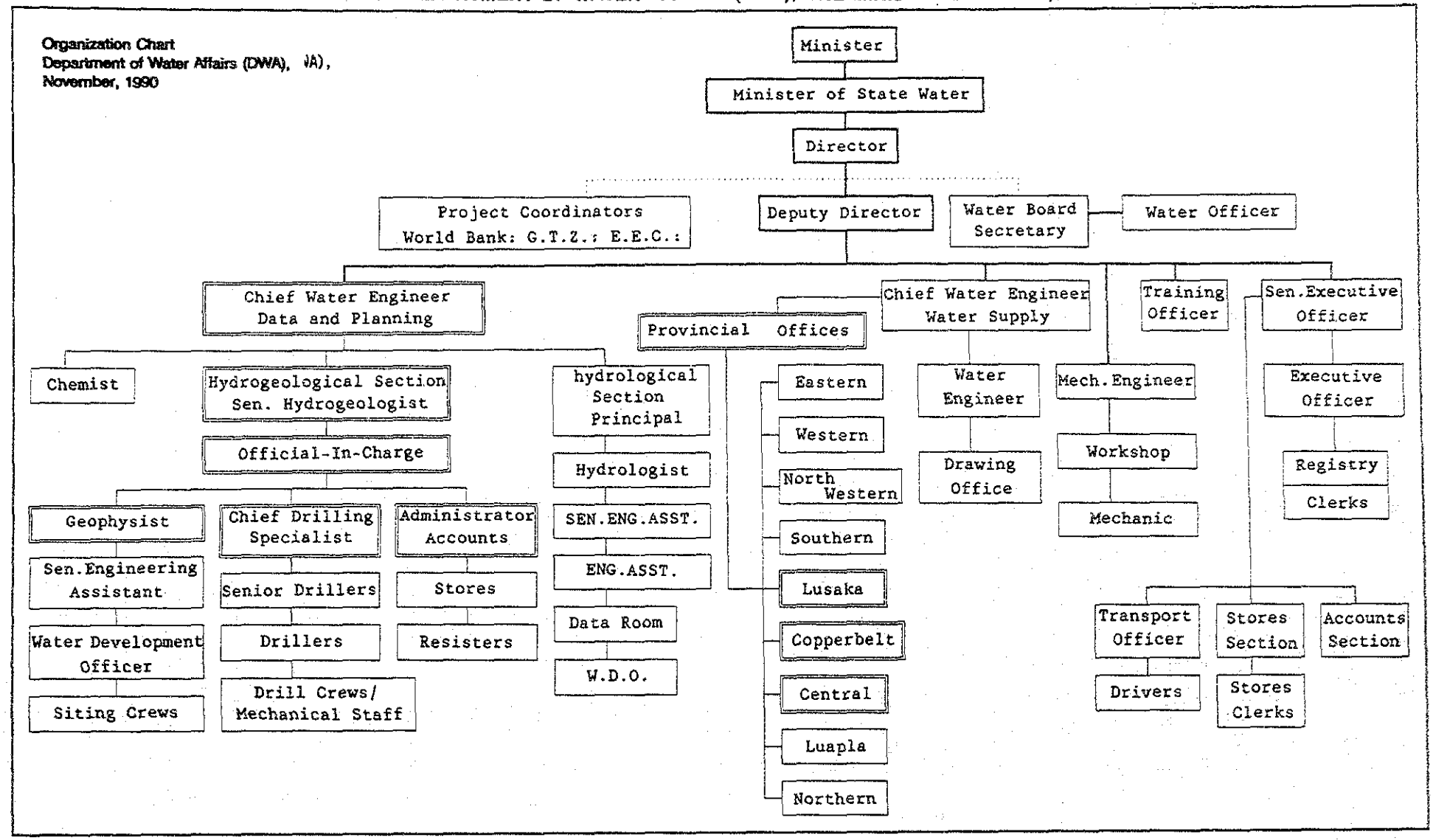


TABLE 2 - 7 FINANCIAL SITUATION OF DWA

(1988 - 1990)

No.	Description	1988	1989	1990
1.	National budget (Mil.Kwacha)	8,303	12,376	29,926
	(Mil.U.S.$)	($830)	($890)	($748)
2.	MWLNR's budget (Mil.Kwacha)	110	151	348
3.	DWA's budget (Mil.Kwacha)	50	95	204
4.	DWA's finance for development plan(Mil.Kwacha)	28	70	158
5.	Share of development plan in DWA's budget (%)	56%	74%	77%
6.	Share of foreign assistance in DWA's development plan(%)	84%	61%	87%
7.	Average exchange rate of Kwacha against U.S.$	10	13.9	40

Table 2-8 shows the record of DWA's past performance related to the development of water resources, including the construction of boreholes and hand dug wells for rural water supplies. Two dam sites were developed in Southern Province, while the construction of boreholes and dug wells amounted to 809 and 1,167 sites respectively over the country, with their yearly constructions ranging from 134 to 261 and from 116 to 467 respectively. The most active operations in borehole construction were noticed in Western Province (470 boreholes), Southern Province (190 ones) and Lusaka Province (94 ones). The fast development in these provinces has been supported by development assistance; by Norway for Western Province, by Japan for Southern Province and by Japan's Non-Project Grant Aid for Lusaka Province.

In the sector of dug-well construction, the World Bank assisted Northern Province (296 wells), Luapura Province (161 wells) and Copperbelt (81 wells), while Germany and Norway provided assistance respectively to Northwestern Province (153 wells) and Western Province.

TABLE 2 - 8 a DWA'S RECENT ACHIEVEMENT FOR WATER RESOURCES DEVELOPMENTS (DAMS, DUG WELLS AND BOREHOLES) 1986 - 1989

PRVC. / YEAR	LUSAKA			CENTRAL			SOUTHERN			WESTERN			N-WEST			COPPERBELT			NORTHERN			LUAPULA			EASTERN			TOTAL		
	D	W	B	D	W	B	D	W	B	D	W	B	D	W	B	D	W	B	D	W	B	D	W	B	D	W	B	D	W	B
1986	–	6	13	–	20	0	1	–	21	–	6	61	–	37	1	–	66	11	–	205	5	–	114	15	–	13	7	1	467	134
1987	–	9	18	–	2	–	1	4	88	–	14	111	–	4	1	–	9	0	–	50	2	–	22	0	–	2	4	1	116	224
1988	–	–	29	–	110	2	–	0	25	–	16	112	–	29	3	–	0	2	–	24	1	–	21	14	–	0	2	–	200	190
1989	–	14	34	–	58	2	–	0	15	–	202	186	–	83	2	–	6	1	–	17	11	–	4	7	–	–	3	–	384	261
SUB-TOTAL	–	29	94	–	190	4	2	4	149	–	238	470	–	153	7	–	81	14	–	296	19	–	161	36	–	15	16	2	1167	809

* D : DAM W : DUG WELL B : BOREHOLE

TABLE 2 - 8 b DETAILS OF DWA'S PAST ACHIEVEMENT FOR WATER RESOURCES DEVELOPMENTS (DAMS, DUG WELLS AND BOREHOLES) 1964 - 1985

