financially self-sustaining basis. In this respect, the financial capabilities for executing this project are assured. However, care must be taken so that the operation costs of the new water supply facilities to be constructed by this project do not create a burden on the LWSC. Therefore, as is explained later, a self-sustaining method, in principle, will be the goal for the water supply activities in the George Complex.

(3) Evaluation of Management Capabilities

The LWSC alone manages the entire water supply and sewerage undertakings in the Lusaka City since its establishment in March, 1988, and the transfer of control of water supply and sewerage from the City Council in January, 1990. Although the current water supply situation presents many problems, the LWSC, having experience in managing the undertakings until now, is endeavoring to upgrade its services. Overall, with respect to management capabilities, the LWSC is competent enough to be the executing agency for this project. Further, the LWSC is responsible for managing all of the existing water supply works, including pumping, treatment, transmission and distribution. In addition, concerning the public faucets constructed with assistance from foreign countries and which cannot collect fees, the LWSC is taking responsibilities for their operation and maintenance.

3.2.3 Consideration of Management Capabilities

(1) Management Policy

The goal of the operation and maintenance plan is to manage the water supply system in the George Complex on a self-sustaining basis. Achieving this goal in the initial stage will, however, be difficult. Financial assistances from governmental agencies supporting the Lusaka Water and Sewerage Company, such as the Ministry of Local Government and Housing and the Lusaka City Council, as well as financial support from the LWSC itself, will support the operation and maintenance of the water supply systems.

Comparison of "Self-Sustaining" and "Cross-Subsidization" Methods

An alternative to the self-sustaining system for operation and maintenance of the water supply facilities to be constructed by this project can be given. This method includes managing the overall balance of the LWSC as part of the water supply undertakings of the Lusaka City, which means that, through inhouse compensation called "Cross subsidization", funds will be transferred from its profitable divisions to its unprofitable divisions. Even in this Project, if the water supply activities in the George Complex is operating at a deficit, the operation cost will come from the budget pooled at the LWSC. However, because the LWSC's management is not yet consolidated, a self-sustaining system of water supply (excluding large repairs and renovations), by soliciting self-help measures from the residents, is desirable to provide a minimum water supply in the George Complex. Consequently, as will be discussed in detail later, the operation on a self-sustaining basis is possible. Although this method is in principle feasible, if difficulties do arise in actuality, the operation can be maintained through subsidies from the LWSC.

Zambia's Draft Plan for Operation and Management

In advance of the basic design study, a draft plan related to maintenance was discussed between the LWSC and the LCC. As a result of these discussions, the following draft plan was proposed to Japan.

1) Sharing of maintenance responsibilities by the ward development committees

   a. Employment of a plumber, a plumber's helper, and a fee collection team and its helper in each ward.
   b. Facility operation and maintenance by the plumber, the plumber's helper, and the fee collection team and its helper.
   c. Light repairs such as the replacement of broken taps.
   d. Creation of a fee collection method, collection of fees,

and delivery of revenue to the LWSC by the ward development committees.

e. Ten percent of the revenue delivered to the LWSC will be distributed to the ward development committees, and the remaining 90% will be deposited in the account of the LWSC under the name of the ward development committees.

2) Share of maintenance work by the LWSC

a. Maintenance of wells and distribution pipelines and the payment of electrical power fees.
b. Remuneration for the plumber, the plumber's helper, and the fee collection team and its helper employed by each ward development committees.
c. Provision of training related to the maintenance of public faucets for the plumber in each ward.
d. Provision of operation and maintenance guidance for the plumber, the plumber's helper, and the fee collection team and its helper employed by each ward.
e. Support of water leakage repairs along the water distribution pipelines.
f. Provision of maintenance equipment and fixtures necessary for each ward.
g. Dispatch of specialists according to the request of the ward development committees.
h. Continuation of regular (monthly) meetings conducted by the LWSC and the representatives of ward development committees.
i. Provision of financial support through subsidies for capital shortages of the ward development committees.
j. Residents are responsible for the operation and maintenance of the new water supply system. If public faucets are damaged by vandalism, replacement of taps will be paid by the residents. It is the responsibility of LWSC to inform the residents of this system.

Modified Draft for Operation and Maintenance

In the above draft plan, the ward development committees organized in each ward of the George Complex will be responsible for the majority of the on-site maintenance operations, while remaining under the supervision of the LWSC. As this draft depends mainly on the ward development committees, its comprehensive use in this project is judged to be appropriate. Considering LWSC's request (activities as part of residents' self-help efforts), the study team judged that the participation of ward development committees, within the range shown below, is appropriate in order to supplement the LWSC's water service operation system in this project.

1) The section chairman will notify residents on matters related to water fees, water fee payment due date, payment confirmation, and notice to nonpaying water users (section chairmen: refer to 3.1.1). Payers of water fees will pay their fees directly to the accounting section of the LWSC; the section chairman does not receive any water fees.
2) Public relations and educational activities for residents (public sanitation and the correct usage of the water supply facilities)
3) Provide information related to the operation and maintenance of the water supply facilities and the use of each facility.
4) Conduct regular (monthly) meetings between the LWSC and the representatives of the ward development committees.

Based on the above operation policies, the LWSC is required, along with the implementation of this project, to establish an independent division in the George Complex to be in charge of facilities operation and maintenance, fee collection, and other related work.

(2) Violence against Public Facilities (Vandalism)

In the Lusaka satellite areas including the George Complex, due

to the high rate of vandalism where public facilities are damaged, problems in management and maintenance of the designed water supply facilities are feared. From the start of study on this Project, vandalism to the existing water supply facilities was thought to be due to the problem in maintenance. However, upon investigation of the vandalized facilities, the conclusion was that the incidents were numerous in areas where water was not supplied, and no damage was found in areas where water was supplied even in small quantities. The questionnaire inquiries to the residents carried out during the field survey revealed that the residents themselves have strong wills to protect the water supply facilities. Consequently, we believe that if a stable supply of water is provided, vandalism will not occur.

Furthermore, a self patrol group called the 'Neighbourhood Watching Association' is organized by the residents, whereby during the day, woman, and during the night, men go on patrol. This kind of residents' activity seems to be effective to prevent vandalism.

3.2.4 Consideration of Water Supply Facilities

Although the water supply facilities requested are confirmed and agreed to be basically unchanged during the site survey and the discussions with the Government of Zambia, the chlorination facilities and the operation and maintenance facilities are added to the request and included in the Project through the examination of the implementation plan.

The water supply facilities are examined and finalized as follows:

(1) Boreholes as Water Sources

Since surface water utilizable as water source is not available, and shallow groundwater is contaminate near the George Complex, the construction of boreholes which can pump up a safe and stable

supply of groundwater is judged to be viable.

(2) Chlorination Facilities

Although it was considered that contamination of groundwater of deeper formations was not found in accordance with the data of water quality analysis of the samples from the same formations collected from the existing boreholes in the dry season conducted by the study team, the intrusion of contaminants to some of the existing boreholes from the surface was reported based on the analysis conducted by the Lusaka Water and Sewerage Company in the rainy season. Therefore, installation of the chlorination facilities was judged to be necessary in order to provide a sanitary and stable water supply all through the year.

(3) Water Distribution Facilities

Generally two methods of water distribution are available: the pumping method and the gravity method.

Either method is technically feasible for the George Complex because the topography of this area, though gently sloped, has virtually no undulations which would obstruct the distribution flow of water. Each method will be examined as follows.

Pumping Method

In the pumping method, water is supplied directly due to pumping head losses through pressurized tanks. To regulate the required supply rate, ground type tanks are used as temporary storage and the supply is controlled either electrically or mechanically by booster pumps. This method has advantages such as the structure of ground tanks is simpler than elevated type tanks, and the tank can be installed near the water source without consideration of the topography. However, the disadvantages are a complicated control system and the necessity of booster pumps in addition to

the borehole pump. Therefore, electrical and mechanical parts are increased which means operation and maintenance becomes more difficult, more electrical power is consumed, and water supply is suspended during blackouts.

Gravity Method

The gravity method supplies water utilizing the head loss due to the height difference of the storage tank elevation. In order to obtain sufficient pressure, the water tank is installed on a higher position making use of topographic conditions or an elevated tank is used. An elevated tank is more appropriate for this Project because of the topographic conditions of the project area.

This method has such advantages as the control is simpler, less working mechanical components are found, only the borehole pump is needed and water stored in the tank can be supplied during emergencies like black-outs.

When selecting this method, the appropriateness of the tank capacity must be considered, but in consideration of the capacity required for this project, an elevated tank is judged to be appropriate.

The disadvantage of this method, on the other hand, is that a specified construction site for the tank may be needed which may not necessarily be near the borehole nor the service area.

Distribution Method for the George Complex

The gravity method is judged to be more suitable than the pumping method for this project through the integrated examination of the topographic conditions, the water demand to be supplied, the economic evaluations, and the operation and maintenance considerations. The existing water supply facilities for the Lusaka City have also utilized the gravity method for these reasons.

(4) Distribution Pipelines

The distribution pipelines are to be buried which is a basic construction method for urban water supplies in consideration of the facilities themselves and to avoid traffic inconvenience. Laying distribution pipes underground will not present any problems although there are some places where rocks appear in the George Complex. PVC pipes will be used for the distribution pipes because of the easiness in installation, and appropriate protection of the distribution pipelines laid under roads where traffic is normally heavy will be considered.

(5) Supply Method

The selection of the supply method must consider if the water is sanitary to the users, the supplied water is of stable and sufficient quantity, the water can be obtained without much effort and the water can be supplied economically. An appropriate operation and maintenance of the system and a stable cost recovery are vital to meet these requirements.

Two water supply methods are available: the house connection system and the public faucet system. Although house connections are more convenient for the users if the supply has sufficient quantity and pressure, the users must pay for the connection pipelines and water meters under the present system of the LWSC. Furthermore, for house connections, the users are obliged to pay the water fee on a quantitative fee basis, which means the fee is charged according to be consumed amount as measured by water meters. While the LWSC is obliged to guarantee a supply of safe and stable water, they can expect stable cost recovery from house connected consumers.

On the other hand, the public faucet system supplies water to the residents through the public faucets installed outside of houses to be used by a number of households in the service area. This system generally consumes less water per person and costs less

than house connections. Although the LWSC can sell water poured into a container and collect the fee at the supply facility, the water consumption rate is very difficult to be specified except when an honest self declaration is made by the users. Therefore, the LWSC should provide a well prepared water fee collection system to recover the cost.

Water Supply System for the George Complex

Using public faucets is an appropriate water supply system to meet the social environment and living standards of the George Complex where numerous low income people reside. Moreover, since this project has objectives to urgently solve the problem of water borne diseases such as cholera, water meters will be installed for each public faucet in order to determine and manage the water consumption at the public faucets.

(6) Operation and Maintenance Offices

Although the project area has a service area of 4.8 km^2 and more than 110,000 served population in 1993, the LWSC has no offices or branch offices in this area for the operation and maintenance of the water supply facilities. The water supply operations in this project aims to establish a self-sustaining system. Also, it is very important for the project not only to complete the construction of water supply facilities, but also the smooth operation and management after completion of the construction. Therefore, it is necessary to construct operation and maintenance offices to carry out all works related to the water supply system of the Project. The operation and maintenance can be handled more easily if the operation is divided into several blocks than to keep it as a unit from the scale of water supply of this Project. Thus, a main division office for carrying out the management of the whole water supply system and subdivision offices in each service area for field operations should be constructed.

(7) Miscellaneous Facilities

1) Laundry Facilities

Laundry facilities attached to the public faucets are requested. Laundry facilities have been provided for several similar projects such as the Japanese Small Scale Grant Aid Project and the LWSC projects, and is being appreciated by the residents. The provision of the laundry facilities is considered to contribute to the improvement in the health conditions of the residents and to raising the standard of living. At the same time, these facilities can be assumed to have secondary effects of offering places for discussions to form a local community and also for education on improved operation and maintenance of the water supply facilities. From this view, the construction of laundry facilities attached to the public faucets is deemed to be feasible.

However, the experience of the Japanese Small Scale Grant Aid Project reveals that water is meaninglessly being wasted during washing without closing the water taps at the laundry facility. Therefore, the facilities should be designed so that water use can be restricted such as by hour. In addition, waste water should be treated with septic tanks.

2) Public Showers

Although public showers are considered to be attached to the public faucets and the laundry facilities to obtain similar effects as that for the laundry facilities, the public showers are decided not to be constructed in this project. This is because a huge amount of water will be additionally needed and more complex operational and maintenance problems will arise.

3) Installation of the Announcement Board

An announcement board will be installed above each public faucet in order to supplement the daily business of the George Division, such as public relations related to the designation of users and water fee payment. The names or house numbers of registered users will be listed on a board above the public faucets; the water fee and payment due dates will also be listed on the board. The board is intended to stimulate interest on a daily basis among the residents in the project area, and its effects are expected to be significant because of the necessity and promotion of registration for unregistered users and the common use of related information.

(8) Renovation of Existing Facilities

The renovation of the existing facilities includes the renovations of well pits of the existing boreholes, and those of existing pipelines. It is aimed to renovate the Japanese Small Scale Grant Aid Project and SAP projects. Those wells are in very serious condition from the sanitation point of view, because contamination of the wells is suspected due to the absence of effective sealing of the well heads to prevent contaminants from entering the wells during the rainy season. Immediate renovation of these existing facilities is needed because this project aims for an urgent solution to the cholera epidemic and because assuring sanitary water sources is also desired for the facilities which are being well operated and appreciated by the inhabitants.

3.2.5 Procurement of Equipment and Materials for Operation and Maintenance

Procurement of equipment and materials for operation maintenance of the water supply facilities is judged to be necessary in addition to the

construction of water supply facilities through the site survey and the discussions with the Zambian side. The necessary equipment and materials are as follows.

The objectives of the procurement of equipment and materials are: (1) strengthening the operation and maintenance of the facilities, (2) improving the effectiveness of the educational promotions to the residents and the water fee collection.

The LWSC is capable of using the equipment and materials planned to be supplied in this project because its technical level is satisfactorily high as mentioned before. Equipment for repairing the submersible pumps for the boreholes can be used not only for the water supply facilities in the George Complex, but also for the LWSC itself and it is expected to raise the technical level of the LWSC on a whole. The procurement of the trucks for transport of materials, water-tankers for emergency supply of water, pump-hoist trucks for maintenance of submersible motor pumps, and water quality analysis equipment for the George Division as well as the LWSC is also planned.

Furthermore, procurement of personal computers, which are already in use in the LWSC for effectuating such various desk works as the registration of the users, the water supply management, the equipment management, the financial management, and the personnel management is needed for the smooth operation of the water supply facilities in the George Complex. Also, small vehicles for transport of personnel and materials and bicycles for the maintenance personnel to visit the Complex are needed as well. In addition, audio-visual equipment and other animation tools will be effective for public relations and education to the residents.

3.2.6 Basic Policy for Grant-Aid Cooperation

Based on the above discussions, the feasibility and effects of this project as well as the ability of the Zambian executing agency, the LWSC, were confirmed for the implementation of this project. As the

benefits of this project meet the objectives for which grant-aid cooperation is provided, the execution of this project through grant aid is judged to be appropriate. Based on the assumption of Japanese grant aid, an outline of the project was discussed and a basic design study was conducted. However, based on the study results, in terms of the contents of the project, the initial request was modified after an examination of the water supply facilities to be constructed and the equipment and materials to be procured.

3.3 Project Description

3.3.1 Executing Agency and Operational Structure

Executing Agency

The LWSC is the execution agency for this project under the supervision of the MLGH of Zambia. The water supply system to be constructed in this project will be the LWSC's first undertaking using new facilities since 1989.

Water Supply System and its Management

The water supply facilities to be constructed in the project area of the George Complex is an independent system (satellite system) separate from the existing facilities which supply water throughout the Lusaka City. The LWSC will establish the George Division and work towards creating a self-sustaining system in the project area. The George Division will handle all of the works related to water supply services of this project.

3.3.2 Execution Plan

(1) Characteristics of Project

While this project covers the service area of the LWSC, improvement of the poor water supply conditions of the Lusaka

satellite area, as part of the development plan of the LWSC, is one aspect of the project. The other facet is emergency water supply in the George Complex where waterborne communicable diseases such as cholera are conspicuous. That is, with respect to water supply activities and construction of supply facilities, attaining the water supply service level demanded by the urban water supply sector of the LWSC on the one hand, and placing emphasis on the immediate effects on emergency measures against cholera on the other. This project requires that attention be placed on harmonizing these two viewpoints.

Concerning the extension works for the Lusaka water supply system, as was explained previously, the satellite area will be covered by a "Satellite System", and therefore, this project will also be designed along this line.

On the other hand, as an emergency measure for rehabilitation of the presently poor water supply condition, the construction of an independently new water supply system which will assure a minimum supply rate through public faucets, without considering house connections, is in demand. In this respect, the use of existing supply and distribution facilities which show deterioration or damages, and contaminated hand-dug wells will be discontinued; and facilities which provide a stable supply of water and which require minimum repairs and tolerate wear will be constructed. An organization which can sustainably manage these facilities needs to be formed.

In the project area, an independent water supply system to be handled by the LWSC will be constructed, and in the existing water supply system serving the entire the Lusaka City, the use of existing supply pipelines which have considerable breaks and leaks will be discontinued. However, the wells now in operation will continue to be used, but to prevent contamination from the exterior and to ease operations, the area around the wells will be renovated, and these will be used to supply the present house connection users. Consequently, this will contribute to

reduction in the rates of leakages and illegal connections. In addition, the use of the hand-dug wells noticeably contaminated at the present time, which are unavoidably used by many of the residents, can be discontinued.

(2) Design Period and Per Capita Supply Rate

Target Year of the Project

The Zambian government has requested a 10 year target for the project. If the target year is too long, investment will become excessive, and, if the target year is too short, an extension of the project will be necessary before reaching the target year. As a result, many projects tend to be 10 to 15 years in length.

Based on the request from the Zambian government, this project targets low-income residential areas. The urgency in increasing the water supply environment is high as a countermeasure against the frequent occurrence of waterborne diseases. Taking into consideration the various operational problems, the project has been targeted for a period of 10 years.

Per Capita Supply Rate

Looking at the changes in the water consumption rate per person per day of the Lusaka City water supply undertakings, the water consumption rate has always exceeded 200 liters: 240 lit in 1963, 240 lit in 1974, 290 lit in 1985, and greater than 200 liters throughout the 1990s. These figures include domestic water and the water for city functions. The above figures are average values calculated based on the daily average water supply rate and served population. The actual water consumption situation is rather uneven, depending on the service area and category of demand. When determining the per capita supply rate, water usage of similar types must be considered. The LWSC conducted an earlier project supported by the EC, the AfDB, and the Japanese government, based on the WHO standards for the project's per

capita supply rate. The per capita supply rate requested for this project is 70 l/ca/d for house connections and 35 l/ca/d for public faucets in the low-income residential service areas. This project targets the per capita supply rate for public faucets as water will be supplied through public faucets only.

The Ministry of Energy and Water Development, Department of Water Affairs, which supervises the operation of the water supply for rural cities, towns, villages, and settlements, uses a per capita supply rate of 50 l/ca/d for the lower limit water supply rate in the low-income residential areas when examining the water supply services. The per capita supply rate is 30 l/ca/d for the rural water supply using hand pumps. Although the project area belongs to the capital of the Lusaka City, the per capita supply rate was determined as 35 l/ca/d after consideration of the actual situation of consumption in the project area where clean tap water and unsanitary hand-dug wells are used, including the characteristics of the satellite areas, the scale of the water supply areas, and the facility as an independent water supply system.

(3) Water Source Plan

In the project area, water contamination of the existing hand-dug wells presently being used by the residents is a serious problem. The assurance of a safe and stable water source is the foremost topic for this project. Therefore, in order to supply sanitary water, boreholes are considered for pumping from confined groundwater tables which are not susceptible to influence from the ground surface. Presently, hand-dug wells of 5 to 10 m depths have problems with reduced pumping rates in the dry season and give rise to mass outbreaks of cholera caused by influxes of contaminated water in the rainy season. Consequently, boreholes which assure a sanitary and stable supply of water will be employed.

1) Selection of Drilling Points

The detailed selection of drilling points for boreholes will be determined based on hydrogeological and geophysical decisions. The candidate points were selected in consideration of the relation between the service area and the area showing distribution of the Lusaka Dolomite layer which can guarantee a high probability of superior aquifers. Figure 3-2 shows the location of the candidates.

2) Borehole Drilling Depths and Yield

Borehole drilling depths will differ with hydrogeological conditions of that area. Hydrogeological evaluations on well depths, aquifers, rock formations, static water levels, fracture zones and weathered zones were made from results of the hydrogeological survey and geoelectrical prospecting as well as borehole logging data. These results are listed in Table 3-3.