PRVC. / YEAR	LUSAKA & CENTRAL			SOUTHERN			WESTERN			N-WESTERN			COPPERBELT			NORTHERN			LUAPULA			EASTERN			TOTAL		
	D	W	B	D	W	B	D	W	B	D	W	B	D	W	B	D	W	B	D	W	B	D	W	B	D	W	B
1964	2	3	14	1	21	8	1	–	–	–	–	–	–	–	14	1	–	2	–	–	–	3	71	10	8	95	48
1965	1	6	15	5	19	11	–	–	–	–	–	–	–	28	15	–	–	2	–	–	–	5	72	10	11	125	53
1966	2	19	29	1	5	15	–	–	5	–	–	3	–	14	13	–	–	3	–	–	–	1	22	10	4	60	78
1967	3	38	78	2	4	17	–	–	1	–	–	–	–	15	21	–	–	4	–	4	–	8	121	14	13	182	135
1968	–	22	51	4	2	28	–	–	4	–	5	–	–	5	16	1	–	–	–	17	–	2	167	9	7	218	108
1969	1	33	53	3	10	49	–	8	133	–	19	–	–	31	25	–	–	–	–	30	–	1	155	18	5	286	278
1970	3	37	51	1	49	31	–	21	114	–	23	–	–	18	8	–	6	1	–	96	–	1	131	46	5	381	251
1971	–	64	95	–	95	76	–	13	135	–	30	2	–	21	22	–	24	–	–	22	–	1	134	48	1	403	378
1972	–	10	23	1	53	31	–	18	112	–	34	2	–	14	20	–	9	–	–	60	1	2	89	52	3	287	241
1973	–	9	14	1	68	17	–	28	55	–	33	8	–	45	4	–	20	3	–	31	19	1	112	57	2	346	177
1974	–	26	25	–	73	23	–	28	157	–	29	4	–	19	25	–	11	1	–	15	10	1	170	39	1	371	284
1975	1	42	32	–	34	79	–	19	77	1	29	–	–	23	24	2	–	–	–	70	11	1	47	39	5	264	252
1976	–	21	25	1	62	24	–	19	35	–	40	8	–	29	20	1	11	2	–	85	4	–	68	29	2	335	147
1977	1	11	12	–	35	26	–	5	35	1	20	16	–	8	8	–	15	6	–	26	2	1	30	13	3	150	118
1978	–	32	9	–	27	14	–	4	17	–	24	1	–	–	10	–	31	–	–	17	3	–	26	16	0	161	70
1979	–	8	8	–	23	16	–	9	29	–	24	6	–	12	4	–	15	9	–	17	1	–	50	10	0	158	83
1980	–	17	10	–	14	2	3	52	14	–	10	2	–	–	2	–	10	3	–	13	3	1	27	10	4	143	46
1981	–	1	25	–	–	3	–	36	3	–	15	3	–	1	12	–	–	2	–	2	5	–	9	12	0	64	65
1982	–	12	22	–	18	21	–	76	71	–	15	4	–	16	1	–	17	5	–	–	2	1	12	9	1	166	135
1983	–	12	46	10	55	11	–	54	48	–	20	4	–	4	1	–	28	5	1	–	2	–	17	5	11	190	122
1984	–	8	–	4	4	16	–	46	45	–	36	3	–	14	–	–	14	2	–	22	1	–	4	5	4	148	72
1985	–	6	38	6	1	9	–	9	32	–	63	4	–	40	–	–	78	5	–	48	6	–	12	15	6	257	109
SUB-TOTAL	14	437	675	40	672	527	4	445	1122	2	469	70	–	357	265	5	289	55	1	575	70	30	1546	476	96	4790	3260
GRAND TOTAL 1964-89	14	656	773	42	676	676	4	683	1592	2	622	77	–	438	279	5	585	74	1	736	106	30	1561	492	97	5956	4069

* D : DAM W : DUG WELL B : BOREHOLE

The Department plans to execute rural water supplies with two units of rotary type drilling rigs deployed in each province by the year 2000 for the purpose of serving clean and safe drinking water to the country's entire population. The current status of DWA's rig deployment in the respective provinces is shown in Table 2-9. The four offices of Lusaka (DWA Headquarters), Southern, Western and Northern Provinces are in possession of more than two rigs each of either rotary or percussion type to engage in drilling boreholes free from concern of drying up. Northwestern, Luapura and Eastern Provinces each have one percussion rig, and drilling operations have been continuing. On the other hand, Lusaka Central and Copperbelt Provinces currently have no workable rigs, and are dependent on assistance by Lusaka's headquarters. This situation caused the Government of Zambia to make a renewed request for this Project to the Government of Japan.

TABLE 2 - 9 DEPLOYMENT OF DWA'S DRILLING MACHINES

(DECEMBER, 1990)

NO.	PROVINCE	ROTARY RIGS		PERCUSSION RIGS		TOTAL	
		NO. OF WORKING UNITS	NO. OF UNITS IN NEED OF REPAIR	NO. OF WORKING UNITS	NO. OF UNITS IN NEED OF REPAIR	NO. OF WORKING UNITS	NO. OF UNITSIN NEED OF REPAIR
1.	LUSAKA	2 *	0	0	1	2	1
2.	CENTRAL	0	0	0	0	0	0
3.	SOUTHERN	2 *	0	1	0	3	0
4.	WESTERN	1	0	2	0	3	0
5.	NORTH-WESTERN	0	0	1	0	1	0
6.	COPPERBELT	0	0	0	1	0	1
7.	NORTHERN	1	0	1	0	2	0
8.	LUAPLA	0	0	1	0	1	0
9.	EASTERN	0	0	1	0	1	0
TOTAL		6	0	7	2	12	2

* ROTARY RIGS OF JAPANESE MAKE (SUPPLIED IN 1986 AND 1989)

2.6 JAPAN'S GRANT AID PROJECTS

In the past, the Government of Japan extended its grant aid for the water sector in Zambia, under which the two projects entitled "Groundwater Development Project in the Republic of Zambia, Phases I and II", were executed respectively in 1985 and 1988, in the project area of Southern Province. The successful results of those projects were acknowledged by the Government of the Republic of Zambia, and prompted it to make a renewed request to the Government of Japan for an additional project with plans to install 200 boreholes with water facilities including the procurement of two units of drilling rigs for the rural population in Lusaka, Central and Copperbelt Provinces. The present study team for the basic design study for this Project visited the sites of those preceding projects during the field survey this time and studied the outcome of the projects, for the purpose of reflecting essential factors in findings into the forthcoming Project.

2.6.1 GROUNDWATER DEVELOPMENT PROJECT IN SOUTHERN PROVINCE, PHASE I

Ground Water Development Project in Southern Province, Phase I was executed in 1986 as grant aid from the Government of Japan based upon the basic design study carried out in 1985. In total, 102 boreholes were constructed under this project, 43 directly completed by the Japanese side, and 59 by the Zambian side, namely the DWA. The details of the results are shown in Table 2-10.

As a result of this project, six districts comprising this Province (except for Livingston Urban District) were uniformly provided with water supply facilities of boreholes with hand pumps. After March 1987, when the planned boreholes at 43 sites were completed by the Japanese side, the DWA commenced its own drilling operations with staff trained through the implementation of the project, and successfully ended the installation of water supply facilities at 59 sites in August 1987.

TABLE 2 - 10 BOREHOLE CONSTRUCTION RECORD UNDER SOUTHERN PROVINCE GROUNDWATER DEVELOPMENT PROJECT (PHASE I)

NO.	DISTRICT	PERFORMANCE OF THE JAPANESE CONTRACTOR		PERFORMANCE OF DWA		TOTAL
		TARGET	COMPLETED	TARGET	COMPLETED	
1.	Gwembe	17	17	5	5	22
2.	Mazabuka	12	12	2	2	14
3.	Monze	14	14	-	-	14
4.	Choma	-	-	14	14	14
5.	Namwala	-	-	14	14	14
6.	Kalomo	-	-	24	24	24
7.	Living-stone	-	-	-	-	-
TOTAL		43	43	59	59	102

DWA, 1987

The study team witnessed several cases of negligence of rural communities which were responsible for the installation of appurtenant facilities surrounding boreholes such as drain line, soakaways, fences, etc. The project, however, was judged to have successfully been performed as a whole.

2.6.2 GROUNDWATER DEVELOPMENT PROJECT IN SOUTHERN PROVINCE, PHASE II

The Phase II project aimed to complete not only water supply facilities of boreholes with pumps at 120 sites but rehabilitation works of existing boreholes at 100 sites, utilizing the two drilling rigs supplied under the previous project of Phase I. In March 1990, 32 facilities were accomplished by the Japanese side, and by November of the same year the Zambian side had completed 40 facilities among the targeted 88 (45.5 % of the target). This project has been handled by the Mazabuka District Office of Southern Province. According to the judgement of the study team during the visit to this office, its activities and performance were well organized and managed, with the execution of the project progressing in good order under the control of staff trained through technology transfer. Nevertheless they were

found currently facing a problem. After the Gulf Crisis in August 1990 the fuel cost had soared to 52.4 Kwacha per liter from its prewar price of 10 Kwacha. Moreover they could not get even a drop of fuel supply throughout that August. Such a situation had forced them to suspend the operation and to readjust their budgetary arrangements for the project, eventually resulting in the delay in its progress. Table 2-11 shows the current status of borehole construction, and Table 2-12, that of rehabilitation works under this project.

TABLE 2 - 11 BOREHOLE CONSTRUCTION RECORD UNDER SOUTHERN PROVINCE GROUNDWATER DEVELOPMENT PROJECT (PHASE II)

NO.	DISTRICT	PERFORMANCE OF THE JAPANESE CONTRACTOR		PERFORMANCE OF DWA		
		TARGET	COMPLETED	TARGET	COMPLETED	REMAINING
1.	Gwembe	-	-	14	5	9
2.	Mazabuka	-	-	20	8	12
3.	Monze	20	20	8	7	1
4.	Choma	-	-	29	6	23
5.	Namwala	-	-	9	6	3
6.	Kalomo	9	9 (*6)	8	8	0
7.	Living-stone	3	3	-	-	-
TOTAL		32	32(*6)	88	40	48

* NO. OF DRY WELLS,

DWA, November, 1990

TABLE 2 - 12 RECORD OF BOREHOLE REHABILITATION WORKS UNDER SOUTHERN PROVINCE GROUNDWATER DEVELOPMENT PROJECT (PHASE II)

NO.	DISTRICT	PERFORMANCE OF THE JAPANESE CONTRACTOR		PERFORMANCE OF DWA		
		TARGET	COMPLETED	TARGET	COMPLETED	REMAINING
1.	Gwembe	-	-	15	9	6
2.	Mazabuka	3	3	12	0	12
3.	Monze	20	20	-	-	-
4.	Choma	-	-	20	0	20
5.	Namwala	-	-	10	8	2
6.	Kalomo	17	17	1	0	1
7.	Living-stone	-	-	2	0	2
TOTAL		40	40	60	17	43

DWA, November, 1990

The results of this project indicate that the rate of success in borehole construction stood at 81.3 percent, with six (6) dry boreholes among 32 ones completed as a result of Japanese responsibility. In view of the performance of this project, it is judged that the target of this new Project should be set around the same rate of 80 percent, since the hydrogeological environment of these three Provinces cannot be assessed to be more favorable than Southern Province.

The review of this previous project has also made it clear that the rehabilitation of existing boreholes, including repair of broken-down pump units is significantly effective. At several sites, waste water was found stagnant in the surroundings of the boreholes, indicating the necessity of installation/improvement of drainage facilities with soakaways, for which each community was held responsible. Under the present circumstances of rural communities, it might become necessary to include those appurtenant facilities in this Project.

2.6.3 DRILLING RIGS SUPPLIED UNDER NON-PROJECT GRANT ASSISTANCE

Two units of drilling rigs of Japanese make were procured under the so-called Japan's Non-Project Grant Assistance for structural adjustment support for low-income debt-distressed countries in Sub-Saharan Africa, and are stationed in the DWA's Headquarters in Lusaka. The tender was held in 1988 and the two rigs were delivered to Lusaka in May 1989. The operation of those rigs commenced in June, and 110 boreholes were already completed in the four Provinces of Lusaka, Central, Copperbelt and Eastern, by November 1990 when the survey of this basic design study team was conducted. The study team came across one of the crews which was on the way back to Lusaka after it had completed the operation at a site in Ndola Rural District of Copperbelt Province. During the encounter, the members of the study team recognized the well-maintained condition of the equipment they were carrying.

Those rigs are of the same type of rotary machines which were previously supplied to Southern Province under Japan's first grant aid project in this sector. Initially, this Project had an alternative to adopt those rigs for construction of water supply facilities at 200 sites in three Provinces. However, since the rigs were discovered to have fully been utilized by Lusaka Headquarters for another schemes of its own, it turned out that there was no choice but to employ new machines. Table 2-13 shows the performance up to the present of the two rigs supplied under non-project grant assistance.

TABLE 2 - 13 PERFORMANCE OF DRILLING RIGS SUPPLIED UNDER NON-PROJECT ASSISTANCE

Province	Lusaka	Central	Copperbelt	Eastern	
Type	Boreholes	Boreholes	Boreholes	Boreholes	Total
1988	-	-	-	-	-
1989	34	12	4	7	57
1990	37	8	2	6	53
Total	71	20	6	13	110

2.7 OUTLINE OF REQUEST

Japanese economic assistance in the rural water supply scheme demonstrated successful results through the two projects; Ground Water Development Project Phase I in 1985 and Phase II, requested in 1988 and completed in 1990, contributing to the efforts of the Zambian Government to relieve the draught-stricken areas of Southern Province. Following these projects, the request for Phase III is intended for the rural water supply development mainly consisting of construction of boreholes at 200 sites in three provinces of Lusaka, Central and Copperbelt, where the coverage of rural water supplies remains remarkably low and inhabitants have frequently been threatened with depletion of water sources due to far less rainfall than that in other areas of the country.

The initial request of 1988 consisted of two proposals, one for the two provinces of Lusaka and Central, and the other, for Ndola Rural District of Copperbelt Province. In August, 1990, these two requests were agreed between the DWA and the NCDP to be combined into a single one involving these provinces with a plan to construct 200 boreholes. In response to the two revised requests, the Government of Japan decided to carry out the basic design study of the Project, and Japan International Cooperation Agency (JICA) dispatched a study team in November, 1990, headed by Mr. Osamu Ikeda, Deputy Director of International Cooperation, International Affairs Division, Minister's Secretariat, Ministry of Health and Welfare.

The request was comprised of a plan to procure two units of drilling rigs along with other equipment, machinery and materials necessary for groundwater development and rural water supplies and to install 200 boreholes with water facilities in the three provinces. It also included the requirements for technology transfer and procurement of equipment and materials for operation and maintenance. The outline of this proposal is summarized as follows:

1) The objective of the Project is to provide safe and clean drinking water to the rural inhabitants of Lusaka Province, Central Province and Ndola Rural District of Copperbelt Province in order to stabilize and improve the rural life of the Project area.

2) The Project sites are listed as follows:

a.	Lusaka Province	Lusaka Rural District	45 sites
		Luangwa District	10 sites
b.	Central Province	Kabwe Rural District	30 sites
		Mkushi District	30 sites
		Mumbwa District	20 sites
		Serenje District	15 sites
c.	Copperbelt Province	Ndola Rural District	50 sites

3) Major components of the Project are as follows:

a. Construction of 200 boreholes with water facilities in the Project area.

b. Rehabilitation of 100 existing boreholes in the Project area .

c. Procurement of equipment and materials required for the works including two units of drilling rigs

d. Technology transfer for the implementation of the Project.

4) The Ministry of Water, Land and Mineral Resources will execute, operate and maintain the Project through the Department of Water Affairs.

CHAPTER III

DESCRIPTION OF THE PROJECT AREA

CHAPTER III

DESCRIPTION OF THE PROJECT AREA

3.1 PROJECT AREA

The Project area covers seven administrative units of Districts in three Provinces of Lusaka, Central and Copperbelt, with a total area of 147,617 km², about 20 percent of the whole country (752,614 km²) and roughly equivalent to 40 percent of that of Japan. Meanwhile, Japan's previous grant aid projects, Groundwater Development Phases I and II for Southern Province, were conducted in an area of 85,283 km², and the study on the results of those preceding projects by the present basic design study team was performed in two Districts of Mazabuka and Monze.

The original request for grant aid from the Government of Zambia consisted of two proposals, one for Lusaka and Central Provinces and the other for Ndola District of Copperbelt Province. These two were integrated for the final request for construction of new water supply facilities at 200 sites. Nevertheless, the list attached to the request included 372 sites with a planned population of 184,579, as summarized in Table 3 - 1.

The study team, therefore, took steps to decide on the priority sites of 200 for implementation under the Project through the consultation with local authorities of district councils as well as responsible staff of the offices of the DWA's Headquarters, Provincial Water Engineer Offices and District Offices concerned.

TABLE 3 - 1 LIST OF PROJECT SITES UNDER THE REQUEST

	Province	District	No. of Sites	Planned Population	Population Total
	1. Lusaka	Lusaka Rural	67	51,750	60,340
		Luangwa	27	8,590	
	2. Central	Kabwe Rural	55	18,890	78,939
		Mkushi	58	23,820	
		Mumbwa	47	23,889	
		Serenje	36	12,340	
	3. Copper-belt	Ndola	82	45,300	45,300
Total	3 Provinces	7 Districts	372	184,579	

A priority has been given on the following basis:

1) Sites having public institutions such as schools, hospitals, etc., where no suitable sources of drinking water exist;
2) Sites suffering from frequent occurrences of waterborne diseases due to contaminated water;
3) Sites developed or developing under the Government's policies for promotion of agricultural industry, where no water facilities have yet been provided;
4) Sites badly and urgently in need of water;
5) Densely-populated sites where drinking water would be chronically scarce during dry seasons;

It has also been found that the sites eliminated in the selection included a considerable number of those where the existing facilities were left unused, because of damaged pumping units or other reasons. This situation has led to a concept that this Project should involve additional sites for rehabilitation works of the existing boreholes, replacing pump units with new ones.

As a result of this process of priority selection, the project sites thus decided upon for new facility construction are summarized in

Table 3 - 2, with their locations indicated in Fig. 3 - 1. The detailed list of the sites is attached in the Appendix to this report.

TABLE 3 - 2 SUMMARY OF AGREED PROJECT SITES

	Province	District	No. of Sites	Planned Population
	1. Lusaka	Lusaka Rural	45	39,700
		Luangwa	10	3,730
	(Sub Total)		55	43,430
	2. Central	Kabwe Rural	30	21,700
		Mkushi	30	19,700
		Mumbwa	20	9,388
		Serenje	15	8,470
	(Sub Total)		95	59,258
	3. Copper-belt	Ndola	50	16,700
	(Sub Total)		50	16,700
Total	3 Provinces	7 Districts	200	119,388

The total population planned to be served by new water supply facilities amounts to 119,388, accounting for 14 percent of the whole regional population of 850,900 in 1989, and upon completion of the Project, will have augmented the coverage of 24 percent at present to 38 percent.

In addition, the sites of borehole rehabilitation count 100 in three districts of two Provinces of Lusaka and Copperbelt. Central Province is not included in this type of work, since Germany is now handling a similar project there. The locations of these 100 sites are shown in Fig. 3 - 1; the districtwise numbers of sites and beneficiaries, in Table 3 - 3; and the full names of the sites, in the Appendix.