Table 3-3 Hydrogeological Evaluation in the Project Area

Well Depth (m)	Aquifer	Pumping Rate m^3/hr	S.W.L. (m)	D.W.L. (m)	Draw Down (m)	Specific Capacity $m^3/d/m$	Screen Pos. (m)	Weathered Zone (m)
38	Lusaka Dolomite	8	1.5	3	1	3	14	1
|	Limestone	|	|	|	|	|	|	|
85	Schist, Quartzite	500	26	30	12	500	55	20

Judging from well screen locations, the depths of aquifers range from 14 m to 55 m in the Lusaka satellite area. From analyses of hydrogeological and geoelectrical prospecting results, the excellent Lusaka Dolomite layer which is likely to be the aquifer to be exploited was found to exist between 40 m and 85 m. The locations of the fissures or cavities of Dolomite shows various depths. Further, it is found that from the list of the existing boreholes that screens or slotted casings are being set for

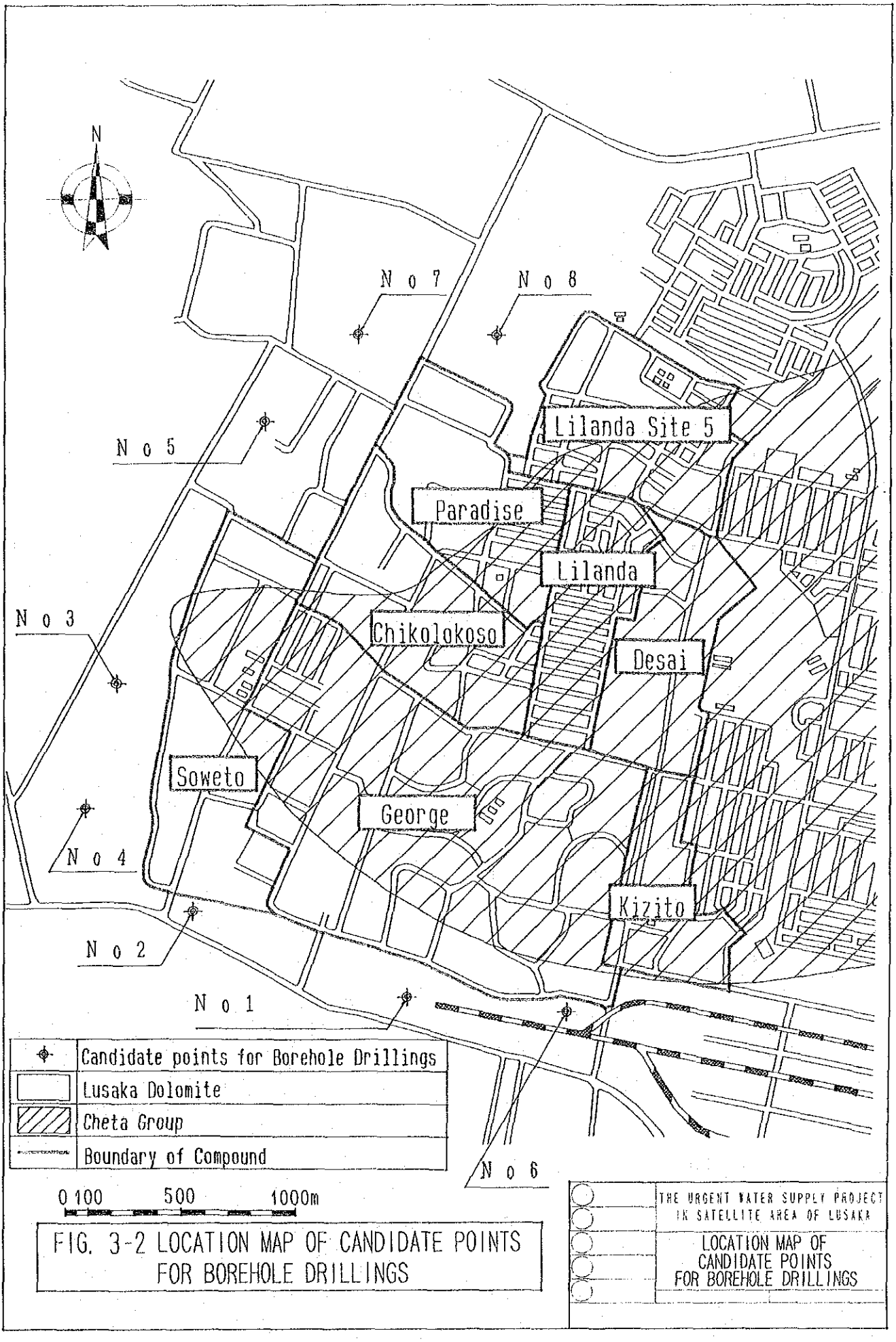


FIG. 3-2 LOCATION MAP OF CANDIDATE POINTS FOR BOREHOLE DRILLINGS

approximately 30-40 m and it shows that these are not always with single aquifer in the borehole. In this Project, the geophysical logging will be done after the drilling, and it will help to set the screen at the appropriate depth. Therefore, the position and length of screen will be decided by considering analyses of geoelectrical prospecting and thickness of assumed aquifer, relation between screen integration and specific capacity at the candidate sites.

Since the geoelectrical prospecting results revealed that the main aquifer is located at a deeper layer and the thickness of weathered zones and unconsolidated formations are thick in certain areas, the average drilling depth is judged to be 80 m.

3) Rate of Success of Boreholes

Allowance

When constructing boreholes in areas having hydrogeological conditions such as those in the project area, even in areas showing distributions of the excellent Lusaka Dolomite layer, we must bear in mind that the aquifer cannot always assure a sufficient quantity and quality of water due to restrictions in natural environmental conditions. As a consequence, in case of unsuccessful boreholes, delays in construction schedule and surpluses in materials must be taken into consideration.

Results of Existing Boreholes

At the present time, in the Lusaka satellite areas, 70 boreholes are used for drinking water purposes. Of these boreholes, the majority at 83.7% use the Lusaka Dolomite layer as the main aquifer. Table 3-4 displays the pumping rates of aquifers, and this indicates that percentages of wells which can satisfy the design pumping rate of 50 m^3/hr are 69.7% for the Lusaka Dolomite layer, 33.3% for the Cheta Group layer and 60% for the other layers.

Although the Cheta Group layer overlays most of the project area

of the George Complex, drillings are proposed in the outer circumference where the Lusaka Dolomite is found. From geolelectrical prospectings conducted in this area during the site survey, existence of aquifers were investigated, and candidate points judged to be most suitable were selected. Refer to the Appendix for the results of analyses made on geoelectrical prospecting data.

Success Rate

As a consequence, from Table 3-4, since the percentage of wells pumping over 50 m^3/hr from the Lusaka Dolomite layer is 69.7%, a success rate is assumed at around 70%. Therefore, as a drilling method to avoid the risk and also to minimize the cost, drilling will be conducted with a smaller diameter and reamed to the designed diameter after the confirmation of the aquifers available for planned pumping rate.

Table 3-4 Relationship between Aquifer and Pumping Rate of Existing Boreholes

Aquifer	Aquifer Occurrence Ratio	Pumping rate		Well Depth
Lusaka Dolomite (Dolomite, Limestone)	83.7%	1.under 50m^3/hr	30.3%	40-92m
		2.above 50m^3/hr	69.7%	
Cheta Group (Quartzite)	6.1%	1.under 50m^3/hr	66.7%	58-70m
		2.above 50m^3/hr	33.3%	
Others (Fractured zone, Schists)	10.2%	1.under 50m^3/hr	40.0%	60-85m
		2.above 50m^3/hr	60.0%	

4) Selection of Water Sources

The water source will be groundwater. As schists have low storage capacities as aquifers, the aquifers targeted for groundwater development are located in the Lusaka Dolomite layer, and prevention of water leakage from the upper aquifer (laterite

and gravel underlayer) will be considered. The maximum pumping rate is 50 m^3/hr per well, based on the storage capacity of the groundwater. From the viewpoint of well recovery and the operability and maintainability of the pumping equipment, pumping hours will be 10-14 hours per day. Water source development is sought outside of the residential areas.

(4) Design Served Population

According to the logistical curve which estimates the saturation point for the population based on 1993 population estimation figures (1990 census), the basis for the design served population is the estimated population figures at the end of the ten year period in 2003. (The estimated population is shown in Table 4-2)

(5) Number of Drillings

Based on the above information, when the total population (Σp) is 129,629 persons, the per capita supply rate (qC) is 35 lit/c/d, then the total daily supply rate (ΣQd) is $\Sigma Qd = \Sigma P \times qC$

= 129,629 persons x 35 lit/c/d ÷ 1,000 lit/m^3 = 4,537m^3/d.

When the pumping rate per well (Qwh) is 50 m^3/hr and the cumulative sum pumping hours per day (hw) is 12 hours, the number of wells (W) is

$W = \Sigma Qd \div (Qwh \times hw)$

= 4,537 m^3/d ÷ (50 m^3/hr x 12hr) = 7.56 .

From the above, the number of wells is 8: to attain the design supply rate for year 2003.

(6) Water Quality

Water samples were collected during the site survey from the existing boreholes, which were drilled near the candidate points for borehole drilling penetrating the same target aquifer of the Project to estimate water quality of the candidate points.

The analysis results of the water samples are summarized in Table

3-5. The analysis results reveal that all water sources have satisfactory points for borehole drilling and should be appropriate as water sources for drinking water.

Table 3-5 Water Quality Analysis Results of Water Samples Collected from the Existing Boreholes near Candidate Points

Site	Twikatne	Chunga	Water Quality Standard	
Item	LWSC B/H No.70	LWSC B/H No.12	WHO	Japan
EC μS/cm	760	840	2,000	-
pH	6.75	7.21	7.0 - 8.5	5.8 - 8.6
Fe ppm	0.2	0.2	0.3	0.3
NO_2 - N mg/l	0.006	0.000	-	-
NO_3 - N mg/l	-	0.23	40 - 80	10
NH_4 - N mg/l	0.4	0.0	0.5	-
F ppm	0.0	0.0	1.0 - 1.5	0.8
Calcium Hardness ppm	325	210	-	-
Total Hardness ppm	565	230	100 - 500	300
Cl ppm	110	60	200 - 400	200
Coliform Group ea/ml	1	0	0	Negative
Bacteria Group ea/ml	3	31	-	100

(7) Groundwater Use and Environmental Considerations

Groundwater is an important and resource for daily living of residents who cannot generally use surface water at their disposal, Under the condition that groundwater can be pumped from

the boreholes drilled. However, precautions should be examined before the groundwater development starts to prevent environmental problems which may arise in due course of the development accompanied with the environmental change of water contaminations and subsidences related to the groundwater developments despite the easiness of groundwater development.

The major environmental problems related to water development already observed in the Project area will be considered and discussed as follows:

1) Water Contaminations related to Water Borne Diseases

The mass outbreak of cholera is a serious problem frequently occurring in the satellite area. It is considered that the outbreak is caused by the influxes of contaminated water in the rainy season to the shallow layer aquifer which is the water source of the hand-dug wells. The water contamination is limited to the shallow groundwater (unconfined groundwater formation) and is believed to be caused by the intrusion of massive untreated domestic effluent water and excrements beyond the natural purification capacity of soils.

There is a laterite formation which contains such a shallow layer aquifer under the George Complex and water for daily living is being supplied by simple hand-dug wells from the formation. The use of highly contaminated aquifer should by stopped when sanitary and stable water supply begins as a result of the implementation of the Project.

As mentioned before, this contamination is limited to shallow layer aquifers so far, and does not affect the deeper aquifers (confined) which are the target formations of this Project. Even in some boreholes, however, contaminations are found due to inappropriate construction or structure of the borehole.

2) Over Pumping and Production Deterioration

Production deterioration is mainly caused by over-pumping. Over-pumping is normally monitored by either the yearly change in water table and pumping rates or the water balance of groundwater. At the present conditions, over-pumping problems cannot be monitored time to time and evaluated scientifically in Zambia due to the absence of observation wells which can monitor water tables and pumping rates together. The LWSC has recently started monitoring of water tables and has to compile sufficient data yet.

Furthermore, seasonal divisions of Wet and Dry seasons in Zambia are clear, and the climate change directly affects the water tables: the water table is largely influenced by the seasons and annual precipitation.

The target formations of the Project is called the Lusaka Dolomite formation which is composed of Dolomite and limestone. The formation broadly lies in the western part of Zambia having an area of more than 30% of the total national land. Rains during the rainy season is stored in the formation. The water table of the formation appears to the surface in the huge swamps of Lukanga and Kafue as shown in the Appendix-8.2(4) Drainage System of the Lusaka Area, and groundwater in the formation moves from North to South, and flows to the Zambezi River, the largest river in the Zambia, and the Kafue River, its branch.

The groundwater in the formation is confined in this huge underground stream system and recharged in the Lusaka area. In the rainy season when the groundwater recharge rate increases, the confinement of the aquifer also increases to raise the water level near the Lusaka area. In the dry season, the confinement is decreased which lowers the water level. From these facts, the change in precipitation rate can be judged to affect the water level. The formation has a particular rock structure of fissures and cavities of limestone so that groundwater is susceptible to

the pressure change of groundwater lying in the fissures and cavities. In this area, however, subsidence may not be a problem because the aquifer is composed of rocks. If the formation is of sedimentary rocks such as alluvial and dilavial formations, subsidence due to over-pumping may be a problem. By and large, the LWSC, in cooperation with the DWA, is recommended to monitor the water levels continuously and compile accurate observatory data to plan countermeasures for the water level lowering in the drought years (such as by controlling the pumping rate). Upon the implementation of this Project, it is recommended to carry out development of groundwater resources in taking full considerations of these conditions.

(8) Number of Water Supply Facilities

To simplify the pumping control in relation to the water level of the elevated tank, one water distribution facility per water source borehole will be constructed by this project. Therefore, eight systems which include facilities from water source to distribution will be necessary, and the service area will be divided into eight areas in order to match the number of water supply facilities.

3.3.3 Outline of Water Supply Facilities

In this project, the George Complex is divided into eight service areas, and independent water supply systems will be constructed in each service area. The flow chart of the water supply system is shown as Figure 3-3.

The water supply facilities include pumping facilities, transmission facilities, elevated tanks, chlorination facilities and distribution facilities. The existing facilities will be rehabilitated. Water pumped up from the borehole will be chlorinated, then transmitted to the elevated tank, and distributed by gravity to public faucets and laundry facilities. The chlorination will be operated mainly during the rainy season when the possibility for groundwater contamination is the greatest.

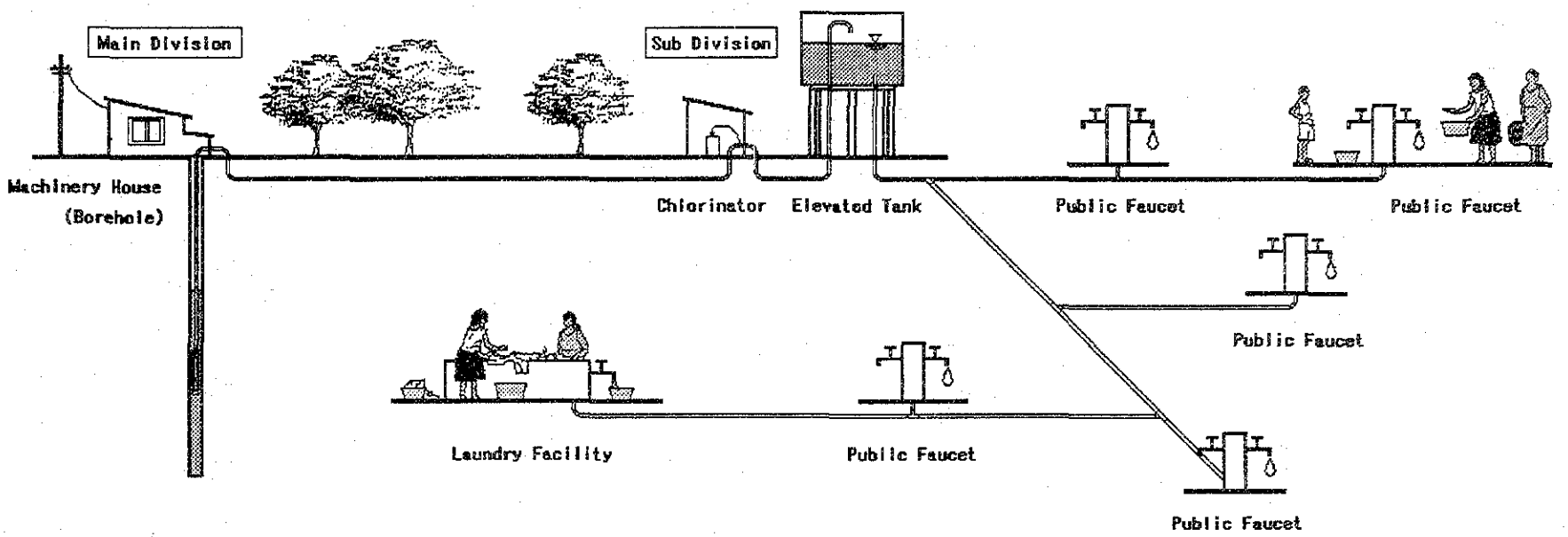


Fig. 3 - 3 Flow Chart of Water Supply System

3.3.4 Scheduled Site for Facilities Construction

The George Division main building will be constructed outside of the residential area in the George Complex. One borehole water source and a machinery house will be constructed within the property of the George Division. Other water source wells and machinery houses will also be constructed outside of the residential area of the George Complex. Sub-division buildings will be constructed within the services areas, and elevated water tanks will be constructed within the property of the sub-divisions. Fences will be constructed around the George Division main building, machinery houses, and sub-division buildings for security. Public faucets and laundry facilities will be constructed along road sides and on vacant property in the residential areas of the George Complex. The construction sites are owned by the LCC or the Zambian government and can be used for this project, but it is necessary to specify the sites, reconfirm site use, and secure the sites at the stage of detailed design because of the possibility of illegal occupation by residents.

3.3.5 Outline of Equipment and Materials for Operation and Maintenance

As mentioned in the discussion of equipment and materials procurement in 3.2.5., this project will supply the George Division with the necessary equipment to improve the overall functions of the LWSC. The equipment and materials to be procured can be divided into (1) vehicles, (2) equipment for improvement, inspection, and repairs, (3) equipment for inspection and testing, and (4) spare parts and standbys. The following three locations will be supplied with the above equipment based on usage: (1) George Division, (2) Sub-division and, (3) the LWSC workshop. Table 3-6 shows a list of the equipment and materials to be procured through this project.

Table 3 - 6 List of Equipment and Materials for Operation and Maintenance

Item	Q'ty	Purpose	Allocation
1.Cargo Truck with Crane	1	Transport of equipment	Workshop
2.Water Tank Truck	2	Emergency water supply for inhabitants	Workshop
3.Station Wagon	1	Transport of personnel	Main division
4.Pickup Truck	2	Transport of equipment and personnel	Main division
5.Pump Hoist	1	Maintenance of pumping equipment	Workshop
6.Workshop Equipment	2	Maintenance and Repair	Workshop
7.Tools for Pipe Installation	16	Maintenance of pipelines	Main, Sub divisions
8.Water Level Meter	8	Monitoring of groundwater level	Main, Sub divisions
9.Conductivity Meter	8	Monitoring of water quality	Main, Sub divisions
10.pH Meter	8	Monitoring of water quality	Main, Sub divisions
11.Water Quality Analysis Kit (Station type)	1	Analyses for water quality at laboratory	LWSC Laboratory
12.Water Quality Analysis Kit (Portable type)	8	Inspection of water quality at sites (Especially coliform group)	Main, Sub divisions
13.Standby Pumping Unit	8	Standby Pump to be used during repairs, etc.	Workshop
14.Standby Water Tap	1	Replacement of Taps	Main division
15.Data Processing Equipment (Personnel Computer)	3	Data management, issuing bills, accounting	Main division
16.Bicycle (Off-road type)	60	Transport of personnel for patrol and billing	Main division
17.Kit for Public Relations and Educational Promotion	1	Promotion of public sanitation, water fee payment, etc.	Main division
18.Spare Parts	1	Repair, maintenance and replacement	Workshop + Main division

3.3.6 Operation and Maintenance Plan

The operation flow at the George Division based on the operation policy, its organization, and work assignment of each personnel are shown below. However, the situation can be handled flexibly if inconvenient situations arise during the actual operation, and alternations may be considered.

(1) Flow of Operation

The operation of the water supply system at the George Division can be summarized into the following main works.

Planning and Management

1) Operation Planning and Service Control

The management functions are to establish an operation plan for the activities executed by and related to all offices and to control and coordinate the activities and services conducted by the all offices for the Project. Recording, filing and reporting of the activities and services shall be included in the function.

Fee Collection

2) Public Relations for Water Usage Registration by Residents

During facilities construction, the George Division, together with the LWSC, will conduct public relations activities for residents in the water service area and for residents in the adjacent non-served areas. These activities will be related to water supply details, water fees based on category, registration procedures, and date of registration.

3) Registration and Creation of the Registration Ledger

The details of the water supply and observation duties, such as the maintenance of the water supply imposed on the registered users and the payment of water fees, will be explained to the residents who wish to use the water at the George Division main building. Registration for water supply use will be conducted after obtaining agreement from individual residents. As well, for registered users,

notification will be given for the category classifications, the assignment of public faucets, the monthly flat fee, payment location, due dates, and the supervisor's name (section chairman). A water fee collection card will be issued, and a ledger of registered users will be created.

4) Submission of the registration ledger
The George Division will submit the registration ledger to the section chairman and the ward councillor, and support fee collection.

5) Announcement of Registered Users
ased on the registration ledger, the George Division will announce the names or the house numbers of the registered users on an announcement board to be installed at the public faucets.

6) Announcement of the Water Fee Payment Date
One week before the fixed water fee due date, the George Division will announce the due date and payment location on the public faucet board in order to inform the registered users of the upcoming payment. Bills will not be issued directly to registered users. Upon this announcement, each section chairman will directly encourage fee payment from the registered users under their supervision.

7) Collection of Water Fees
Registered users pay water fees directly at the George Division main building. Sub-divisions only accept fee payments on specified days, during certain periods of time. In this case the person in charge of fee collection from the accounting section at the George Division will go to the sub-divisions. The main building accepts fee payments without restrictions. The number of persons in charge of accepting fees should be kept to a minimum, and a specified employee from the accounting section of the LWSC will be responsible for this work.

8) Treatment of Collected Fees

Collected water fees will be calculated and placed in the safe at the George Division main building for a period of time. Witnessed by the chief of the George Division and the accounting staff from the main building, the collected fees will be audited and deposited in a bank.

9) Notice and Removal from Registration

When the due date for water fee payment has passed, each section chairman will check the cards of the registered users under their responsibility. The chairman will request payment from those users who have not paid their fee. In regard to the registered users who have not paid their water fee for some time after the due date, the George Division will submit an unpaid users name list to each section chairman, and the chairman will request payment once again. The George Division will inform those who refuse payment of their removal from the registration ledger and confiscate their user card. Their names will be removed from the announcement board at the public faucet, and the names of those removed from the registration ledger will be announced on the board.

10) Control of Water Consumption

As a result of water meter readings of each water supply facility every month, the George Division will recommend water conservation to registered water users in cases where the use of water significantly increases compared with other water supply facilities or where chronic increases in water use are observed. As a result of this notification, the George Division will announce a change in the category setting within a range that matches the water value and increase the fees for the users of water facilities where water saving is ignored. These actions will be carried out after a certain period of time.

Operation and Maintenance

11) Operation (Operating the facilities)

Borehole pumping equipment and chlorination equipment will be operated, and the operation records will be recorded.

12) Maintenance (Maintenance of the facilities)
Maintenance, inspection, and repairing of the facilities, as well as recording of the maintenance services will be carried out.

13) Materials Control (Procurement and Management of Materials)
Inventory of the materials necessary for management of the facilities will be controlled and prcurement plan will be prepered.

Miscellaneous

14) Public Relations and Education
Public relations and education to the residents through the cooperation of the self-governing organizations of the residents will be promoted. The necessity of self-payment by the recipients and sanitary knowledge should be emphasized and educated to the residents thoroughly.

15) Complaints
Complaints from the registered users will be handled.

16) Personnel Relations
The services related to personnel relations of all personnel who are working in the George Division are handled. This includes working records, wages, promotions, social welfare, and training.

(2) Organization Chart
Figure 3-4 shows the organization chart for the George Division which will be established in this Project.

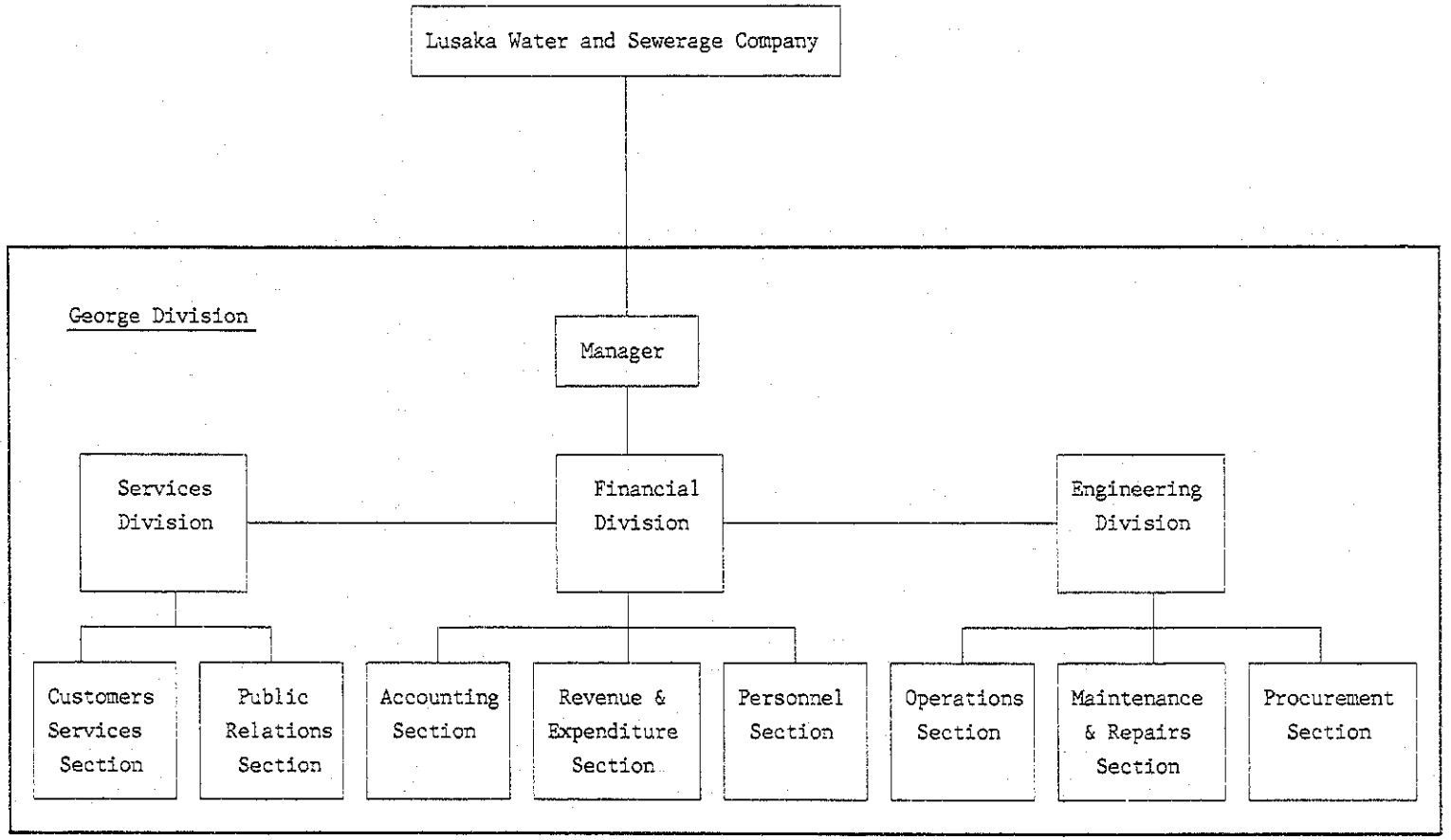


Fig. 3 - 4 Organization Chart of George Division

(3) Job Description and Responsibilities

The job description and its responsibilities for the execution of the jobs 1) through 16) described above shall be explained as follows:

General Manager:	Operation Plan, service management
Service Section:	Services related to registration (preparation of registration book, promotion for the registration, receipt and cancellation of the registration and its posting on the board, etc.), reading water meters, complaints.
Public Relations:	Promotion of the registration, PR and educations on sanitary knowledge.
Accounting Section :	Posting the fee collection date on the board, receipt and recording of water fees, preparation of the un-paid user list.
Casher :	Receipt and recording of the water fees, control of the collected fees.
Personnel Section :	Personnel control, human relations
Field Operation :	Operation of facilities
Maintenance :	Maintenance, inspection, repairing
Materials Control :	Procurement and control of materials

In addition, Watchmen (guards) shall be hired as follows. They work at night only.

Main Division
- Building : 2 persons * 1 place

Machinery
- House : 2 persons * 8 places

Sub Division
- Building : 2 persons * 8 places

(4) Personnel Plan

A personnel plan will be established based on the number of personnel necessary to manage and operate the above mentioned George Division. As the Project is divided into four Phases, it is necessary to hire required personnel based on the personnel plan which is planned to meet the service area and served population for operation, maintenance and management for each phase. It is necessary, therefore, to complete hiring the necessary personnel to establish the George Division organization by the end of the first phase construction and then increase the personnel to meet the completion of facilities and expansion of the operation. Hence, the LWSC shall provide a minimum number of personnel who are needed to run an initial operation and the LWSC shall hire all planned personnel by the end of Phase-4. For the allocation of personnel, Table 3-7 shows the personnel plan for each phase. It should be examined for the implementation based on the actual performance of each section with adjustment because this table indicates the estimate of performance.

Table 3-7 Personnel Plan for Each Phase

	1st phase	2nd phase	3rd phase	4th phase
Number of Sevice Areas	1	4	6	8
Manager	1	1	1	1
Customers service Section	3	12	19	26
Public Relations Section	1	1	2	2
Accounting Section	1	1	2	2
Revenue & Expenditure Section	1	1	1	1
Personnel Section	1	1	1	1
Operation Section	2	8	12	16
Maintenance & Repairs Section	3	6	9	12
Engineering Section	1	1	2	2
Sub-Total	14	32	49	63
Guardmen	6	18	26	32
Total	20	50	75	95

(5) Operation and Maintenance Plan

Daily operation and maintenance activities are divided into (1) the operation of the water source facilities, the elevated tank and the chlorinator, and (2) the maintenance and repair of pipelines and public faucets. Operations deal mainly with pump operations and chlorine dosing, while maintenance deals with the inspection and repair of the troubled facilities. In case the George Division cannot solve the problems, maintenance specialists shall be dispatched from the LWSC workshop. As mentioned earlier, the LWSC possesses sufficient level of technology for the maintenance of the water supply facilities but it is worried that the LWSC may have a short of spare parts. Therefore, supplying sufficient amounts of spare parts together with the supply of equipment is very vital.

It is also necessary that personnel for maintenance shall be responsible for keeping tools. That is, the George Division is recommended to employ a penalty system to deduct the cost of tools missing from the salary of persons who lose the tools by the periodical inspection of tools so that the loss of tools will be prevented.

(6) Financial Plan

Establishing a financial plan which can cover the costs for the operation of the water supply facilities to be constructed in the Project is very important. It is assumed that the expenditure comes from direct operation costs (electricity, chlorine disinfection, labor, administrative work), the maintenance and repair costs for buildings, equipment and tools, and a reserve fund, but depreciation shall not be included.

On the other hand, it is assumed that the revenue shall be the water fees (from public faucet users), but that no subsidies will be included unless the account shows a deficit. The water fee collection ratio is assumed to be 55%, corresponding to the

results of the site and service charge collection in the George Complex, and then, the ratio is increased to 70%, 80%, 90%, and 100%. A balance sheet was tried by setting the monthly fee payment of each household at K330. - which is fixed as the rate for the public faucet users, and then the higher rates such as K400. -, K500 -, K600 -and K700 - are tried. (Refer to the Appendix-10 for details.)

The calculation revealed that it may be necessary to set a high water fee to operate profitably particularly for the initial stage, Phase-1, when the operation of the facilities constructed starts, due to relatively high operation costs for less number of residents in the service area. However, it may be more practical if the water fee is settled to make profit in the second Phase so that it can reduce the burden to the residents. In this case, the LWSC will make up the deficit during the first phase, but its amount may not be significant (Refer to Appendix-10). This is because the salary and wages will be relatively large to a limited number of the recipient population in the first Phase when the number of service areas is small. It is presumed that this situation will be solved in the second Phase when the service area is extended and recipient population is doubled.

Estimation of the fee collection ratio is very difficult because reliable information is limited to the records of the site and service charge of which only 55% is available and consequently, several unknown factors need to be estimated. If the fee collection rate is set at a very low level, it may make the future improvement of that difficult. Therefore, it is advisable that the target ratio be set at a higher level to leave a future effort for the improvement of management.

In any case, it is necessary to decide the water fee through the discussions with the concerned parties of the LWSC and the Lusaka City Council, and by reflecting the opinion of the residents and the Ward Development Committees. The result of the questionnaire shows that the average affordable amount as water fee is at

K871.-/household/month, and therefore, this indicates that the range of K400 - K700.-/household/month will be realistic.

It is advisable for the George Division to report its monthly balance sheet to the LWSC in order to clarify the actual operation situation.

It is predicted that the area where the water supply facilities are constructed will co-exist with the area where those are not yet constructed in the same Complex until the Project is completed, since the Project is planned to be implemented in four Phases. During this period, the residents of the area not yet constructed may visit the area constructed to take water. Although it is very difficult to estimate the number of residents from the area not yet constructed and the water quantity to take, it may be wise to consider such situations to avoid any trouble. It is recommended for the LWSC to study the special service for the residents of the area not yet constructed who wish to register with a special water fee.

(7) Due Date for Organization

All necessary arrangements on management and organization required for the water supply activities including all of the above mentioned items need to be established and prepared not later than one month before the commencement of supplying water.

3.4 Technical Cooperation

Dispatch of Experts

This project emphasizes continual operation and maintenance and aims to strengthen the management of the George Division. The LWSC, as the execution agency, possesses a high level of technicality, and therefore, technical cooperation in the form of the dispatch of experts is not necessary. However, the consultant team in charge of detailed design and supervision will include personnel to take charge of the

planning of the operation and management of the project (refer to 4.4.2 Construction and Supervisory Plan).

Counterpart Training

Although the LWSC is expected to allocate personnel who have adequate level of technology for the execution of the Project, it is advisable for the LWSC to provide a counterpart training programme and let them recognize the points of considerations thoroughly on the operation and management for the facilities and the equipment procured by the Project.

CHAPTER 4

BASIC DESIGN

CHAPTER 4

BASIC DESIGN

4.1 Design Policy

The design policy of the project will be determined based on considerations of the natural and social conditions of Zambia, the actual conditions of construction and procurement, the characteristics of the water supply activities in the targetted areas, the operation and management system and ability of the executing agency.

In particular, coordination with the existing operating facilities should be considered. Efforts should be made to limit over specifications by taking cost performance into consideration, including the upgrading of existing facilities, safety, and durability.

This project is designed so that each phase will be self-completed, but in order for Zambia to expand the facilities in the future through self-help efforts, pipelines, branchings, valve types, and layout should be carefully considered. In particular for the maintenance system, efforts should be made to coordinate the problems related to the actual situation of the existing structure, facilities, and equipment.

4.1.1 Natural Conditions

Since this project will depend on groundwater sources, a thorough discussion of the hydrogeological and meteorological conditions are necessary. Special consideration is given to the relationship between the development potential and conservation of groundwater. Furthermore, the consideration must include the geological and meteorological constraints on design of facilities and equipment.

4.1.2 Social Conditions

The majority of residents of the George Complex are low income people who have moved from rural areas, so that the level of education is low, and knowledge about health issues and sanitation is lacking. Community solidarity, or in other words, community awareness created through common interests which can be seen in rural communities, is lacking in urban areas. Combining these factors with the poverty that exists in the area, destruction and theft of public property (vandalism) are common. In order to ensure the trouble-free management of facilities, education of residents on the common interests in public facilities and sanitary environment could be helpful, along with plans for facilities likely to have effects on deterring such acts of destruction and theft.

4.1.3 Supply of Equipment and Materials

In regard to construction related to the water supply project and the supply of equipment and materials, special attention should be given to using equipment and materials that are easily obtained in Zambia or in nearby countries, as well as consideration of the smooth progress of the project, contributions to the Zambian economy, and maintenance and repair (excluding special items). In particular, the construction labor force should consist of residents from the project area as much as possible. This will improve the awareness of the project through direct participation in the facility construction and improve the awareness of the need for facility maintenance.

4.1.4 Executing Agency

The LWSC, which will be the executing agency, extends over a period of six years since establishment after separation from the LCC. However, because its current operation began in November, 1991, its actual management is little more than two years. Nevertheless, the LWSC is involved in development assistance projects, including the one with Japan's grant aid, and is actively striving to improve the operation, maintenance and management of the water supply facilities transferred

from the Lusaka City Council. As for this project, the LWSC is now concentrating all its efforts on planning for personnel employment, budget allocation and other institutional matters, since it undertakes for the first time a comprehensive water supply system in a specific area on a self-sustaining basis.

4.1.5 Plan for Supply of Equipment and Materials

Generalizing the above policies, facilities and equipment to be used for the project will be designed to fit to various features of the George Complex. With the basic design policy aimed at durability and easiness in operation and maintenance, their structures must be simple and strong. Control should be simple and kept to a minimum, and countermeasures against vandalism and theft must be considered.

4.1.6 Construction Period

(1) Implementation Schedule

This project divides the project area into eight water supply service areas; an independent water supply system will be constructed in each of the eight service areas. Four phases are necessary to execute the overall construction according to the Japanese grant-aid system. In particular, it is necessary to observe the development situation of LWSC's operation and maintenance system upon the completion of a certain number of the service areas. Therefore, the project will be implemented on a step-by-step basis, with a monitoring survey and interim evaluation conducted in between the stages of construction in order to confirm the operation of the project. This monitoring survey will confirm the operation and maintenance by the George Division to be newly established. After the second phase construction is completed, and several months of operation have passed, a monitoring survey of the water supply system will be carried out. Based on the results of the monitoring survey, continuation of the project into the third phase will be determined by an interim evaluation conducted by the Japanese

government, and necessary improvements will be made.

(2) Construction Period

The construction period should take into consideration the relationship of water source development with the number of facilities to be constructed and existing facilities, and the project's content and scale, to ensure that interruptions in the water supply operations and traffic do not overly affect city functions and the lives of city residents. Construction should be completed efficiently; for example, if the construction period extends into the rainy season, the construction schedule should be determined so that the rainy season does not interfere with the progress of construction. During the peak of the rainy season, there may be problems in supplying construction material because of the intense flow of water, but other than the rainy season, there should be no problems related to access as the construction area is located near the capital. Table 4-1 shows the relationship between the step-by-step execution based on phasing and the monitoring survey.

Table 4-1 Step-Wise Implementation and Phasing

Phasing	Number of Service Areas	
	Number Implemented by phase	Cumulative Sum
1st Phase	1	1
2nd Phase	3	4
Monitoring Period	-	4
3rd Phase	2	6
4th Phase	2	8

4.2 Study and Examination on Design Criteria

4.2.1 Design of Service Areas

The service areas are divided into eight based on the pumping rate per

well and the daily supply rate, taken from the overall population and population density in each compound. Upon considering various factors such as boundaries of compounds and wards, layout of distribution pipelines, locations of candidate boreholes, the following conditions are established to determine the service area divisions.

(1) Based on the well capacity (50 m^3/h) for each water supply system, the served population for each of the eight service areas should be almost equal.

(2) As the water distribution pipelines will be laid along streets, the boundaries of the areas will correspond to these streets.

The service areas will be determined based on technical considerations. The priority order among the eight service areas is from Area 1 to Area 8. Given the priority of the compounds requested by the Zambian government (1. George, 2. Soweto, 3. Chikolokoso, 4. Desai, 5. Paradise, 6. Lilanda Site 5, and 7. Kizito) and the occurrence of cholera from which this order is determined, the compounds in the service area are classified in order of their emergencies for project implementation. The map showing the service areas is shown in Figure 4-1.

4.2.2 Planning for Water Supply Rate

The LWSC does not have its own design standards for water supply, and therefore it uses WHO standards. This project uses a per capita supply rate of 35 l/d, and the target year is 2003 (10 years), as requested by the LWSC.

For the basic design, the daily water supply rate and hourly maximum water supply rate are determined for each service area based on the survey results of the daily water consumption trends and peak consumption rates. The design population and supply rate for each service area are shown in Table 4-2.