Fig. 3-1 LOCATION MAP OF PROJECT SITES

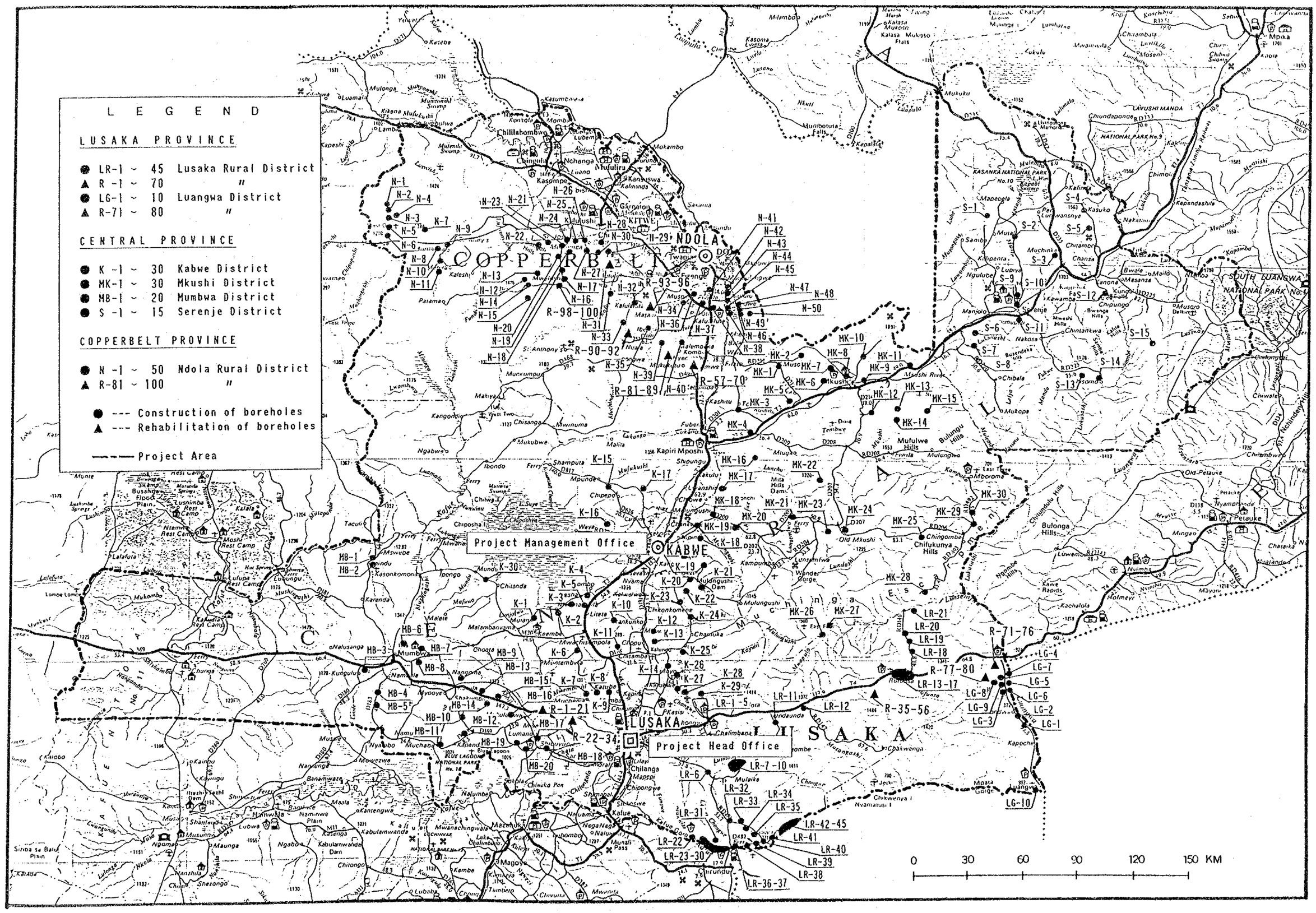


TABLE 3 - 3 LIST OF SITES FOR REHABILITATION WORKS

Province	District	No. of Sites	Population
Lusaka	Lusaka Rural	70	31,890
	Luangwa	10	6,500
Copperbelt	Ndola	20	5,850
Total		100	44,240

The number of beneficiaries through the rehabilitation of existing boreholes amounts to 44,240, roughly corresponding to about 5 percent of the regional population, who can enjoy improved water service.

The Project area has main trunk roads, completely paved, running north to south and east to west across the area; but the approaches to the respective sites need to cover rugged roads of laterite branched from those trunk mains, ranging from a couple of kilometers to 50 km. Those branch roads raise extreme difficulty for access to some of the sites. For this reason, the implementation schedule requires an elaborate study to ensure trouble-free, efficient operation of works. The pattern of settlements in the area is a typical hamlet with households scattered over a wide area, where women and children are forced to walk daily 5 to 7 km to fetch drinking water, one of the most compelling reasons for executing this Project.

3.2 NATURAL ENVIRONMENT

3.2.1 TOPOGRAPHY

The Republic of Zambia is located in the southern part of Central Africa as a landlocked country ranging from 8° to 18° in the south latitude and from 23° to 34° in the east longitude. Most of the

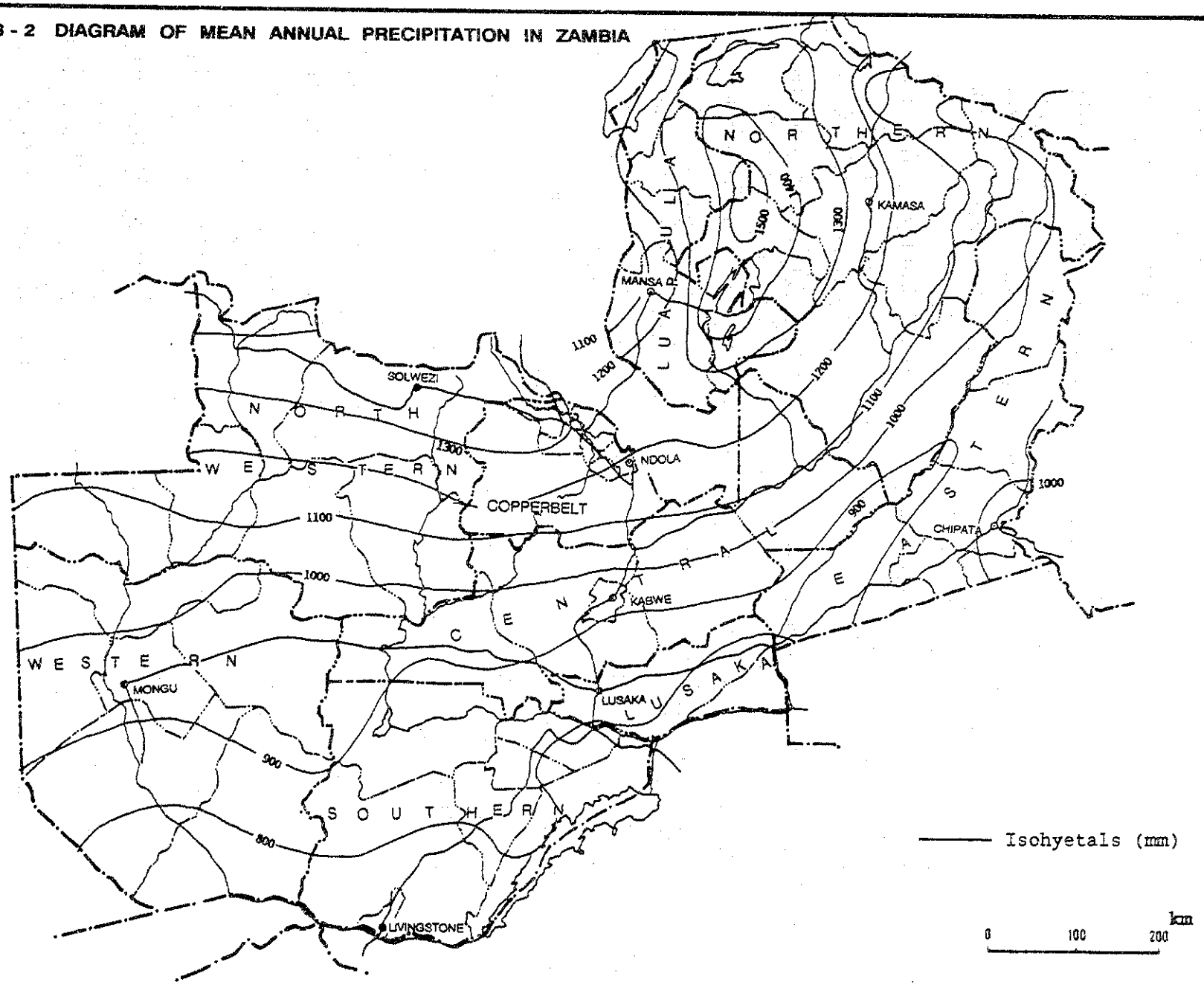
country lies on a high plateau rising from 900 m to 1,500 m in altitude, with its eastern and southwestern regions divided respectively by deep valleys of the Zambeji and the Luangwa Rivers. Those gorges were derived from the East African Rift System. Along the Kafue river system in the central region stretches an extensive swamp called Lukanga Swamp, created by the rise of stream water levels during wet seasons. The land in general is comprised of gently undulating plateaus, sloping down towards south or southeast, with its elevation in the south around 1,000 m and that in the north around 1,400 m. The Project area consisting of Lusaka, Central and Copperbelt Provinces is situated along the old line-of-rail axis running from the central to northern parts of the country, covering an area of 147,617 km^2, extending 400 km from north to south and 500 km from east to west.