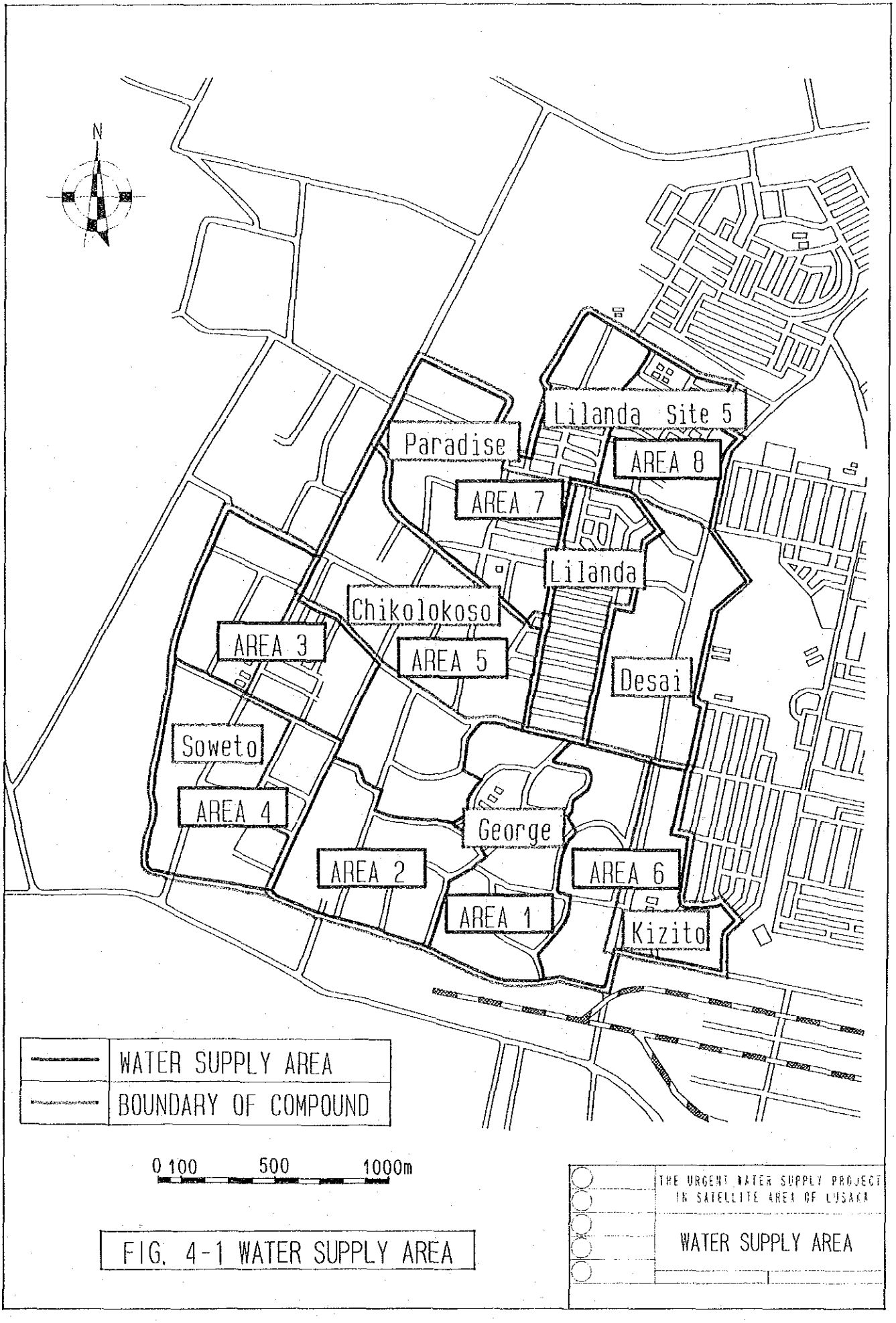


FIG. 4-1 WATER SUPPLY AREA

Table 4-2 Design Population, Daily Average Supply Rate and Maximum Hourly Supply Rate into Service Areas

Served Area	Served Population (2003)	Compound	Daily Average Supply (m^3)	Maximun Hourly Suuply (m^3/hr)
AREA 1	17,293	George	691.7	144.2
AREA 2	15,028	George	601.1	125.2
AREA 3	16,221	George, Soweto	648.8	135.2
AREA 4	16,584	George, Soweto	663.3	138.2
AREA 5	16,321	George, Chikolokoso	652.8	136.0
AREA 6	16,914	George, Kizito	676.6	141.0
AREA 7	15,680	Paradise, Lilanda Site 5	627.2	130.6
AREA 8	15,588	Desai, Lilanda Site 5	623.6	130.0
Total	129,629		5,185.1	1,080.4

4.2.3 Consideration of Water Supply Facilities

As mentioned earlier, the project area is divided into eight service areas and water supply facilities are to be constructed in each area. The facilities in each area will consist of a water source facility, water transmission facilities, water distribution facilities, and operation and maintenance facilities. The design concepts related to these facilities are shown below, and these drawings are shown in 4.3.3.

(1) Water Source Facilities

Water Source

The water source facility consists of a borehole, a pumping unit and an electric power unit to be placed in a machinery house, a guard house and a fence. The average depth of the borehole will

be 80 m. This figure is based on the analysis of geoelectric prospecting results and the hydrogeology of the major aquifer, the Lusaka Dolomite, and other layers in the project area. The well diameter will be 10", which will allow a pumping rate of 50 m^3/hr. The well screen will be a continuous horizontal V slot wound, all-welded type, diameter of 8". To prevent turbulence in the well, a screen intake flow velocity of less than 15 mm/sec will be used and conditions such as the occurrence of turbulent flow and the net positive suction head (NPSH) are considered.

The quality of the groundwater is pH6.9 to 7.3. The existing boreholes use steel casings and stainless steel screens of standard six meters length: these are in common use by the LWSC. According to the local hydrogeological analysis, for construction of boreholes with average depths of 80m, the screen ratio per borehole is about 20% at 18 m, which means the borehole casing will be placed at 62 m.

The machinery house will house the water source well. In order to prevent penetration of contaminants from the surface, the upper part of well is grouted 5 to 6 meters with cement. Moreover, gravel of a selected size is to be packed between the aquifer and the screen.

A centralizer is installed in order to place the screen and the casing in the center of the drilled well. The basic design drawing, based on these design parameters, is attached to 4.3.3.

The pump will operate 10 to 14 hours a day. The pumping water level is calculated based on the above mentioned characteristics of the borehole, and the total head loss is determined based on the water level at discharge side of the elevated water tank and the pipe head loss.

Control of the groundwater level using the low water level control is important for the maintenance of the borehole and prevention of the submersible pump from burning. The control

must also be conducted through the full tank alarm at the elevated tank side. The rating of the submersible pump motor is a three phase alternating current of 380V-50Hz.

The length of the pump riser pipe is determined based on the pumping water level. The pump will be installed in a solid steel plate and concrete foundation.

Electric Power Unit and Machinery House

The electric power unit for each water supply facility will be connected through a service wire from the nearest transmission line with a transformer unit. The secondary electric power is a three phase alternating current of 380V-50Hz. The electric power unit will be mainly used to supply electricity to the well pump, but office power and inhouse lighting will also draw upon this power.

An office will be constructed next to the machinery house for management of the water source facility. Management of the water source facility consists mainly of operation control of the submersible pump and recording the pump operation hours and pumping rates. Machinery house equipment include the electric power unit, pumping equipment, control unit, and plumbing. The electric power unit consists of an electrical control panel and lighting equipment; the pumping equipment consists of a submersible pump; the control unit consists of a storage tank water level control and an alarm unit; and the plumbing consists of a sand separator, a water flow meter, a safety valve, a control valve, a manometer and pipes.

For security, a fence surrounding the water source facility, a guard house, and nighttime lighting equipment are to be installed. The main Division for operation and maintenance is to be established in one of these facilities, but in this instance the office will not be constructed next to the machinery house. Machinery house-A will be constructed independently, and the house-B will be constructed inside the main division.

(2) Water Transmission Facilities

The water transmission facility consists of pipes which connect the water source facility to the elevated water tank and control wiring for water tank level warning. The pipeline will be of polyvinylchloride (PVC), and the control cable will be wired through electrical vinyl conduit. Both kinds of pipes will be laid underground. The laying depth is to be deeper than 1.2 m in order to protect the pipe and to prevent illegal connections. Air vents and drainage valves will be installed depending on the pipeline laying ground levels. In any case, when the pipeline crosses a highway, adequate pipe protection measures will be prepared.

(3) Water Distribution Facilities

The water distribution facility consists of an elevated water tank, distribution pipes and water supply facilities such as public faucets, chlorinator, control equipment and power unit.

Elevated water tank

Elevated water tanks will be installed in residential areas as much as possible considering easiness of distribution management and control and shortening of the pipeline. The tank is to be made of reinforced concrete for durability. An office will be constructed in the control room for operation of the elevated water tank and distribution control. This office will also serve as the subdivision to be used for operation and maintenance as is discussed later. The distribution management consists mainly of the chlorinator as well as control of the water supply and recording of water supply rates. Equipment in the control room consists of an electrical power unit, chlorinator and plumbing. The electric power unit consists of a control panel, an anti-collision beam on top of the tank and lighting units. The plumbing consists of a water flow meter, a control valve, a manometer, and pipes.

The effective capacity is determined by making use of the peak demand and emergency water supply. The height of the elevated tank is determined by considering the topography and the extent of the service area, and furthermore, the height must be in conformity with the supply pressure condition of the LWSC (terminal pressure: 1.0 Kgf/cm^2). In order to meet the daily demands, the water level of the elevated tank and the supply rate must be measured accurately. Therefore, water level control equipment and water flow meter are required. As well, the pipeline system will be designed for accurate and simple operation, and control equipment which requires the simplest maintenance will be selected based on the pump. Because of the height of structures, consideration is also given to installing lightning rods.

Electric Power Unit

The electric power unit for each water supply facility will be connected through service wires from the nearest transmission line with a transformer unit. The secondary electrical power is an alternating current of 240V-50Hz. The electric power unit is used mainly for supplying power to the chlorinator, the office, and lighting units.

A fence surrounding the elevated water tank and a guard house, similar to that for the water source facility, will be built for security, and on-site lighting equipment will be installed for nighttime lighting.

Chlorination

Although the water source for this project is the borehole which can supply groundwater, importance must be placed on supplying water which is sanitarily safe and free from disease-causing organisms. Therefore, from the viewpoint of prevention of water-borne diseases which is the focus of this project, a thorough disinfection of the water is necessary.

The equipment to be used for this project is convenient in terms of its use with sufficient inventory and availability. A constant dosing pump injects and dissolves a high concentration bleaching powder (hypochlorous calcium) which excels in safety and handling as a toxic chlorine agent. For the purpose of disinfection, a double unit system is used which allows an operation change-over in the case of a mechanical breakdown. Provisions for the acquisition of spare parts are necessary.

Chloride agents are highly alkaline and corrosive, and therefore, corrosion-resistant materials should be used. The dosing point is to be prior to water distribution from the elevated tank.

Distribution pipelines

Distribution pipelines will be of polyvinylchloride and laid underground. Using a gravity supply system, the pipelines will be laid along roads, in general, with consideration of the topography and the demand distribution pattern in the service area. When crossing a road, adequate measures considering the depth and load imposed on the pipeline are to be taken to protect the pipeline.

Based on the topography, air vents, drainage valves, control valves, and branch valves will be installed on the pipeline according to necessity.

Connections between Service Areas

Installation of a main distribution pipeline, enabling the connection of several elevated tanks, in order to handle future pipeline rehabilitations and extensions or supply from other elevated tanks when water cannot be supplied from the main elevated tank due to circumstances such as repairing of submersible pumps, rehabilitation of wells, repairing of transmission pipelines or cleaning of tank interiors, will be considered. Moreover, installation of check valves to prevent backflows and standardization of elevated tank bottom altitudes will also be considered. If tank bottom heights are considerably

different, other measures for connections will be taken, but if judged to be inappropriate, connections will not be made.

Connections to Existing Pipelines

This water supply project is a self-sustaining system within a limited area, and therefore the borehole water source does not have availability for supplying water to other areas. Furthermore, damaged parts on the existing supply system, giving cause to leakages and illegal connections, should be separated.

Since the mainstay of the region is rugged land, the formation of a piping arrangement along this land can result in vacuum due to the change in hydraulic pressure. In case vacuum pressure occurs around damaged parts of the existing pipe, there is also the possibility to vacuum wastewater and contaminated water. To Avoid this matter, existing pipes and new pipes will not be jointed.

Public Faucets and Laundry Facilities

As the locations for public faucets face public roads, the traffic conditions and convenience for residents are considered. The public faucets are wall-type with multiple taps, and their structure allow the taps, valves, and meters to be locked and easily maintained. Drainage facilities to maintain proper sanitary conditions will also be installed. Laundry facilities will be constructed next to some public faucets. In this case, a water meter is to be installed at each laundry facility. Special attention is given to the structure of laundry facilities in order to avoid excessive water use. Also, water treatment units will be installed exclusively for the laundry facilities in order to maintain the surrounding environment.

The drawings in 4.3.3 indicate public faucet types A and B and laundry facility. Public faucet type A will be constructed at flat places. As for the type B, the faucet will be erected over a preconstructed drainage ditch to avoid damage to the facility where heavy rains can erode roadsides.

(4) Facilities for Operation and Maintenance

The operation and maintenance facilities consist of one main-division and eight sub-divisions.

Main-division

The main division will be the base for the water supply operations. With the aim of operating as a self-sustaining system, the main division will handle all of the work related to the water supply activities, such as water supply register procedures, meter readings, water fee collections, issuances of notices, operation and maintenance of the water supply facilities, salary payments, work records, customer services, and educational activities for residents on water sanitation. The nature of the work requires an office for desk work, a conference room which can also serve as a public relations office, an information room, a storage room, and a workshop. This main division is to be constructed inside the water source facility of "Area-1" which will be constructed first out of the eight service areas. As the main division is to be used as a field office for the contractor during construction of the water supply facilities, the building must have adequate space.

Sub-division

The sub-division is a building for maintenance, management and meter-reading personnel. The number of sub-divisions is equivalent to the number of water tank facilities. The office, which is attached to the control room to be constructed at the water tank, serves as the sub-division in some cases. The sub-division should allow water fee payments to be accepted on specified days for residents, so that they need not go to the main division to pay the fees.

Construction sites

All sites are the official property of the LCC or the Zambian government. All properties can be used, but it is necessary to ensure their use at the detailed design stage because of the possibility of squatters before the construction.

4.3 Basic Plan

4.3.1 Plan of Water Supply Facilities

The list of the facilities which are designed for each service area is shown in the Table 4-3.

Table 4-3 Design Facilities in Service Area

	Water Source Facility		Water Supply Facility			Management Facility	
	Borehole ϕ8"x80m	Machinery House	Chlorinator	Elevated Water Tank ($300m^3$)	Public Faucet & Laundry Facility	Main Division Building	Sub Division Building
AREA 1	1	1	1	1	50	1	1
AREA 2	1	1	1	1	44	0	1
AREA 3	1	1	1	1	47	0	1
AREA 4	1	1	1	1	48	0	1
AREA 5	1	1	1	1	47	0	1
AREA 6	1	1	1	1	49	0	1
AREA 7	1	1	1	1	45	0	1
AREA 8	1	1	1	1	45	0	1
Total	8	8	8	8	375	1	8

4.3.2 Plan of Equipment and Materials for Operation and Maintenance

Specifications of equipment and materials for operation and maintenance to be procured in this project are listed below.

Item	Quantity	Specification
(1) Vehicles		
1)Cargo Truck with Crane	1 unit	Engine: Water-cooled diesel engine not less than 200PS Drive : 4x4 Crane capacity: 3,000kg/2.5m
2)Water Tanker	2 units	Engine: Water-cooled diesel engine Drive : 4x4 Tank capacity: Not less than 4,000 lit

3)Station Wagon	1 unit	Engine: Water-cooled diesel engine Drive : 4x4 Seats : Not less than 9
4)Pickup Truck	2 units	Type : Single cabin Engine: Water-cooled diesel engine Not less than 80PS Drive : 4x4 Max. load: less than 700kg
5)Pump Hoist	1 unit	Type : 4x4, truck-mounted Engine: Water-cooled diesel engine Not less than 150PS Hoist capacity: Not less than 5,000kg

(2) Maintenance Equipment

1)Work Shop Equipment	2 units	General maintenance equipment Vehicle maintenance equipment Machinists' tools General tools Electrical tools
2)Plumbing Tools	16 units	Tools for pipe maintenance
3)Water Quality Analysis Equipment	1 unit	For laboratory
4)Water Quality Analysis Kit	8 units	Portable type
5)Water Level Meter	8 units	Manual type Measuring depth: 100m
6)Conductivity Meter	8 units	Portable type
7)pH Meter	8 units	Portable, digital type

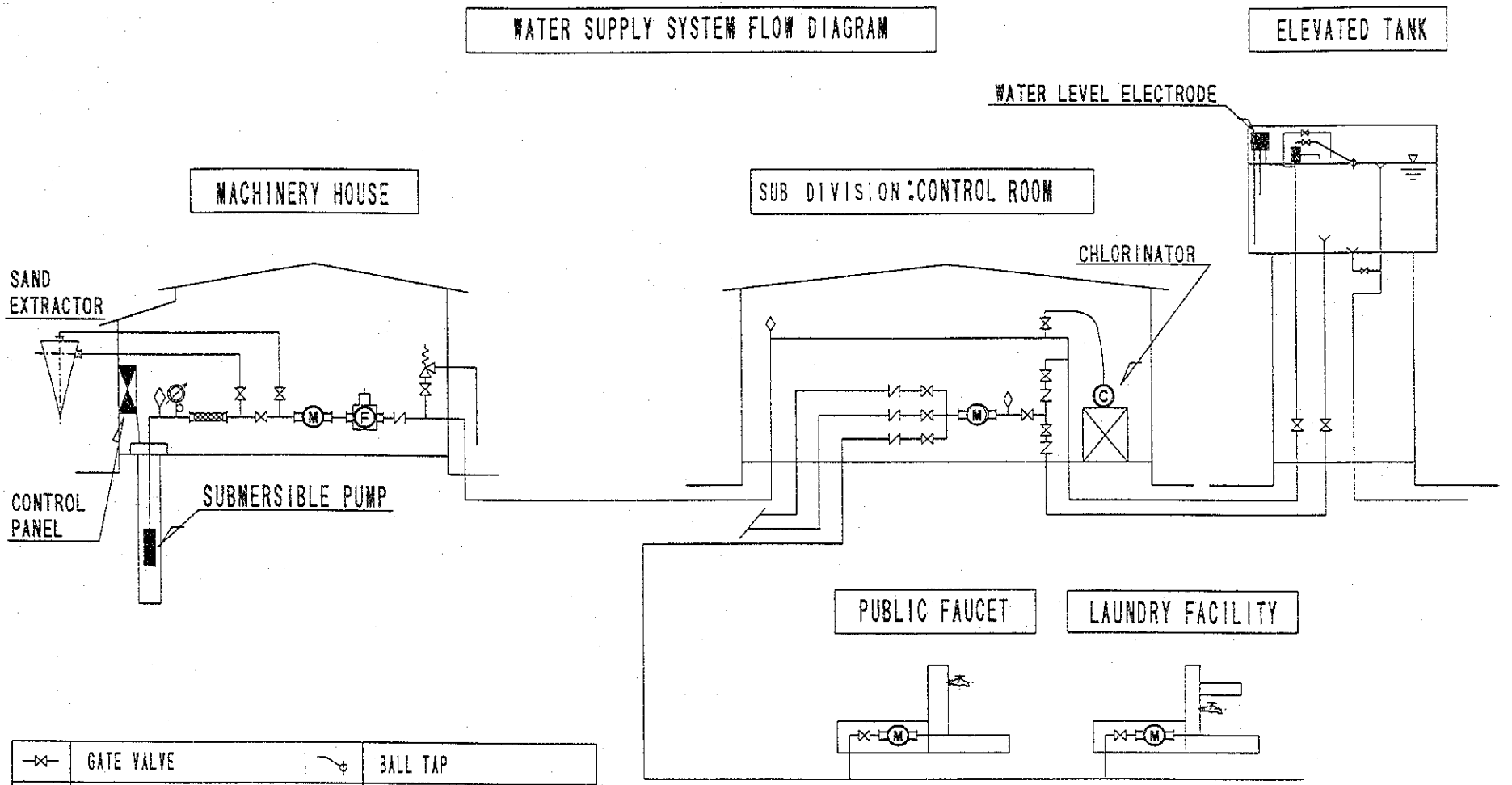
(3)Standby Equipment and Others

1)Standby Pump	8 units	Submersible pump
2)Standby Tap	1 lot	Durable type
3)Data Processing Equipment	3 units	Desk-top personal computer Printer
4)Bicycle	60 units	Off-road type
5)Promotional and Educational Kit	1 unit	For promotion and educational activities
6)Spare Parts	1 lot	15% of equipment cost

4.3.3 Basic Design Drawings

1. Water Supply System Flow Diagram
2. Submersible Pump Installation
3. Main Division Layout Plan
4. Machinery House Type - A Layout Plan
5. Sub Division Layout Plan
6. Elevated Tank 300m^3
7. Main Division
8. Sub Division
9. Machinery House Type - A
10. Machinery House Type - B
11. Septic Tank
12. Public Faucet Type - A
13. Public Faucet Type - B
14. Laundry Facility Type - A
15. Laundry Facility Type - B
16. Borehole Structure