The Project sites are roughly divided into two groups: one includes the sites scattered on the river terraces of about 300 m in elevation along the Kafue and the Luangwa Rivers; and the other covers those on a plateau area of 1,000 to 1,300 m. Paved main roads run mainly on the ridges extending from north to south and from east and west. A portion of the sites require access by ferry across the Mail or other branches of the Kafue River. A greater part of ground surface is mantled with sandy laterite, which is likely to create hazards in places in wet seasons, though raising no difficulty in dry seasons.

3.2.2 CLIMATE

Despite its location in the tropical zone extending from 8° to 18° in the southern latitude, Zambia can enjoys a rather moderate climate of tropical savanna nature, owing to its geographical position lying on a high plateau of 900 m to 1,500 m in altitude. Average annual rainfall data representing the country are shown in Fig. 3-2. Rain generally increases towards the north, registering an average 700 mm per annum in the south and 1,300 mm in the north. Surrounded by ridges in three directions, Luwingu in Northern Province has the highest

FIG. 3 - 2 DIAGRAM OF MEAN ANNUAL PRECIPITATION IN ZAMBIA



record of 1,500 mm on the average in the country.

The Project area, located roughly in the central part of the country, has a record of 750 to 800 mm in Lusaka Province, 900 to 1,100 mm in Central Province and 1,100 mm to 1,300 mm in Copperbelt Province. The wet and dry seasons are distinctly divided in the year; the former ranging from October to April of the succeeding year with the average rainy days per annum ranging 77 days in Southern Province and 84 days in Lusaka and Central Provinces to 97 days in Copperbelt Province. The average temperature of 18°C to 22°C is prevalent throughout the country. The dry season dominates from May to August with a relative cool weather of 15°C to 20°C, followed by the hottest season of the year during September and October when the temperature moves up to 21°C to 25°C. The lowest temperature of around 8°C has been experienced in July, and the highest one of 32°C in October and November. Humidity ranges from 32% to 65% during the dry seasons, and from 58% to 82% during the wet ones. Annual average evaporation registers the values of 2,046 mm to 2,215 mm, nearly three times those of annual precipitation. Various elements of climatology such as average monthly rainfall, temperature, etc. in the Project area are shown in the Appendix to this report.

3.2.3 GEOLOGY

Geology of the Project areas features various series of rocks ranging from basement complex of granite and gneiss, created in the Precambrian period almost three billion years ago, to the latest sediments of the Recent epoch. Precambrian rocks of basement complex are comprised of granite, gneiss and schist, and are broadly distributed in the southeastern and eastern parts of the country, which is overlain by a variety of sedimentary rocks of Paleozoic, Mesozoic and Cenozoic ages called respectively the Katanga, Karoo and Kalahari Rock Systems, occasionally with intrusives of hard rock such as granite and quartzite. Among these rock systems, Katanga mainly consists of metamorphic sedimentary rocks, with a thickness of a couple of thousand

meters, the lower part of which is constituted of shale, dolomite and quartzite, forming a matrix of copper mines, which is now the mainstay of the nation's industry. In Copperbelt and Southern Province are distributed outcrops of Katanga rocks with intrusives of granite.

The lower part of the Mesozoic Karoo rock system is predominantly shale and sandstone, distributed along the eastern rift valleys, while younger Karoo rock of basaltic lava characteristically appears in the western region and around the Victoria Falls in the south. The youngest rock series, Kalahari, is unconsolidated eolian sand including river deports in places, mainly distributed in the western region. In hard rock series such as Katanga and Karoo, faults and fracture zones running north-east and south-west are predominant, followed by those in the direction of east and west. Groundwater occurs mainly in those faults and fractured zones. The geological map is referred to in the Appendix to this Report.

3.2.4 HYDROGEOLOGY

Groundwater is broadly and practically utilized throughout the country as a water supply source. Groundwater in the Project area is grouped into two categories; one is shallow water coming from unconfined aquifers and/or semi-confined aquifers; and the other, confined or artesian water moving through fault or fracture zones of underlying hard rock series.

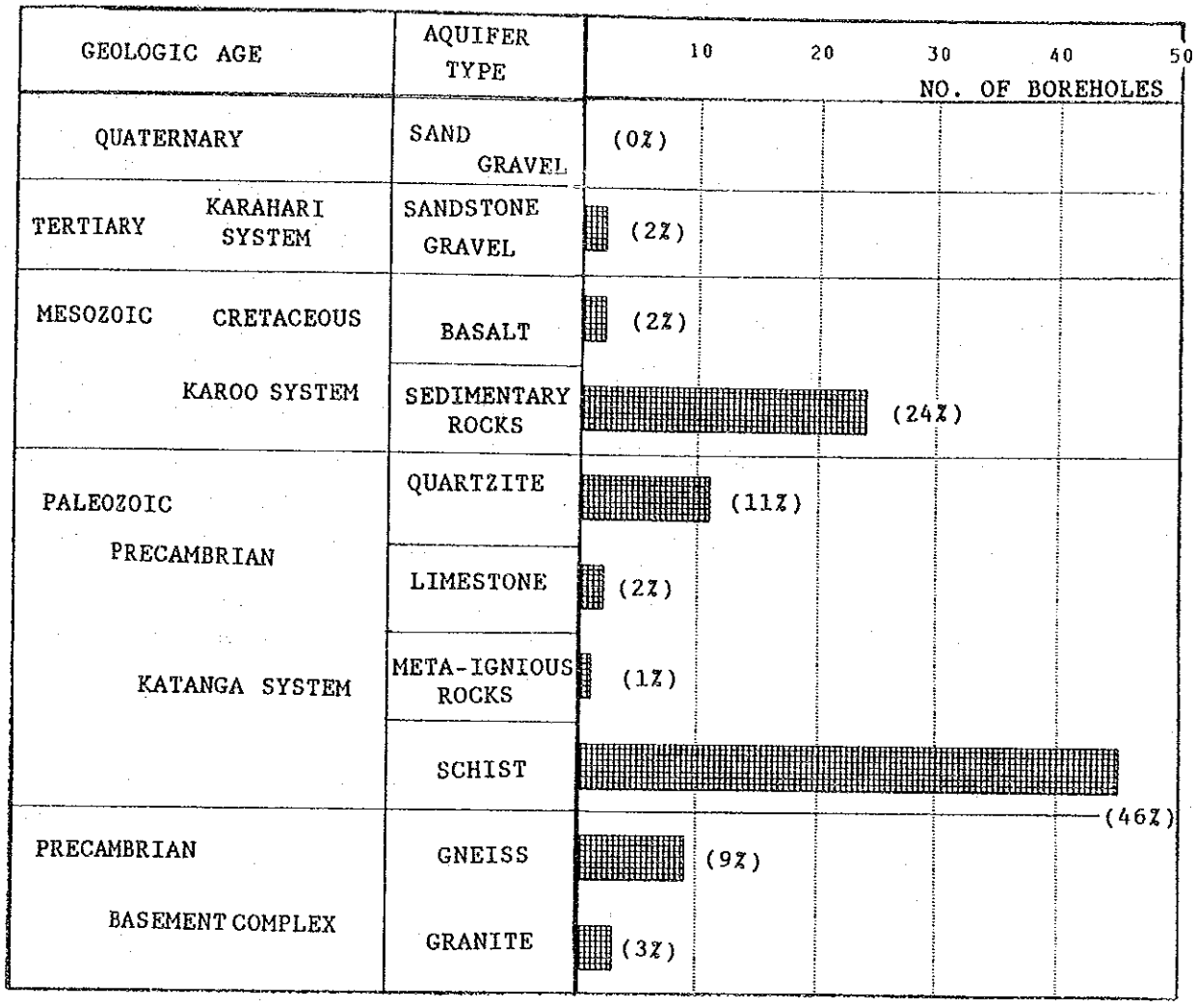
Groundwater currently taken from dug wells of several to around 10 odd meters in depth belongs to unconfined or semi-confined water, which is most likely to have already been contaminated from the ground surface and used to suffer frequent drops of the water levels during dry seasons. In view of such a situation, unconfined and semi-confined aquifers are not considered to be reliable for the Project sources.