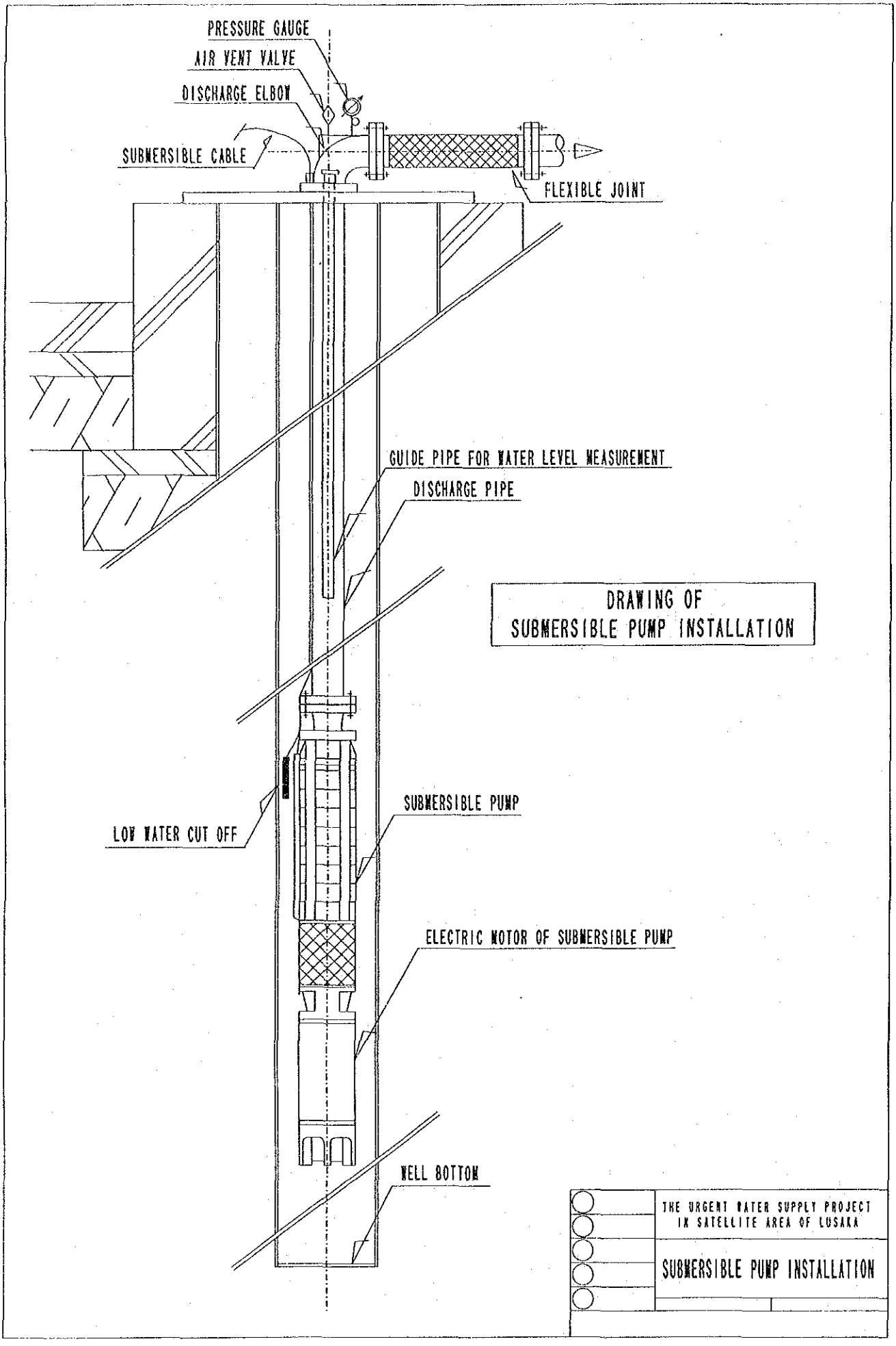
WATER SUPPLY SYSTEM FLOW DIAGRAM

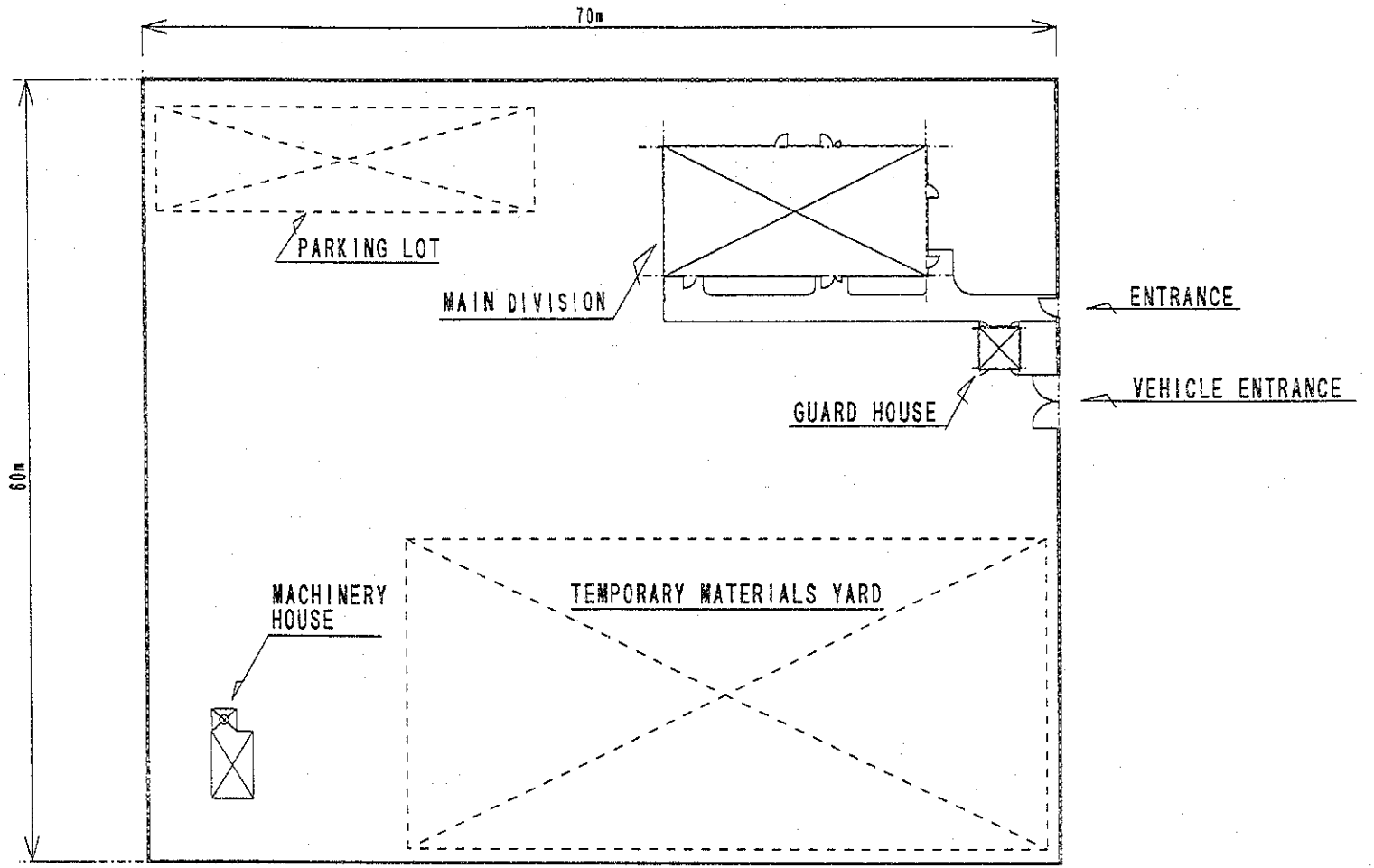


	GATE VALVE		BALL TAP
	CHECK VALVE		AIR VENT VALVE
	SAFETY VALVE		PRESSURE GAUGE
	FLEXIBLE JOINT	M	WATER METER
	WATER LEVEL CONTROL VALVE	F	FLOW GAUGE

THE URGENT WATER SUPPLY PROJECT IN SATELLITE AREA OF LUSAKA

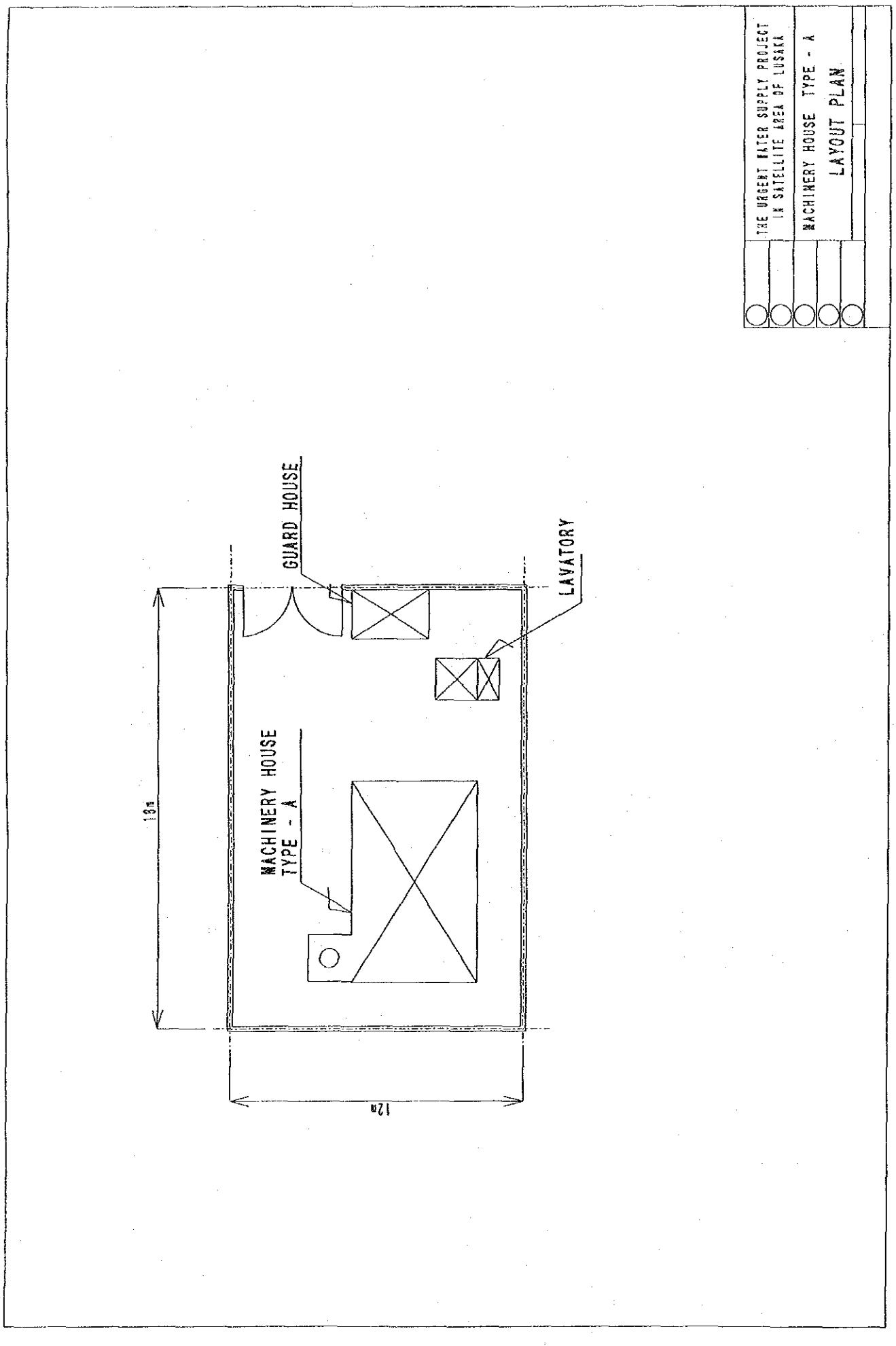
WATER SUPPLY SYSTEM FLOW DIAGRAM

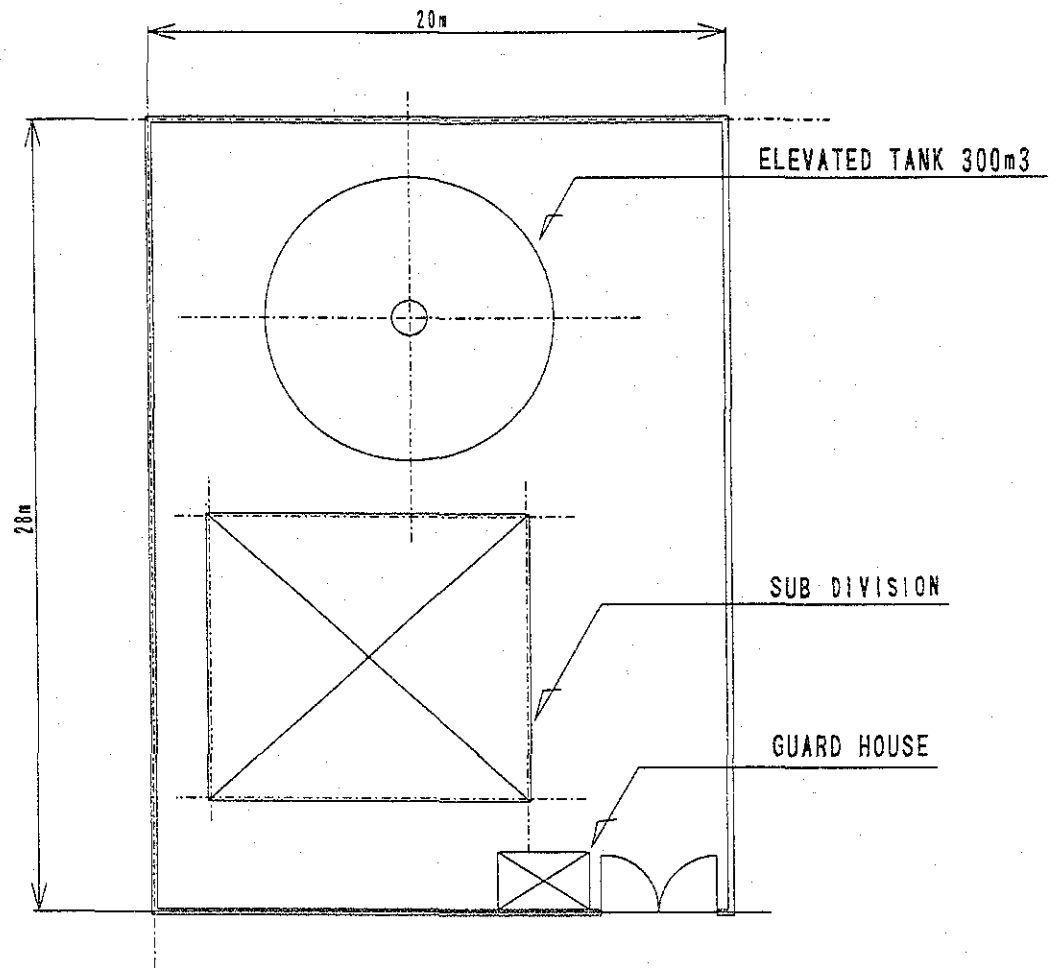

PRESSURE GAUGE
AIR VENT VALVE
DISCHARGE ELBOW
SUBMERSIBLE CABLE
FLEXIBLE JOINT
GUIDE PIPE FOR WATER LEVEL MEASUREMENT
DISCHARGE PIPE
DRAWING OF
SUBMERSIBLE PUMP INSTALLATION
SUBMERSIBLE PUMP
LOW WATER CUT OFF
ELECTRIC MOTOR OF SUBMERSIBLE PUMP
WELL BOTTOM
THE URGENT WATER SUPPLY PROJECT
IN SATELLITE AREA OF LUSAKA
SUBMERSIBLE PUMP INSTALLATION



THE URGENT WATER SUPPLY PROJECT IN SATELLITE AREA OF LUSAKA

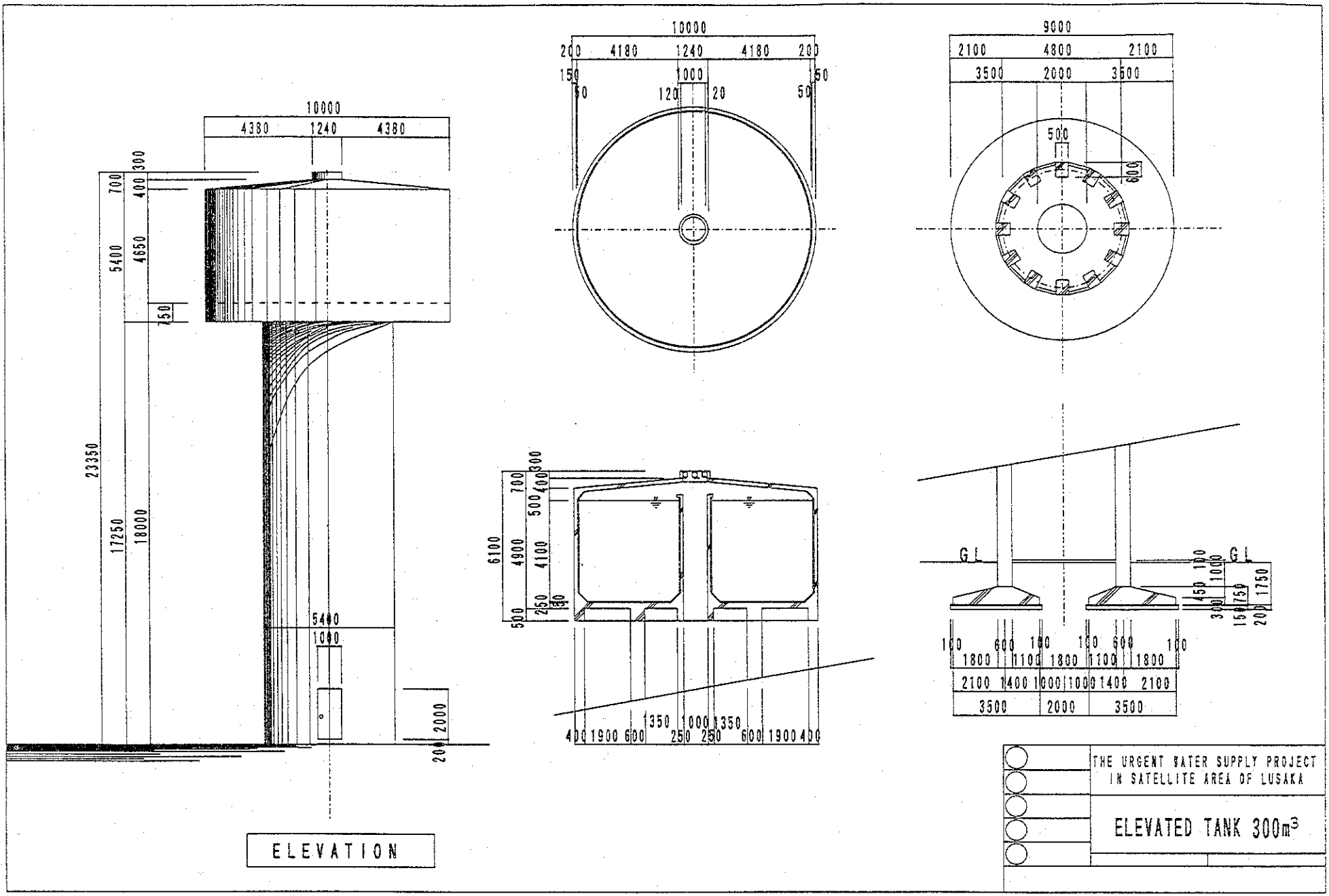
MAIN DIVISION LAYOUT PLAN

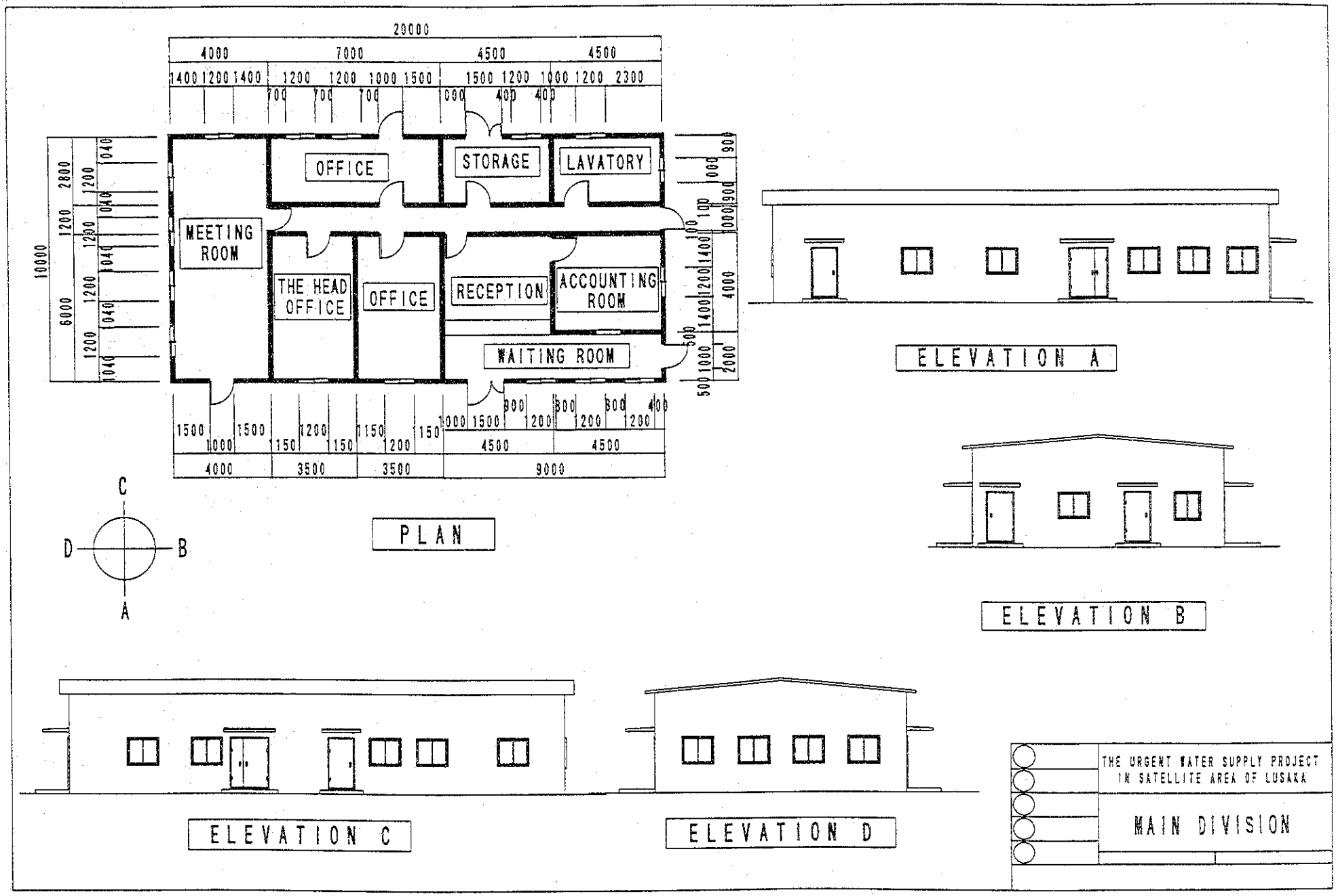

THE URGENT WATER SUPPLY PROJECT
IN SATELLITE AREA OF LUSAKA
MACHINERY HOUSE TYPE - A
LAYOUT PLAN
GUARD HOUSE
LAVATORY
MACHINERY HOUSE
TYPE - A
13m
12m