On the other hand, the other type of groundwater in this area, confined water with a nature of fissure water which runs through fracture zones of limestone, dolomite, gneiss and schist of the Precambrian to Mesozoic ages, can be the principal candidate for the Project. Fracture zones and faults as passages of groundwater flows extend mainly in the directions of northeast to southwest and northwest to southeast in this area, and confined water occurring there is anticipated to possibly eliminate fears of contamination and water level decline.

The results of previous Japanese grant aid projects in Southern Province, Phase I and II, can reinforce the above-described theory in favor of confined water. According to the analysis, more than 200 boreholes drilled under those projects penetrated rock series of all geologic ages; namely Precambrian basement complex of granite and gneiss; Paleozoic Katanga rocks of schist, metamorphic igneous rocks, limestone and quartzite; Mesozoic Karoo of sandstone, mudstone, shale and basalt; and Tertiary Kalahari series of sandstone and conglomerate. Among those rocks, however, the dominant aquifer encountered during the operation was schist belonging to the Katanga series, accounting for an overwhelming 46 percent of all the boreholes. Sedimentary rocks of sandstone and mudstone of Karoo system followed it at a rate of 24 percent, trailed by quartzite of Katanga (11 %) and Precambrian gneiss (9 %). The detailed data on the distribution of aquifers in those projects are shown in Fig. 3 - 3. Quaternary alluvium of sand and gravel can also constitute a good water-bearing formation. Its distribution in Southern Province, however, is quite limited, while this new Project can expect a far wider distribution of this deposits along both the Luangwa and the Kafue rivers.

The great majority of boreholes under those project resulted in yields ranging from 5 to 70 lit/min, with exceptions having rather high rates of 100 to 250 lit/min from such aquifers as sandstone/mudstone of Karoo, schist of Katanga and Precambrian gneiss. The distribution of limestone aquifers is limited in Southern Province. On the other hand, the new Project involves the area near Lusaka City where the existing wells drilled through this kind of rock produce yields of more than 250

FIG3-3 DIAGRAM SHOWING TYPES OF AQUIFERS ENCOUNTERED IN SOUTHERN PROVINCE



lit/min. According to the analysis of drilling and pumping data from the Southern Province project, main aquifers appear to occur in the zone of 20 to 70 m, particularly from 20 to 40 m where the highest yields of 50 to 300 lit/min could be obtained, suggesting that faults and fractures are dominant there.

In comparison, the Project area will have to penetrate deeper than Southern Province did for borehole construction. The former involves a broader stretch of outcropped hard rock series than the latter, although the former has areas favored with loose formations of alluvium such as sand, gravel and clay thickly deposited along the major rivers. A wide range of the static water levels from 6 to 70 m in the Project area are deeper than that in Southern Province, while the yield in the former will vary from 12 to 312 lit/min at roughly the same level as that in the latter or a little more. The depths of main water bearing formations for the new Project are expected to be from 40 to 80 m, with the geologic features and related groundwater occurrence shown in Table 3 - 4. Further detailed analysis of groundwater potential in the Project area will be discussed in Chapter IV in relation to the Project Planning. Various geological and hydrogeological data are also referred to in the Appendix to this report.

TABLE 3 - 4 GEOLOGICAL AND HYDROGEOLOGICAL FEATURES OF ZAMBIA

Geologic Age	Rock System			Rock Type	Aquifer Type	Groundwater
CENOZOIC	Recent to Tertiary	Alluvium - Laterite		Clay, Silt, Sand	Sand & Gravel	○
		Kalahari System Mongu Sands Barotes Sandstone		Sand Sandstone	Sand S.W.L. = 40m - 50m	○
MESOZOIC PALAEOZOIC	Karoo System			Basaltic Lava (Cretaceous)	Lava Fractures	◎
	Jurassic to Upper Carboniferous	Upper Karoo Group		Red Sandstone Sandstone Mudstone Coal	Sandstone Fractures Aquifer Depth = 40m - 50m	
		Lower Karoo Group		Sandstone Conglomerate	S.W.L.= 25m	
PALAEOZOIC PRECAMBRIAN	Katanga System (Lower Palaeozoic to Late Precambriam ?)			Dolomite, Shale Limestone Sandstone, Schist Quartzite	Weathered & Fractured Zones	◎
	Muva System (Precambrian)			Dolomite, Shale Limestone Sandstone, Schist Quartzite	Weathered & Fractured Zones	◎
PRECAMBRIAN	Basement Complex (Lower Precambrian)			Schist, Gneiss Granite	Weathered & Fractured Zones	◎

Groundwater Occurrence: ◎ GOOD
○ FAIR

3.2.5 WATER ANALYSIS

The results of water analyses in the Project area are enumerated in Table 3 - 5. It shows that groundwater in the Project area as a whole is characterized by rather a high value of total hardness, apparently due to a large content of calcium, and an excessive total iron volume over the criterion. A stream water sampling in Serenje District has shown an extraordinarily high rate of 0.9 mg/lit for total iron. The values of pH were roughly in the same range of 6.91 to 7.36 in both groundwater and river water, showing slight acidity. Chlorine was low also in both types of sources, ranging from 1.0 to 26.6 mg/lit. Compared to river water, groundwater samples showed higher electric conductivity, but the range of its values were 290 to 600 micro moh/cm. The low value of 290 micro moh/cm was encountered in sampling at the Kaunga area lying over alluvial deposits forming the river terrace, indicating the influence of stream underflow around that area. Other groundwater samples were all taken from aquifers of hard rocks belonging to Katanga series, with their qualities apparently implying the influence of natures of rocks such as limestone and dolomite through which groundwater moves.

Samples were analyzed, based upon the water quality standard of WHO and Japan. They were collected from the existing boreholes in more or less urbanized local cities in the Project area. All of them satisfy the standards' criteria except for the ammonia and coliform groups. On the other hand, samples in the rural area were mostly from dug wells, more than 80 percent of them showing sings of contamination with coliform groups with whitish turbidity. The water levels in those wells were witnessed to have dropped near to the bottom. Such shallow water in dug wells is not considered to be a stable sanitary source, and this Project is recommended to take confined groundwater in boreholes.

TABLE 3 - 5 WATER SAMPLING DATA IN PROJECT AREA

NO.	NAME OF SITE / SUMPLING DATE	CATEGORY	pH	Cl- (mg/l)	TOTAL HARDNESS (mg/l)	Ca (mg/l)	Mg (mg/l)	So^4- (mg/l)	M-ALKALINITY (mg/l)	NH^4-N (mg/l)	NO^2-N (mg/l)	NO^3-N (mg/l)	F- (mg/l)	T-Fe (mg/l)	COLIFORM (N/ml)	ELECTRIC CONDUCTIVITY (us/cm)
1.	Lusaka 11th Dec.	Groundwater	6.93	15.2	294	76.4	25.0	9.5	244	<0.08	3.5	<0.01	<0.5	<0.03	0	600
2.	Chibombo 13th Dec.	Groundwater	7.18	9.1	327	86.0	27.2	9.4	311	<0.08	1.5	<0.01	<0.5	0.04	0	520
3.	Kaunga 28th Nov.	Groundwater	7.09	1.9	112	25.2	11.9	<5	122	<0.08	<0.1	<0.01	<0.5	0.07	3	290
4.	Kabwe 4th Dec.	Groundwater	7.14	2.1	201	56.0	14.8	<5	198	<0.08	0.4	<0.01	<0.5	<0.03	10	420
5.	Chongwe 12th Dec.	Groundwater	7.36	26.6	267	72.8	20.6	13.5	271	<0.08	0.1	<0.01	<0.5	0.30	15	550
6.	Ndola 6th Dec.	Groundwater	7.35	13.2	274	50.4	35.9	30.0	228	<0.08	0.1	<0.01	<0.5	0.03	0	440
7.	Serenje 6th Dec.	Groundwater	7.12	1.0	6.0	0.8	0.9	<5	35	<0.08	<0.1	<0.01	<0.5	0.90	2	220
8.	Luangwa 28th Nov.	Steram	6.91	2.2	55.6	12.0	6.2	7.0	46	<0.08	<0.1	<0.01	<0.5	0.16	3	130
STANDARD		WHO	7.0-8.5	200-400	100-500	75	50	200	-	0.5	-	40 - 80	1.0-1.5	0.3	MPN 10	2,000
		JAPAN	5.8-8.6	200	300	-	-	200	-	SHALL NOT BE PETECTED IN SAME SAMPLE		10	0.8	0.3	NEGATIVE	-

3.3 CURRENT WATER PRACTICE IN THE PROJECT AREA

3.3.1 FEATURES OF THE PROJECT AREA

Three Provinces of Lusaka, Central and Copperbelt is extended in the central part of the country, with main national roads and railways crossing the area, having a high potential of development in the agricultural and industrial sectors. In this area live 850,900 people (1989), accounting for about 11 percent of the country's total population of 7.8 million and about 22 percent of its rural population of 3.88 million in total. The total area comprised of three provinces occupies 137,929 m^2, roughly corresponding 18.3 percent of the country. Its average population density is 6.2 persons per km^2, comparatively lower than the national average of 10.4, with its district-wise figures ranging from the highest one of 10.7 in Lusaka Rural District to the lowest of 4.2 in Serenje District. The features of the Project area are summarized in Table 3 - 6.