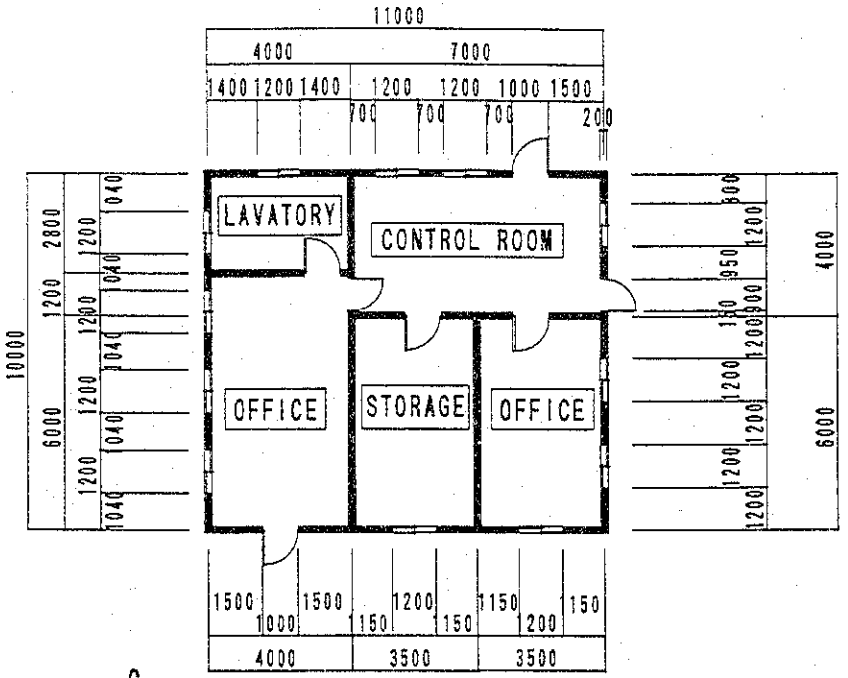


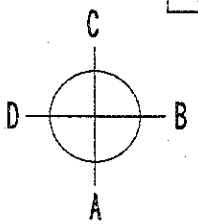
THE URGENT WATER SUPPLY PROJECT
IN SATELLITE AREA OF LUSAKA

SUB DIVISION
LAYOUT PLAN

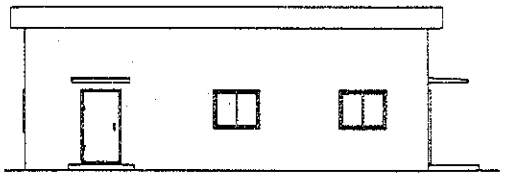

ELEVATION
THE URGENT WATER SUPPLY PROJECT
IN SATELLITE AREA OF LUSAKA
ELEVATED TANK 300m3


20000
4000
7000
4500
4500
OFFICE
STORAGE
LAVATORY
MEETING ROOM
THE HEAD OFFICE
OFFICE
RECEPTION
ACCOUNTING ROOM
WAITING ROOM
10000
6000
4000
4000
3500
3500
9000
PLAN
C
D
B
A
ELEVATION A
ELEVATION B
ELEVATION C
ELEVATION D
THE URGENT WATER SUPPLY PROJECT IN SATELLITE AREA OF LUSAKA
MAIN DIVISION

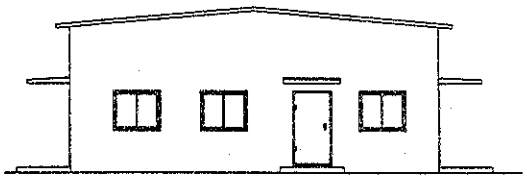




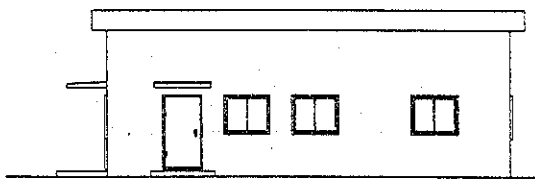
PLAN



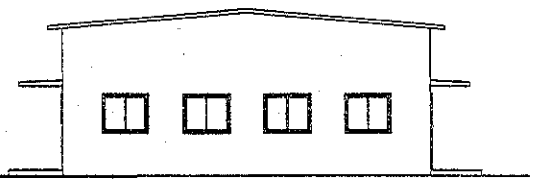
ELEVATION A



ELEVATION B



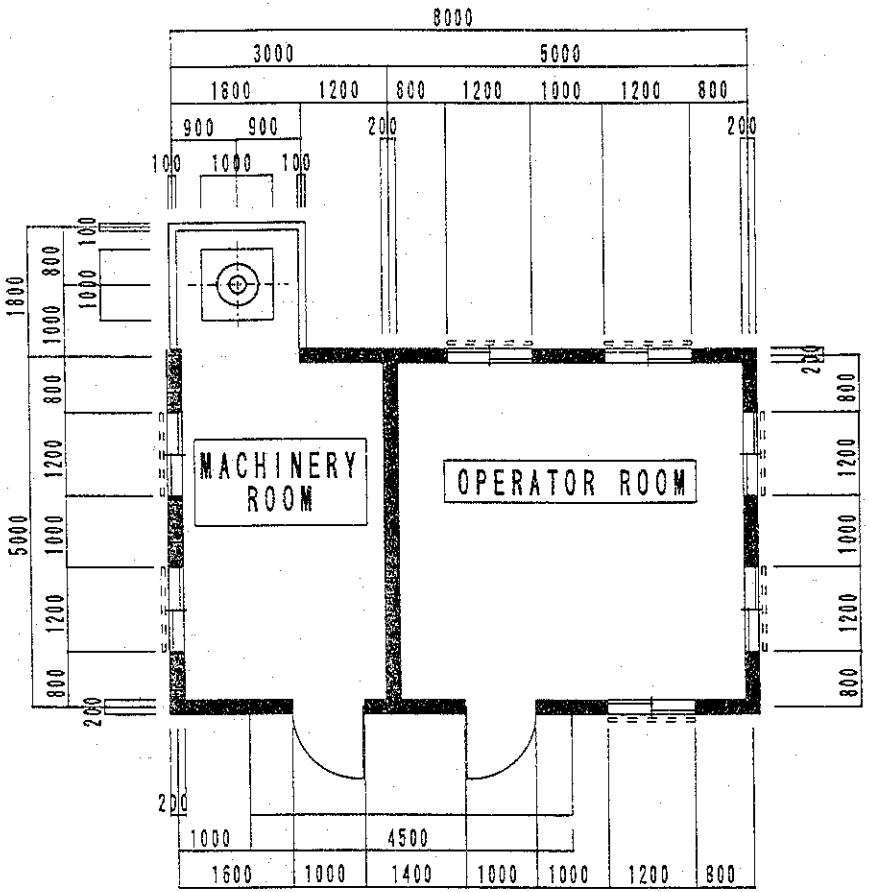
ELEVATION C



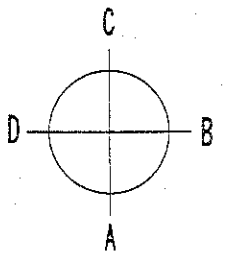
ELEVATION D

THE URGENT WATER SUPPLY PROJECT IN SATELLITE AREA OF LUSAKA

SUB DIVISION



PLAN



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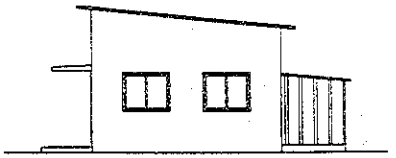

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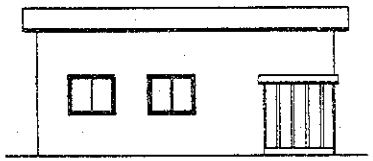

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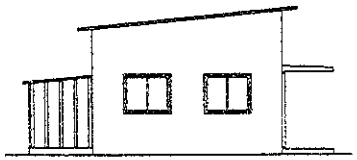
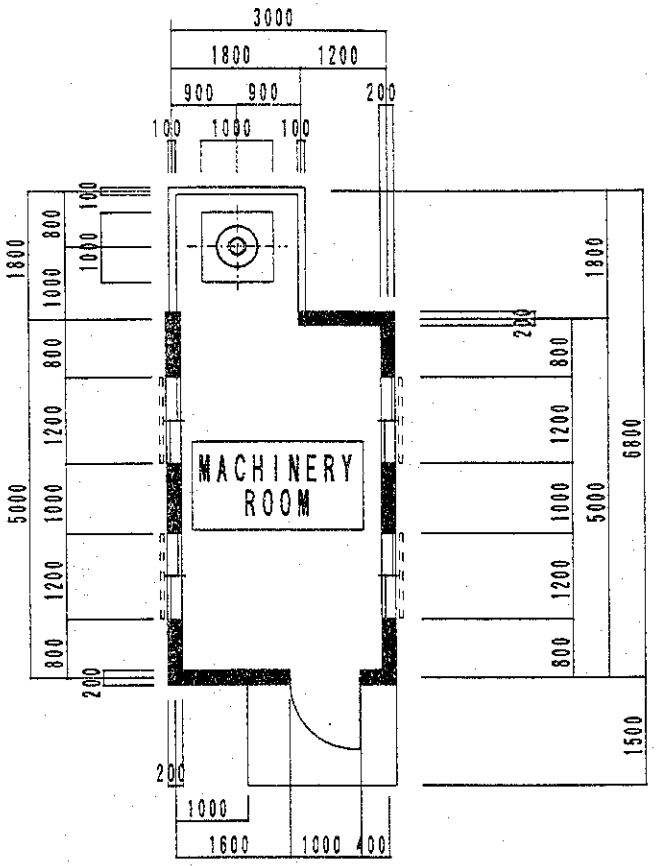


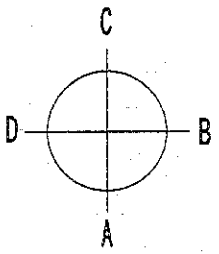
ELEVATION D

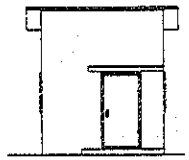
THE URGENT WATER SUPPLY PROJECT IN SATELLITE AREA OF LUSAKA

MACHINERY HOUSE TYPE-A

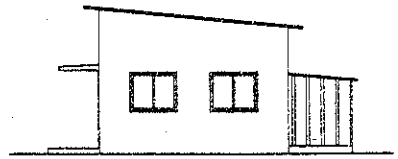


PLAN





ELEVATION A



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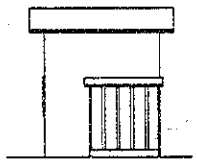

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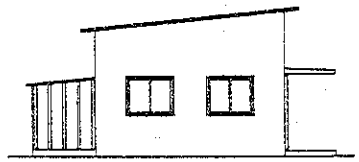
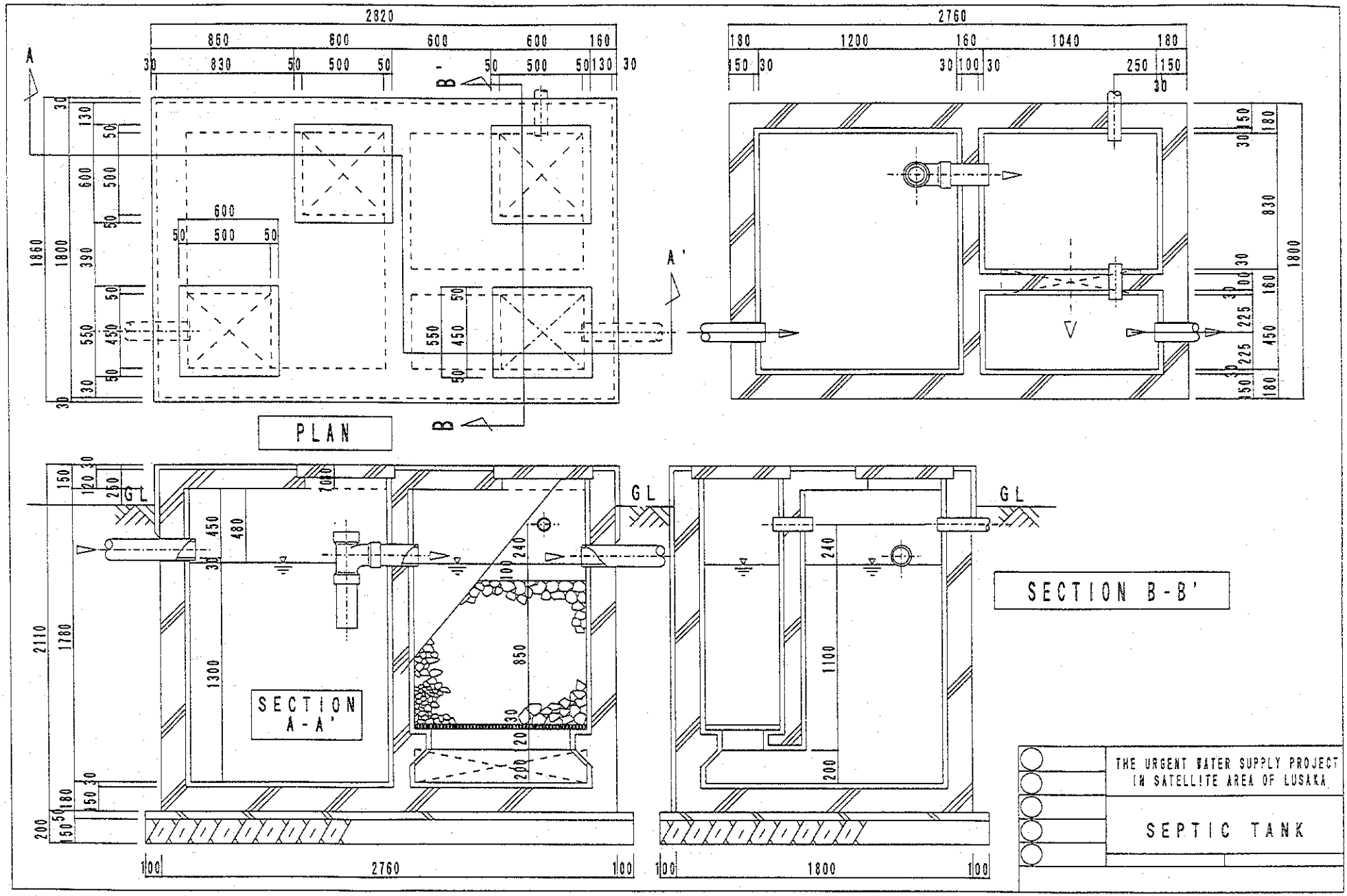
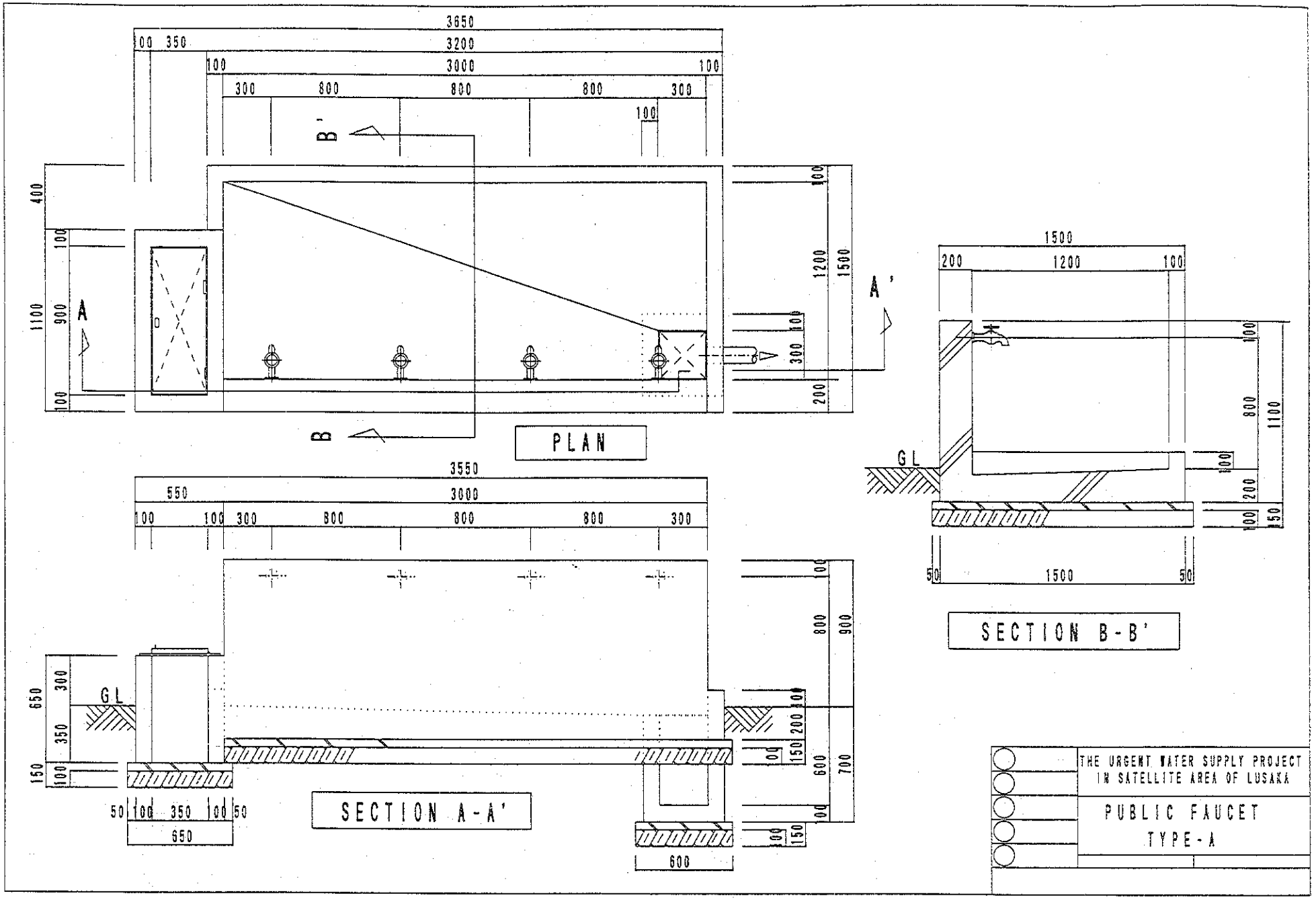