TABLE 3 - 6 FEATURES OF THE PROJECT AREA

Governorate	District	Area (km^2)	No. of Communities	No. of Schools/ Hospitals	Population	
					Estimated in 1989	Density
1. Lusaka	Lusaka Rural	18,065	101	33	192,800	10.7
	Luangwa	3,471	8	5	15,400	4.4
2. Central	Kabwe Rural	25,760	103	33	195,900	7.6
	Mkushi	22,608	51	16	96,700	4.3
	Mumbwa	21,103	59	19	112,400	5.3
	Serenje	23,351	52	17	98,400	4.2
3. Copperbelt	Ndola	23,571	106	34	139,300	5.9
Total:		137,929	480	157	850,900	6.2

The mainstay of the regional industry is agriculture, involving nearly 95 percent of the total population of the area. Most of them, however, run a tiny farm producing minor quantities of cash crops, earning an average income of only 500 to 900 Kwacha per annum (estimated in 1988). The number of rural communities in the area is 480 in total, with their populations ranging from 120 to 5,000 (1,770 on the average). Waterborne diseases account for about 20 percent of patients throughout the area, with a particular case reported in Central Province about the incidence of diarrhoea caused by a certain water source. Public institutions such as schools, hospitals, etc., totals 157, roughly corresponding to one facility for three communities.

3.3.2 CURRENT WATER PRACTICE

Existing water sources in the Project area are traditional hand dug wells, concrete-lining dug wells with chain-buckets for water lifting, boreholes with hand pumps and surface water.

The current situation of existing water sources in the area are listed in Table 3 - 7. Women and children in these rural areas have long been practicing fetching water home from sources at least one kilometer away, most commonly 1 to 3 km distant, with the distance being farther extended to 5 to 7 km during dry seasons. They must repeat going and coming back with water three or five times a day, to serve their families an average rate of per capita per day consumption of 20 to 30 liters. According to the hearings during the field survey by the study team, a consumption rate widely varies from 4 to 60 liters due to factors such as seasons and distances to sources.

TABLE 3 - 7 EXISTING WATER SOURCES IN THE PROJECT AREA

Governorate	District	Existing Water Sources				
		Rainfall (mm/year)	Dug wells (No.)	Boreholes (No.)	Rivers (No.)	No. of Beneficiaries
1. Lusaka	Lusaka	700	83	40	17	38,600
	Rural					
	Luangwa	650	17	10	3	3,100
2. Central	Kabwe	800	277	66	18	39,200
	Rural					
	Mkushi	700	43	31	9	19,300
	Mumbwa	700	177	40	10	22,500
	Serenje	700	53	26	9	19,700
3. Copperbelt	Ndola	1,200	64	24	33	60,300
Total:		-	714	237	99	202,700

1)Wells

The total number of workable existing wells is estimated to 550 in Central Province, 100 in Lusaka Province, and 64 in Ndola Rural, Copperbelt Province. These wells are usually dug by hand and having the lining made of concrete. The typical structure of well is about 15 meter deep with diameter of 1.2 meter. The mostly used water lifting device is windlass with chain and bucket and it shares about 65% of the total number. Approximately 15% of the wells are equipped with hand pump and the blanced 20% are either broken or without any water lifting device.

Based on the survey, the main shortcomings of the existing wells are found as follows:

a. Inadequate protection of well surrounding against contamination

b. Inadequate storage capacity of well

c. Inadequate management for operation and maintenance of water lifting devices

d. Bacteriologically polluted by human activities

About 20% of existing wells have been abondend in the project area due to the above mentioned shortcomings.

2) Boreholes

The existing boreholes in the project area are counted to 50 in Lusaka Province, 163 in Central Province, 24 in Ndola Rural, Copperbelt Province respectively. The boreholes are constructed by cable tool percussion type and/or rotary type of drilling machines, and steel casing is used in unconsolidated materials with screen being placed in the region of the aquifer. It is a normal practice not to place casing in case of boreholes in consolidated or stable formation. The hand pump is usually equipped on the borehole as water lifting device.

As its aquifer is mainly confined, borehole which hardly runs dry even during dry seasons, is a stable and hygienic water source in the area. But at present, approximately 50% of the boreholes are not in use becouse the equipped hand pumps are being out of order. Therefore, under this project, 200 new boreholes will be constructed as well as 100 existing boreholes will be rehabilitated for the improvement of water supply environment in the area. In Central Province a bilateral assistance from the Federal Republic of Germany has an intention to provide rehabilitation work of the existing boreholes, therefore, 100 rehabilitation work of this project will be carried out in two Provinces of Lusaka and Copperbelt.

3.3.3 WATER SUPPLY PLANNING FOR THE PROJECT AREA

The population currently being served by existing water sources in 7 districts of 3 provinces is 202,700 covering 23.8 percent of the total 850,900 estimated in 1989. This rate of coverage is considerably lower than 41 percent of the national average estimated in 1985. The DWA, therefore, aims to serve 50 percent of the country's entire rural population with safe and stable drinking water by 1991, in line with the Plan of Action of the IDWSSD (1981 - 1990). According to this target, the planning of water supplies for this area is summarized in the following table:

TABLE 3 - 8 RURAL AREA WATER SUPPLIES FOR THE PROJECT AREA (7 DISTRICTS OF 3 PROVINCES)

Governorate	District	Population (1989)	Currently Served Population	No. of Facilities(This Project)	Population To Be Served by Year 1991	Population To Be Served by Project
1. Lusaka	Lusaka Rural	192,800	38,600	45	57,800	39,700
	Luangwa	15,400	3,100	10	4,600	3,730
2. Central	Kabwe Rural	195,900	39,200	30	58,750	21,700
	Mkushi	96,700	19,300	30	29,050	19,700
	Mumbwa	112,400	100,200	20	33,700	9,388
	Serenje	98,400	19,700	15	29,500	8,470
3. Copperbelt	Ndola	139,300	60,300	50	9,350	16,700
Total:	7	850,900	202,700	200	222,750	119,388

Parameters of the plan in the above table is explained as follows:

(1) The total population of the area : 850,900

(2) No. of beneficiaries of rural area supplies targeted by 1991 : 425,450

(3) Currently served population : 202,700

(4) Population targeted for service by 1991 : 222,750
(2) - (3)

(5) No. of facilities to achieve the target by 1991 : (Refer to 4.3.2 Details of Project Planning)

a. In case the standard supply rate of 30 lit per capita per day is adopted, one unit of hand can serve 250 people a day. Therefore;
222,750 / 250 = 891 (facilities)

b. In case the minimum supply rate of 5 lit per capita per day is applied, one unit of hand pump can serve 1,500 persons a day. Therefore;
222,750 / 1500 = 149 (facilities)

(6) No. of facilities to be installed under this Project : 200 facilities

(7) Planned served population under this Project : 119,388

The contribution of this Project to the target of the DWA by the year 1991 is that it can cover a population of 119,388 against the DWA's target population of 222,750, leaving 103,362 unserved. The number of facilities required to meet the standard rate of supply of 30 lit. per capita per day is calculated to be 891. However, in case it is basically planned to meet an urgent demand of 5 lit. per capita per day during dry seasons, 149 facilities are enough. In this context, this Project under which 200 facilities are planned to be installed is judged to be one satisfying the basic minimum need of drinking water currently required in the area.

CHAPTER IV

DESCRIPTION OF THE PROJECT

CHAPTER IV

DESCRIPTION OF THE PROJECT

4.1 OBJECTIVES OF THE PROJECT

The rural water supply scheme has been among the overriding strategies of the Government under the ongoing Fourth National Development Plan(1989-1993), with a target to augment its coverage to 50 percent of the entire rural population by the year 1991 in response to the Plan of Action in the United Nation's International Drinking Water Supply and Sanitation Decade (1981-1990). This Project is aimed at contributing to Government's efforts for the social security and improvement of rural life by means of serving clean and safe drinking water. To achieve such objectives, the Project plans to execute the construction work of 200 boreholes and the rehabilitation of 100 existing boreholes, including the supply of equipment and materials required for the implementation.