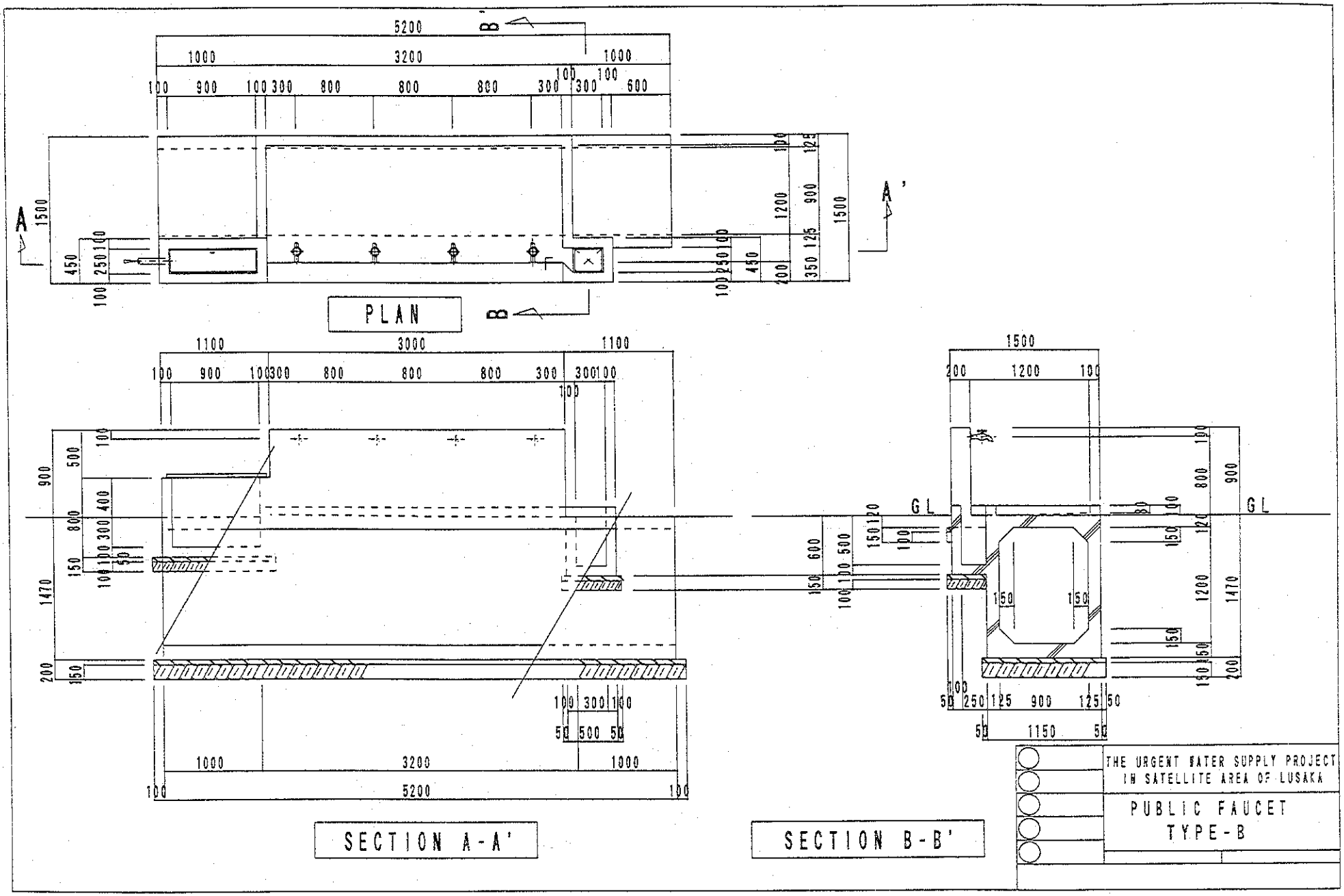
ELEVATION D

THE URGENT WATER SUPPLY PROJECT
IN SATELLITE AREA OF LUSAKA

MACHINERY HOUSE
TYPE-B


PLAN
SECTION A-A'
SECTION B-B'
THE URGENT WATER SUPPLY PROJECT IN SATELLITE AREA OF LUSAKA
SEPTIC TANK


PLAN
SECTION A-A'
SECTION B-B'
GL
THE URGENT WATER SUPPLY PROJECT IN SATELLITE AREA OF LUSAKA
PUBLIC FAUCET
TYPE-A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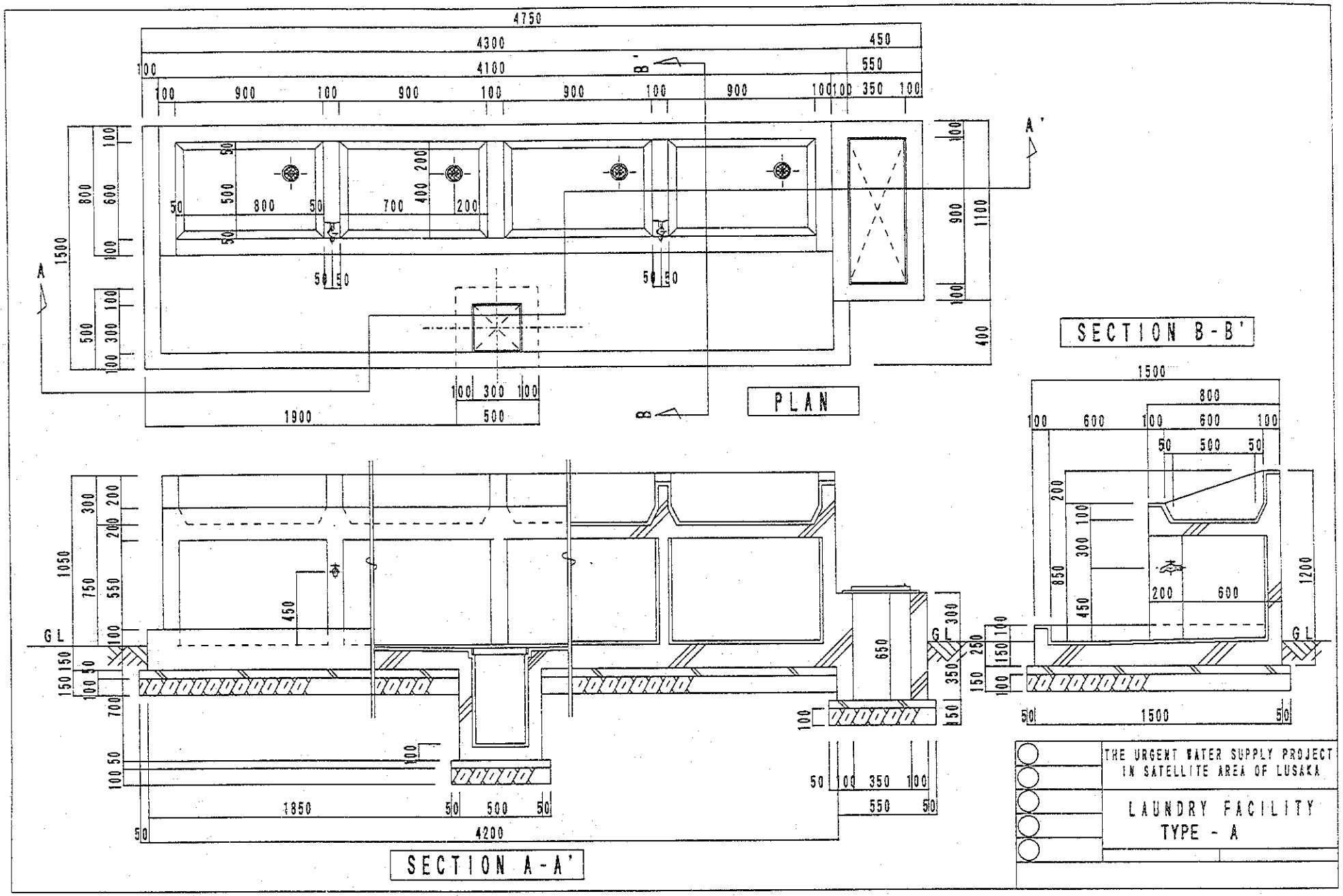
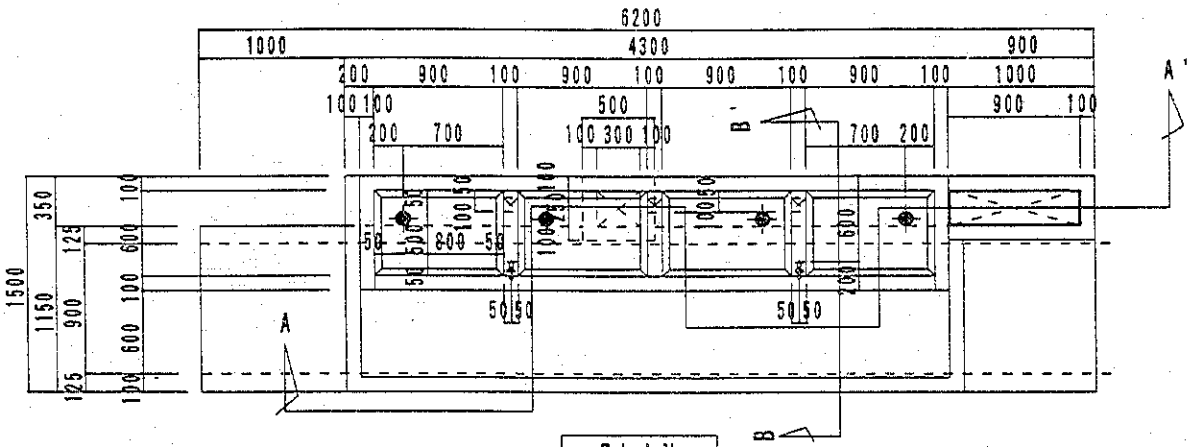
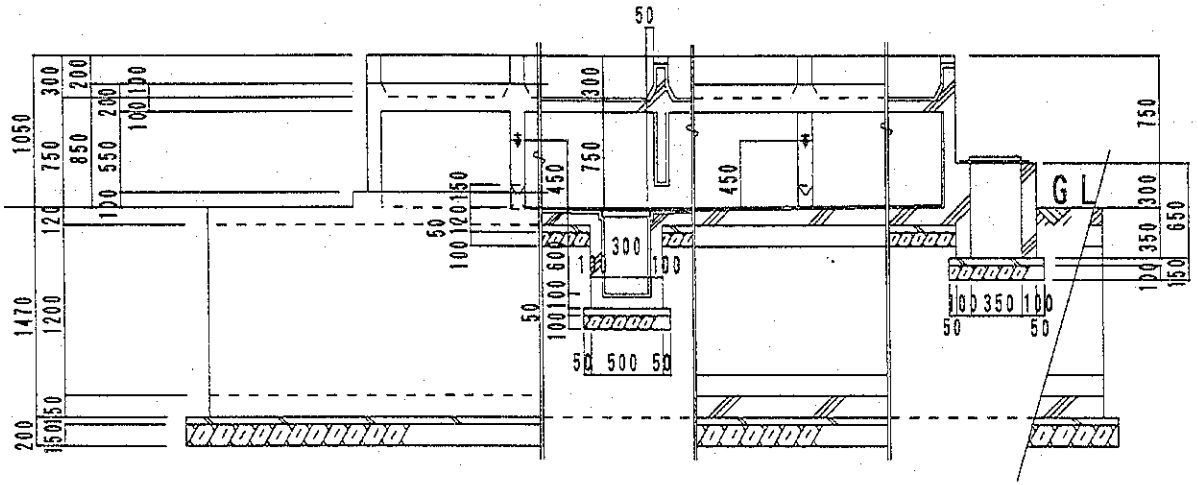
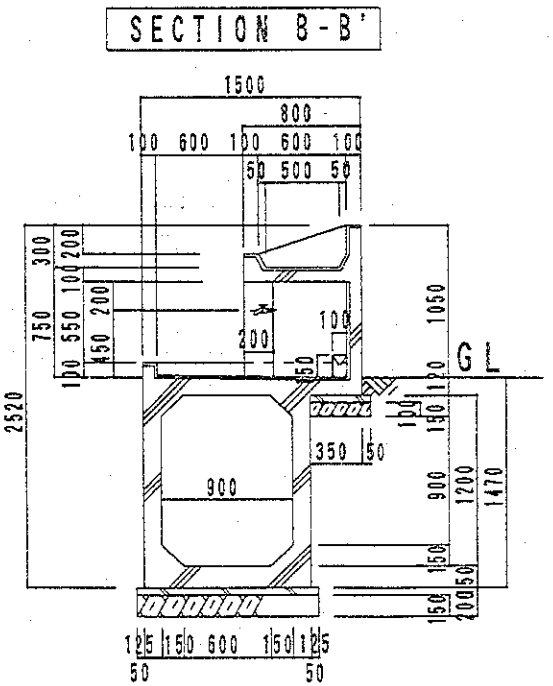
SECTION A-A'
SECTION B-B'
THE URGENT WATER SUPPLY PROJECT
IN SATELLITE AREA OF LUSAKA
PUBLIC FAUCET
TYPE-B


PLAN
SECTION A-A'
SECTION B-B'
THE URGENT WATER SUPPLY PROJECT
IN SATELLITE AREA OF LUSAKA
LAUNDRY FACILITY
TYPE - A

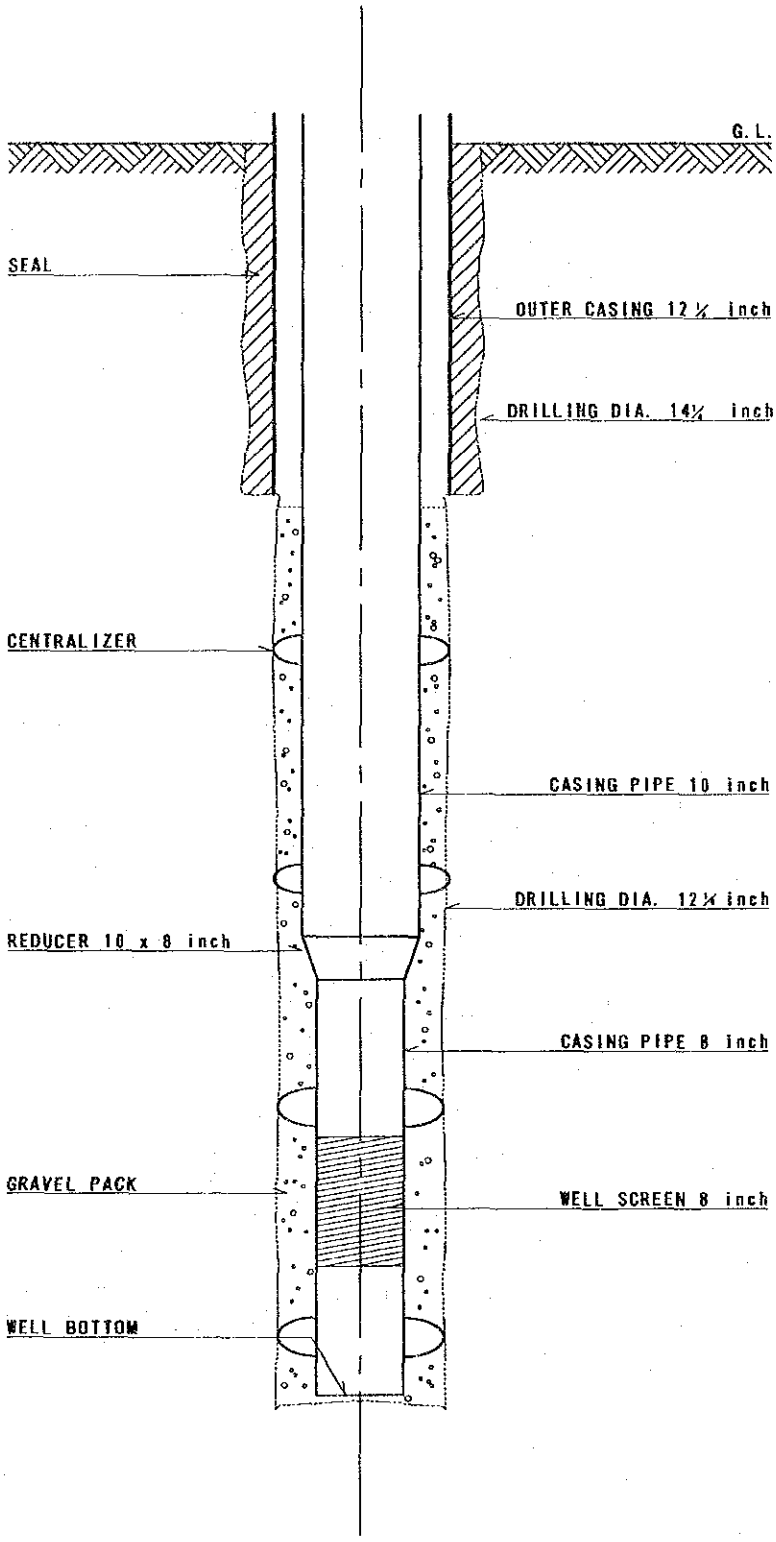






THE URGENT WATER SUPPLY PROJECT
IN SATELLITE AREA OF LUSAKA

LAUNDRY FACILITY
TYPE - B



THE URGENT WATER SUPPLY PROJECT IN SATELLITE AREA OF LUSAKA

BOREHOLE STRUCTURE

4.4 Implementation Plan

As this project is to be implemented through a Japanese grant aid, the implementation plan will be as follows.

4.4.1 Implementation Policy

Contracting

The main body for this project is the LWSC, and has responsibilities for detailed design, site transfer, and operation and maintenance. After the E/N is concluded, the MLGH which supervises the LWSC will enter into agreement with a Japanese consultant related to the detailed design and construction supervision. With the assistance of the Japanese consultant, the LWSC will perform tenders for the construction of the water supply facilities and supply of related equipment and materials. Contractors will be engaged based on the tenders and an evaluation of tender results.

The main contractor for this grant project will be a Japanese firm. After the consultant and contractor sign with the MLGH, the contracts will become effective upon verification by the Japanese Government. The LWSC will create an operation and maintenance system for the new water supply system before the facility is completed.

The main contractor will construct the water supply facilities and supply the equipment and materials necessary for maintenance, under the supervision of the consultant.

The contractor will undertake the project on a turn-key basis. For execution of the project, the contracting firm must possess an abundance of experience in dealing with water supply projects in tropical, semi-arid areas, similar to the project area, as well as possess sufficient understanding of the relevant details. Furthermore, as this project will construct a comprehensive water supply system using groundwater sources from boreholes, the firm is required to possess specialized technology in this field.

Local Cooperation

In order to complete construction within the limited period, local cooperation is essential. A large number of personnel engaged in general construction and a large number of local companies related to water supply facilities construction are available in Zambia. Their abilities in terms of their numbers and the quality of their work can be evaluated to a certain extent.

All problems related to the construction design of water supply facilities, construction laws, and technical standards are to be resolved by the LWSC. However, the collection of fees for the use of the water supply facilities to be constructed by this project requires the cooperation of the LCC and the Ward Development Committees, especially in allocation of the Site & Service charge and promotion of educational activities to residents.

4.4.2 Construction and Supervisory Plan

The process from the detailed design, through tendering and contracting procedures to contracting, construction supervision, and operation guidance will be conducted under the grant aid system by the Japanese consultant as listed below.

Table 4 - 4 Construction and Supervisory Plan

Stage	Order	Contents
Pre-Construction	1	Detailed design
	2	Preparation of tender documents
	3	Administration of tender process for and on behalf of the executing agency
	4	Evaluation of tender results
	5	Assistance in concluding the contract for the construction work
Under-Construction	1	Supervision of construction work
	2	Preparation and advice on O & M Plan
	3	Inspection and technology transfer
	4	Preparation of completion report

Before construction

Prior to construction, all detailed designs necessary to begin the project, including a site survey, will be conducted in the project area, based on the results of the Basic Design Study. Specifications for facilities construction and equipment and materials to be supplied will be determined, and related tender documents will be prepared. Along with the preparation of the tender documents, a tender programme will be prepared after discussions with the relevant ministries and agencies. The executing agency will be supported during the tender process. As well, tender results will be evaluated. The contract process between the executing agency and the selected firm will be assisted.

During Construction

During the construction stage, technicians dispatched to the project area will make discussions with each agency on issues necessary to begin the project, including site transfer of the project sites, and perform quality control and supervision. When the facilities are completed, an acceptance inspection of the equipment and materials will be conducted and an operation and maintenance development plan will be created. Guidance for continuous operation will be provided by the Lusaka Water and Sewerage Company, and reports outlining the completion of the project will be prepared.

Support and Guidance for Operation and Maintenance

A personnel in charge of operation and maintenance for continuous management will be dispatched. This personnel will be dispatched three times as follows:

- At the first time, he will make general preparations for efficient operation and maintenance through matters such as, 1) present conditions of the LWSC on money flow, fee collection and other fee matters, 2) detailed preparation of animation activities, and 3) detailed planning on management.

- At the second time, in preparation for start of operations in phase-1, he will give support and advice on public relations activities, staff selection and preparation of residents' register, as well as fee collection and other administrative work after commencement of the water supply.

- At the third time, he will consult on management matters for phase-2 in consideration of the problems arising in phase-1 upon analysis of these problems.

Moreover, since the service area in phase-2 will become four times that of phase-1 and the work load on fee collection and other administrative activities will increase as well, a state of confusion is foreseen; and therefore, this personnel will carry out his responsibilities until three months after the start of operations.

4.4.3 Procurement Plan for Equipment and Materials

Materials for facilities construction will be based on those used in previous projects through foreign assistance and similar projects, and local construction materials which can satisfy these needs will be evaluated on their cost, quality and quantity. This means that established local standards will be used as much as possible because local products such as cement, aggregate and others are available. Products manufactured in neighboring countries such as pipes are also available in the local market. Vehicles, water analysis instruments and other such equipment will be procured from Japan, and products from a third country will not be procured. The source of procurement for the main equipment and materials are indicated below.

(1) Procurement from Japan
Vehicles, submersible pumps and their standbys, water analysis instruments, taps, off-road bicycles, etc.

(2) Local Procurement
Cement, aggregate, chlorinators, pipes, valves, power units,

water flow meters, electric wire, etc.

4.4.4 Scope of Work

The scope of work for this project is divided into those to be carried out by the Japanese government and those by the Zambian government. The responsibilities of the Japanese side in this project are as follows.

(1) Construct boreholes, water supply facilities and operation and maintenance division buildings within the project area.

(2) Supply the equipment and materials necessary for maintenance and management of the water supply facilities.

(3) Prepare and implement a programme for system improvement on operation and maintenance.

(4) Perform consulting services during implementation of the project.

The responsibilities of the Zambian side in this project are as follows.

Lusaka Water and Sewerage Company

During the implementation stage:

(1) Acquire land for construction work.

(2) Prepare access roads as needed.

(3) Provide banking arrangements and bear any bank commission charges related to the project.

(4) Arrange duty clearance and tax exemptions for equipment and materials to be imported.

(5) Promote smooth customs procedures.

(6) Furnish data and information.

(7) Dispatch counterpart personnel.

After completion of the facilities:

(1) Select and educate personnel to improve the operation, maintenance and management system.

(2) Enlighten residents about fee collection and public sanitation.

(3) Consider sufficient measures against vandalism during as well as after construction of the facilities.

Lusaka City Council

(1) Secure the construction site.

(2) Exclude the water fee from the present site and service charge to avoid double collection of the water fee.

(3) Cooperate with the LWSC, provide educational activities for public sanitation and fee collection for residents, and request support from the section chairmen.

4.4.5 Implementation Schedule

(1) Implementation by Phasing

The construction of the water supply facilities for this project will be conducted by dividing the construction period into four phases; a monitoring survey and interim evaluation will be conducted in between phase-2 and phase-3, as mentioned above. Table 4-5 shows the schedule for each phase. Table 4-5 shows the service areas to be developed in each phase.