4.2 REVIEW OF THE REQUEST BY THE GOVERNMENT OF ZAMBIA

4.2.1 FEASIBILITY AND NECESSITY OF THE PROJECT

The previous grant aid projects entitled Groundwater Development Project, Phases I and II, for Southern Province were extended to the Government of Zambia by the Government of Japan to relieve hardships of the rural people in that area suffering from the devastating effects of drought through the construction of drinking water facilities. Those projects could achieve highly acclaimed results. On the other hand, this Project plans to cover the three Provinces of Lusaka, Central and Copperbelt, where the expansion of rural water supplies through

groundwater development has helplessly been constrained due to a lack of suitable equipment and where the great majority of the rural population has long been yearning for stable sources of clean drinking water. With the country's largest cities of the Capital of Lusaka, Kabwe and Ndola situated within a close proximity of the rural area of the respective provinces, the rural water supply scheme, if performed extensively and effectively, could have an effect to deter a large-scale migration of agricultural population into urbanized areas as a result of the settlement and stabilization of rural life represented by the establishment of leading agriculture centers in places through improvement of water environment, and thereby to contribute to one of main targets of the Fourth National Development Plan. It is evident that the Project can play a decisive role for that purpose. Currently the coverage of rural area water supplies in the Project area remains confined to a remarkably low level of 24 percent. This Project, if implemented, can serve an additional population of about 120,000, elevating the rate of coverage by 14 percent. Women and children will be released from the painstaking work of fetching water from distant sources, and possibly contribute to the reinforcement of the labor force for production. To the great majority of the rural population in the Project area without any sources of hygienic, stable drinking water, the realization of public water supplies is among their earnest wishes to meet one of their basic human needs. From this meaning, the plan of this Project is judged to qualify as a grant aid project to be taken up by the Government of Japan.

4.2.2 APPROACH TO PROJECT IMPLEMENTATION

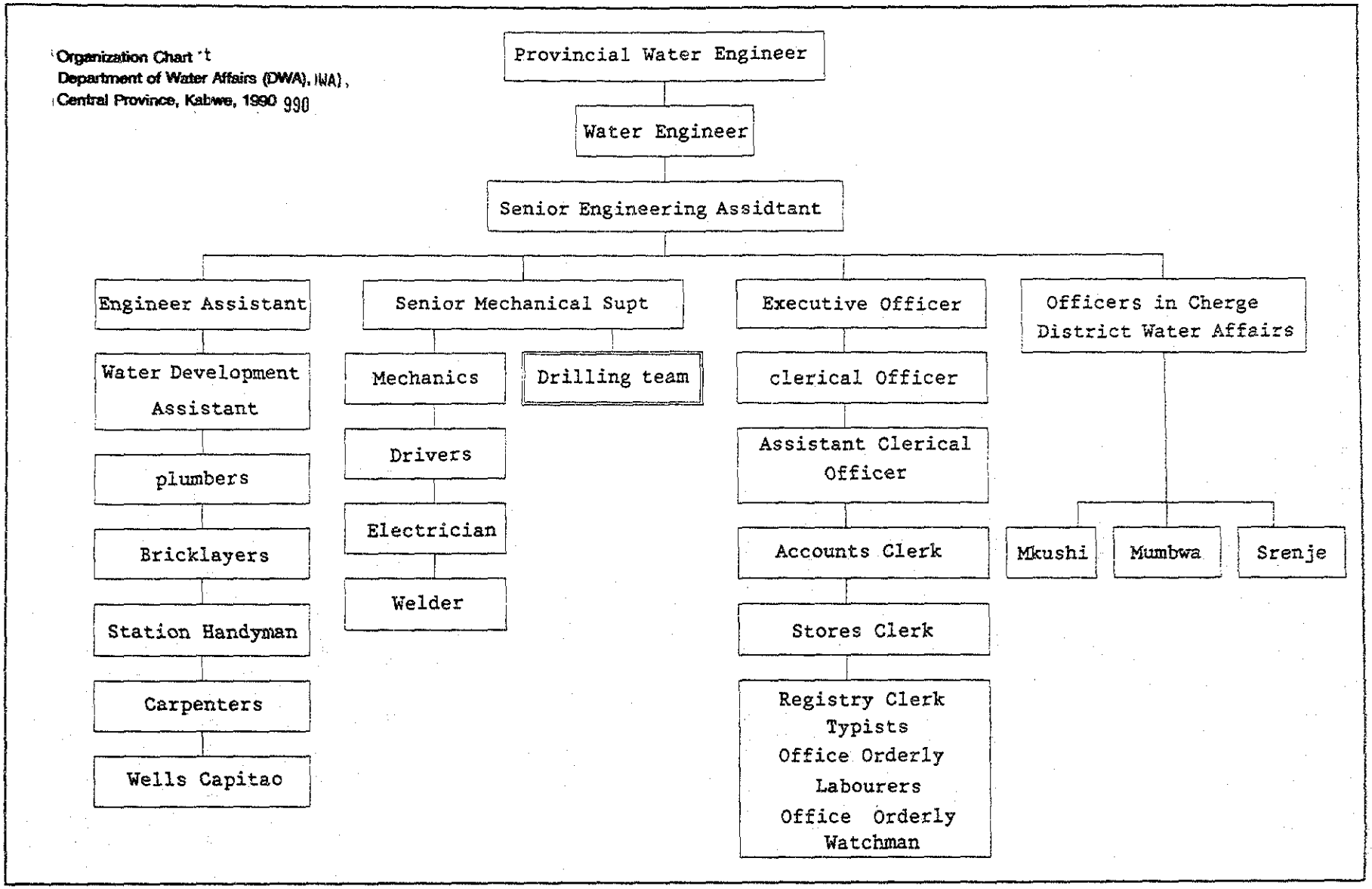
The execution of the Project is to be presided by the Director of the DWA, under direct control of its offices of Data and Planning for administrative affairs and Hydrogeological Section for technical and engineering matters. Particularly Hydrogeological Section is to play a leading role among a number of DWA's offices as follows: to select competent and qualified personnel for technology transfer out of DWA Headquarters' staffs in the hydrogeological team, the drilling crew and administrative office as well as those stationed at the Provincial

Water Engineer Offices of the three provinces where the Project is executed; and to organize the Japanese project team composed mainly of personnel thus appointed. Upon completion of this phase, the promotion of rural area supplies in three provinces will be taken over by those DWA's engineers who participate in this Project for technology transfer.

Since the Project area stretches over a broad expanse of 147,617 km² with three provinces involved, roughly corresponding to 40 percent of the total area of Japan, there arises a necessity of installing a project operation base with a function of a depot at a point conveniently located for traffic enabling easy and minimized access of staff and crew to and from the sites. The best suited place for the purpose is Kabwe City, since its location is a hub of the Project area, linked to the other two major cities of Lusaka and Ndola in the area by the trunk main. Moreover, its urbanized environment could strengthen the function of a depot. Although this city already has DWA's Provincial Water Engineer Office, with an organization as shown in Fig. 4-1, its existing facilities and activities were found far from being relevant for operations of this Project, as illustrated by the drilling team mentioned in the organization chart, which has had no activities up to now due to lack of equipment. An adequate site for this operation base has been proposed by the DWA for the implementation of the Project.

Taking into account the DWA's experience in the implementation of the past Japanese grant aid projects in Southern Province as well as the size and scale of the present Project, the setup of organization for the Project implementation is proposed, including the following components; the Project supervisory team, the equipment maintenance and control unit, the workshop unit, the hydrogeological survey units, drilling units, water facilities installation units and rehabilitation work units (For the details, refer to Section 4.3.1).

Fig. 4 - 1 ORGANIZATION CHART OF PROVINCIAL WATER ENGINEER OFFICE (DWA, CENTRAL PROVINCE)



For the implementation of the Project, the Government of Zambia is required to make a financial arrangement for the activities of counterpart engineers involved in the Project. The national budget in 1988 was 8,300 million Kwacha (830 million U.S. dollars), while it spiralled in 1990 to about 29,900 million Kwacha (about 750 million U.S. dollars). Although the apparent value of the latter is about three times that of the former, the substantial one in exchange of the U.S. dollar dropped by 28 percent, due to inflation and the devaluation of Kwacha against the dollar. Under such a framework, the DWA's budget increased from 50 million Kwacha in 1988 to 204 million in 1990, with its share in the whole fund of the Ministry of Water, Land and Natural Resources growing from about 45 percent in 1988 to 58.6 percent in 1990, significantly enhancing its position within the Ministry. Within the Department, the allocation of its fund for development planning has been the highest one ranging from 74 to 84 percent. Anticipated foreign investment in this planning is growing, with its share in 1990 put at 87 percent.

In the past, the DWA shared a portion of the implementation cost for Groundwater Development Projects in Southern Province. During Phase I of that project, its expenses for local personnel, fuel and materials was 530,000 Kwacha (4,200 U.S. dollars) in 1985, while in Phase II in 1988, its share rose to 2,310,000 Kwacha(230,000 U.S. dollars), accounting for about 5 percent of its total annual budget for that year. Using this fund, the works are still ongoing by its own staff, although the progress has lately been curbed because of the fuel cost spiralling under the influence of the Gulf Crisis. For this Project, the estimated cost for personnel only to be shared by the DWA reaches 3.3 million to 7.0 million Kwacha (43,000-156,000 U.S. dollars), accounting for 1.6 to 3.4 percent of the Department's total budget in 1989, for each of the five stages dividing the entire program. The expense for fuel and materials, therefore, is proposed to be shared this time by the Japanese side. Such arrangements are considered to substantially relieve the responsibilities of the DWA and to raise little difficulty in the Project implementation on the Zambian side.