Table 4-5 Implementation Schedule

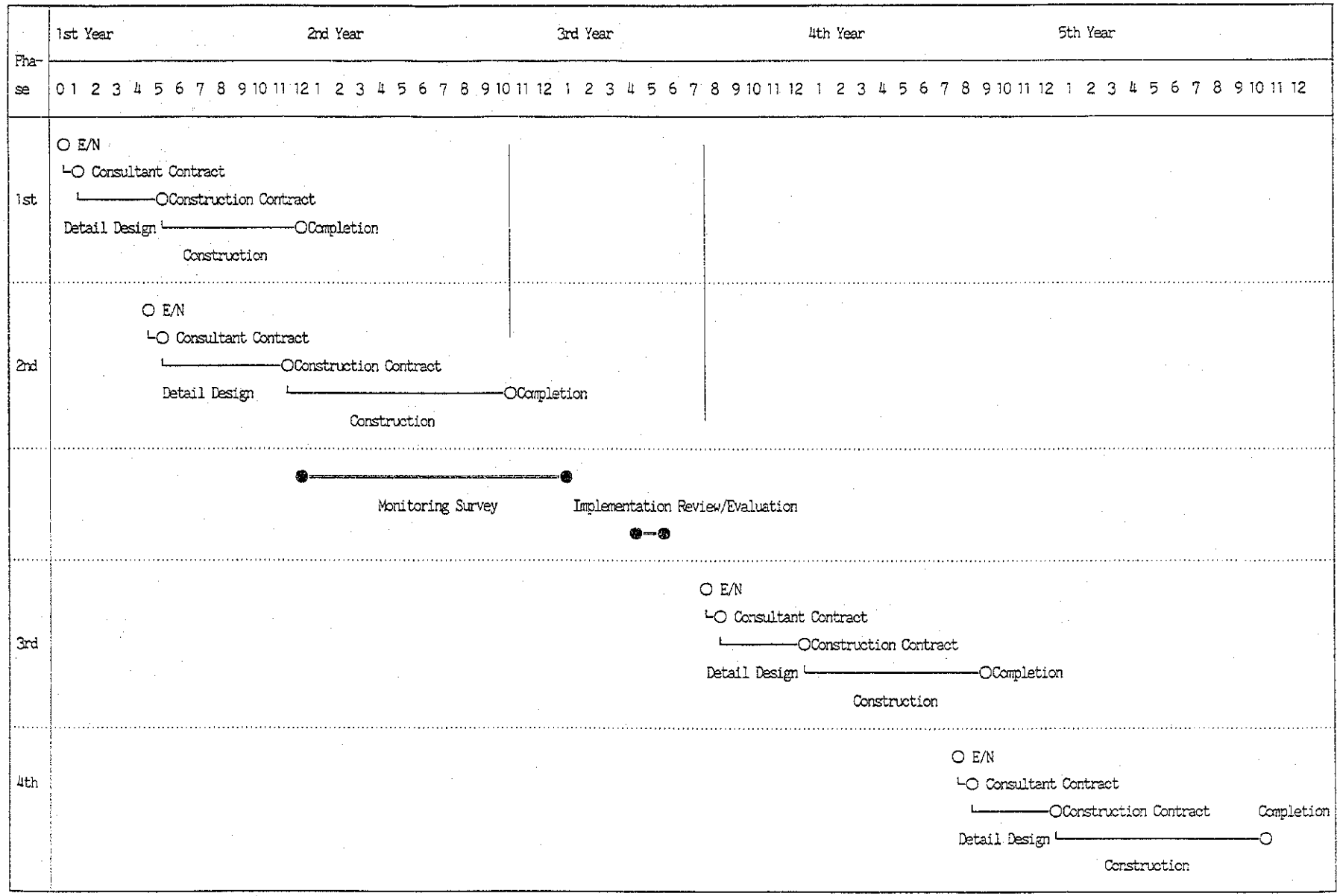


Table 4-6 Service Area by Phase

Phase 1	Pahse 2	Monitoring	Phase 3	Phase 4
Area 1 Part of George	Area 2 Part of George Area 3 Part of George Part of Soweto Area 4 Part of George Part of Soweto	Area 1-4 Implementaion Review	Area 5 Part of George Chikilokoso Area 6 Part of George Kizito	Area 7 Paradise Part of Lilanda Site 5 Area 8 Desai Part of Lilanda Site 5

(2) Conditionality and Monitoring Survey Items

Whether or not the goals of this project are achieved depends on the efforts of the Zambian side in regard to whether the constructed facilities are managed and maintained as planned by the LWSC and whether the residents cooperate in fee payment and use facilities properly. The above efforts will be reviewed and evaluated on the halfway of the project period, namely after the completion of the second phase. Whether or not the project can be continued will be determined based on the results of the review.

Monitoring will begin at the implementation stage of the first phase. After one year of operation, the operation situation and the management system will be surveyed and confirmed. However, the scale of the water supply facilities constructed during the first phase will be limited (only in one service area), and payment of the labour cost will be heavy. Moreover, effective operation will be difficult at the beginning. Following the completion of the construction in three service areas during the second phase, smoother operations are predicted with the operation of four service areas (50% of the service areas). Therefore, monitoring should be conducted at least six months after beginning operation of the facilities constructed during the second phase.

In terms of the monitoring method, the LWSC shall submit periodic (quarterly) reports and data to the Japan International Cooperation Agency, Zambia Office, from the beginning of construction. The LWSC will also utilize the advice and cooperation provided by the Japanese consultant, which is in charge of the detailed design and construction supervision. The JICA office in Zambia will compile the submitted reports and data, and report these details to its headquarters. The evaluation will be conducted by the Japanese side, based on these reports. Whether to continue the project or not will be decided by the Japanese government upon discussions by the Ministry of Foreign Affairs, JICA and the Consultant pertaining to the implementation review.

The goal of operation and maintenance is to supply a safe and stable water supply on a continuous basis. There are important conditions which must be achieved within a limited period as evidence of efficient facilities operation and maintenance, as mentioned above. Appendix 11 shows the monitoring survey list related to the detailed survey items. Table 4-7 shows the conditions, related items, and an outline of what should be achieved.

Table 4-7 Conditions to be Achieved and Monitoring Survey Items

Conditions to be Achieved	Monitoring Survey Items
Safe and stable water supply	* Measurement of water quality, pressure, and flow rate * Actual situation of the water supply hours, pumping rate, water distribution rate, disinfection, and operation of facilities and equipment * Repairing locations, frequencies, and countermeasures
Improvement system	* Adjustment of the budget and the system through the establishment of the divisions, and dispatch of personnel and development of their skills * Coordination between project-related agencies and ministries
Service goals (Served population, sanitation)	* Number of beneficiaries and their growth rates * Occurrence of waterborne diseases
Systematic financial management	* Examination of the operating costs for items such as electrical power, disinfectants, labor, and clerical work * Confirmation of cross-subsidization as a supporting measure for unprofitable sections, which is a policy of the LWSC * Actual situation survey on suspension of supply to nonpaying users and other concrete measures * Evaluation of the fee collection ability through fee calculations
Residents' cooperation	* Number of registered water supply beneficiaries and water usage rate. The actual situation concerning the role of local residents such as ward development communities which function in terms of community formation and section chairmen * Examination of the fee payment ability, and movements by residents to punish those who do not cooperate with the water supply activities, such as nonpaying users and illegal connection consumers

CHAPTER 5

PROJECT EVALUATION AND CONCLUSION

CHAPTER 5

PROJECT EVALUATION AND CONCLUSION

5.1 Project Evaluation

This project follows the Fourth National Development Plan of the Republic of Zambia and governmental structural adjustment programmes in conformity to the high priority ranking in the Social Action Programme. This project will largely contribute to an improvement in the living standards of low-income residents in the satellite areas of Lusaka City. The project is also important as an emergency countermeasure to combat water-borne diseases, such as cholera, which commonly occur during the rainy season, by improving the poor sanitation environment through improved drinking water supply facilities. The following Table 5-1 shows the effects of the project and the level of improvement over the present situation.

Table 5-1 Effect of Implementing the Project and Improvement Over the Present Situation

Present Situation and Problems	Project Countermeasure	Effects and Level of Improvement
1.The source of water for many residents comes from hand-dug wells which are seriously contaminated. Many occurrence of water-borne diseases such as cholera, especially during the rainy season, are reported. This has become a serious social problem.	1.Develop new ground water sources and secure a system which supplies safe drinking water throughout the year, with chlorination during the rainy season when water quality is poor.	1.Residents in the project area can receive a safe and stable water supply throughout the year after completion of the project. Also, water-borne diseases such as cholera can be reduced.

Present Situation and Problems	Project Countermeasure	Effects and Level of Improvement
2.The average water consumption is currently 15-20 lit/capita/day, and the water and sanitation environment is poor, giving rise to low living standards. Economic efficiency and productivity on a national level are being promoted under structural adjustment programs, but improvement of the living environment is necessary as a relief measure for those at the bottom of the social stratum, including low income urban residents, or as a measure to revitalize the low-income group.	2.Through the new water supply system, supply of clean and stable water can be provided at an average rate of 35 lit/capita/day.	2.Water for residents in the project area will be improved both in quality and quantity. Diversified water usage for living will be possible. For low-income urban residents, an improvement of the water and sanitation environment will improve their health and living standards. Effective activation of economic activities can also be expected.
3.In the project area, water is obtained from hand-dug wells and other water sources. The drawing of water by hand and the transportation of water are performed mainly by women and children. This imposes a heavy burden in terms of time and labor.	3.Through this project, public faucets will be constructed in each residential area to allow easy access to water.	3.Women will be liberated from the drawing of water, and opportunities for economic activities with high productivity, leisure, and education will be greatly improved.
4.The project area is located in the satellite area of Lusaka City; its population density is high, but water supply facilities are particularly under developed, even though it is located within Lusaka City. Therefore, a rapid improvement of the water and sanitation environment is required. Operation and maintenance of water supply facilities is difficult , and deterioration in the existing facilities is serious. Therefore, renovation and extension of existing facilities is necessary, but upgrading is not being performed because of financial limitations and concerns over continuous operations. Expensive water fees cannot be paid because of low income standards of the residents.	4.The George Complex, which is project area, will be divided into eight service areas, and facilities construction will be carried out in phases, starting with the area of highest priority. The project aims for a self-sustaining water supply system, with consideration on low-cost operation, and establishment of necessary divisions for operation and maintenance. Furthermore, the executing agency will be required to perform necessary measures such as the dispatch of personnel. This is the basis on which to continue implementing the project.	4.Through construction of water supply facilities, the water supply activities in the satellite area will be in line with the urban water supply. At the same time, if continuous operation of the water supply is possible through this project, it may indicate the possibility of similar water supply projects in other satellite areas in the future.

5.2 Conclusion

This project will provide new water supply facilities in the project area, and the operation and maintenance system will be improved. This will achieve a safe and stable water supply operating on a continuous basis. Through this project, approximately 130,000 residents in the project area will receive benefits, including a reduction in water-borne diseases such as cholera, an improvement in living standards, and

an improvement in the water and sanitation environment. The implementation of this project on a Japanese grant aid basis is very significant and deemed to be feasible.

5.3 Recommendations

The Zambian government recognizes the necessity to take institutional and financial measures and make personnel allocations, as well as the need for support from related organizations such as the MLGH and the LCC. In addition, as a result of the interim evaluation on the monitoring survey to be carried out in this project, the Zambian side agreed that if appropriate measures are not taken, the third and fourth phases of this project cannot be continued.

If the above response is made, the anticipated objects of this project can be attained. However, for a smooth and continuous management of the entire system, the following recommendations are desirable.

To the LWSC

- If the expenditures for management of the George Division surpasses the incomes from water fees, and financial support is requested, the LWSC should take necessary measures to remedy the situation.

To the LCC

- Water fees should be excluded from the current Site & Service charges at an early stage to avoid double collection.
- In conjunction with the LWSC, public relations campaigns on public sanitation and water fee payment should be continuously conducted.

To further enhance the efforts of this project, not only should management which is well off both financially and systematically be considered, but the following points are also recommended.

(1) Conservation and Effective Use of Groundwater Resources

Groundwater pumped from boreholes is the water resource for this project, and the existing water system in Lusaka City is also heavily dependent on groundwater resources. However, sufficient data have not been accumulated to evaluate the potential of groundwater resources in the Lusaka area. It is necessary for the LWSC, with the cooperation of the Ministry of Energy and Water Development, Department of Water Affairs and other water supply related agencies, to make continuous observations of the boreholes to be constructed in this project as well as the existing wells, and monitor annual changes in the groundwater level. This is necessary for the effective use and conservation of groundwater resources. LWSC's active response is requested in regard to this point.

(2) Sewerage Plan and Environmental Sanitation

At the time of the request, the sanitary situation in the George Complex is very poor including many incidents of cholera outbreaks, which gave rise to the high priority rating to the George Complex for this project. Constructing the facilities for a stable supply of clean water would be expected to contribute greatly to avoiding cholera. On the other hand, as to maintenance of the sanitary environment including preventive measures for cholera, construction of water supply and sewerage facilities with countermeasures for wastes and nightsoil, and animation on public health can be effective.

Sewer systems can be divided into wastewater drainage and rain water drainage, but neither of these are installed in this area. Laundry wastewater will be drained through septic tanks which will be installed along with laundry facilities, but septic tanks should be installed for each household to treat domestic wastewater. Although using septic tanks are advisable for nightsoil, impermeable tanks should be installed instead of digging shallow pits to prevent flow into shallow wells. This

leads to avoiding cholera. But since these are short-term solutions, constructing sewer systems is required.

Concerning rainwater, installation of open channels or pipelines is advisable to prevent flow into pit latrines. However, planning for drainage treatment needs to consider discharge points, treatment plant location and geographical features of not only the George Complex but of the whole discharge basin as well. Consequently, since this will require huge costs and long periods of time, planning needs to be carried out on a long term, step-wise basis.

The EC Project stressed refuse management problems in the George Complex, but solutions did not come easily. Actually, refuse is dumped and piled at the corners of the town. After collection of the solid wastes, they can be treated by such methods as incineration, landfilling, and composting. Also, in consideration of the environmental conditions of Lusaka, sanitary landfilling is both technically and economically more viable than incineration or composting.

In spite of the water-borne cholera incidents, some inhabitants still drink water from hand-dug wells in the George Complex. Therefore, the government of Zambia and Lusaka City Council need to extend their animation campaign.

They must make efforts to give long-term education on public sanitation for health care in conjunction with improvement of the above mentioned facilities.

APPENDICES

APPENDIX-1 COUNTRYDATA

1.1 Basic Indicators

①Country Name : Republic of Zambia
②Capital City : Lusaka, Population of 1,030,000 (1992)
③Independence Day : October 24, 1964
④Land Area : 752,614㎢ (Twice of Japan)
⑤Population : 8,400,000 (1992)
⑥Population Density : 11/km²
⑦Population Growth Rate : 3.2% (1980-90 Average)
⑧Urban Population Ratio : About 40% (1988)
⑨Average Life Span : Male;52.9, Female;55.0
⑩Form of Government : Multi Party System ・Single Chamber System
⑪Sovereign : President Frederic Chilba (1991～)
⑫Religion : Christianity, Primitive Religions
⑬Language : English as Common language, Each tribal Language
⑭Tribes : 73 Tribes, Bemba, Nyanja, Tonga, Lunda and others
⑮Education : Primary School Attendance: 96.4 %(1987)
⑯Currency : KWACHA
: Exchange Rate against US$

Year	Value	1993/1	366.64	1993/7	524.75
1988	8.27	1993/2	413.81	1993/8	463.88
1989	13.81	1993/3	458.46	1993/9	395.52
1990	32.89	1993/4	524.42	1993/10	374.14
1991	64.64	1993/5	525.56	1993/11	380.10
1992	156.25	1993/6	550.33	1993/12	557.81

⑰Climate : Subtropical, Three Seasons
May-Aug. (Cold & Dry), Sep.-Nov. (Hot & Dry), Dec.-Apr. (Rainy)

⑱Topography : Plateau tableland (1,000 ～1,300m)

1.2 Economic Indicators

①GDP : (K' millon)

GDP	1987	1988	1989	1990	1991*
Nominal Value	19,779	30,021	60,025	113,341	203,920
Ratio (%)	2.7	6.3	-1.0	-0.4	-1.8

* Estimate

②Economic Activity:

Agriculture	Mine	Industry	Construction	Manufacture	Others
15.7%	7.3%	36.3 %	3.0%	0.5 %	37.2%

③Trade Tendency: (KWACHA)

	1988	1989	1990	1991	1992*
Export(FOB)	9,786,234	18,434,040	39,143,330	69,607,361	129,475,423
Import(FOB)	6,898,128	12,600,537	36,553,687	51,772,821	144,108,535
Balance	2,888,115	5,833,503	2,589,643	17,834,540	-14,633,112

* Estimate

④Main Export/Import Products:

Export Product	1991	1992	Import Product	1991	1992
Nonferrous metals	85.3	92.3	Petroleum	16.1	15.9
Others	14.6	7.7	Food Products	28.7	25.2
			Consumer Products	16.7	16.9
			Capital Goods	14.2	14.2
			Petroleum Products	9.3	12.0

⑤Main Trading Partners: (%)

Exporting to	1991	1992	Importing from	1991	1992
Japan	18.8	20.2	South Africa	20.6	26.8
Belgium	12.9	6.0	UK	18.6	11.8
India	11.3	1.1	UAE	0.0	8.7
France	10.0	6.4	USA	7.1	8.6
Indonesia	5.6	1.1	Zimbabwe	5.5	6.5

⑥Employment by Services: (1991)

Agriculture & Forestry	10.4%
Private Services	30.0%
Industry	14.1%
Mining	14.8%
Others	30.7%

⑦Inflation Rate: (Consumer Price Rise Rate/Former Year)

1985	128.3%
1986	109.5%
1991	93.3%
1992	191.4%
1993	233.2%

⑧Balance of Payments: (Mil. US$)

	1992	1993
Trade Balance	348.5	210.4
Balance on Invisible Trade	-295.1	-208.3
Balance on Changing	307.1	455.9
Balance on capital account	-648.8	-716.5
Final Balance	-288.3	-258.5

⑨External debt:

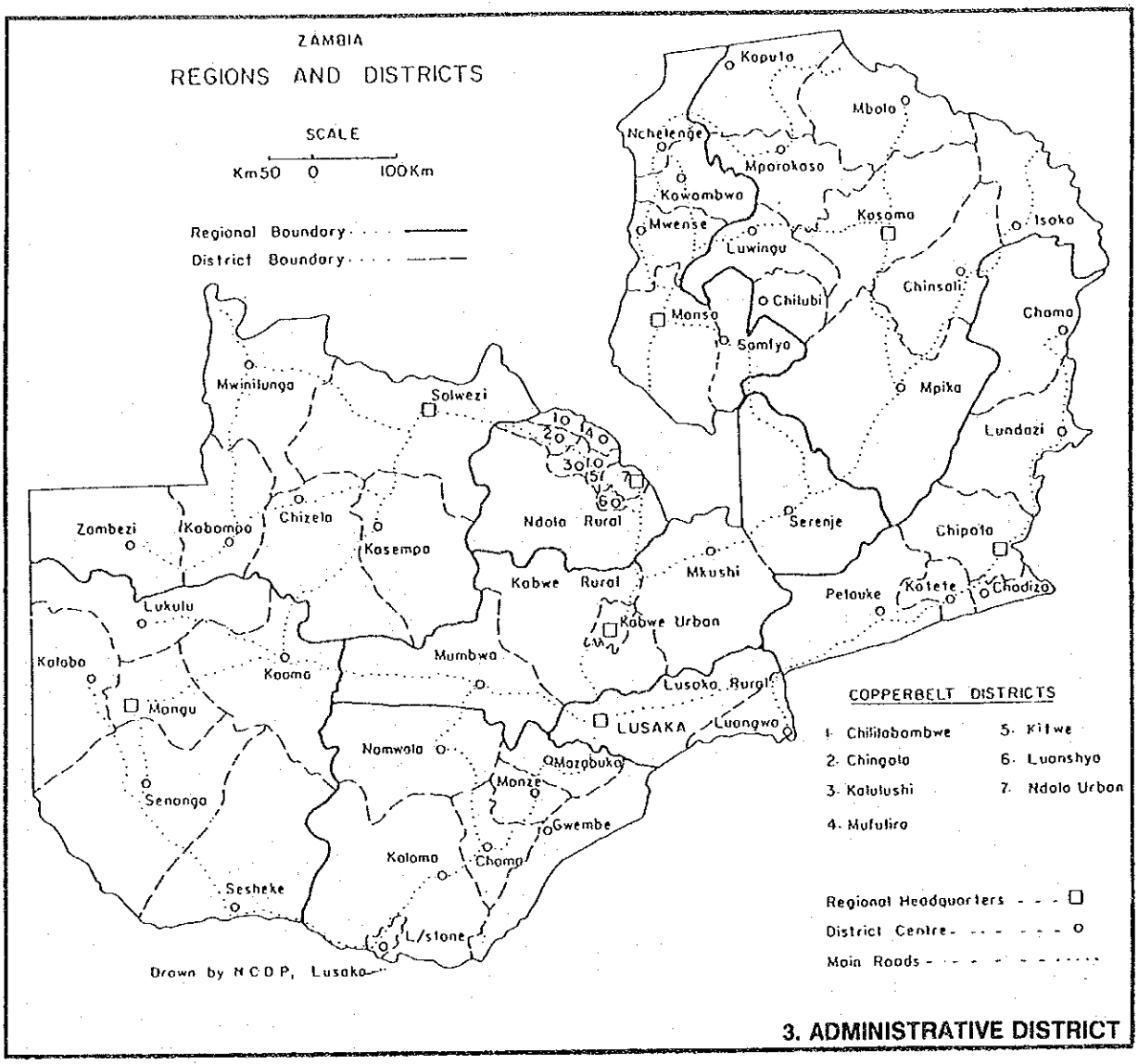
	Balance of External debt (mil. US$)	Debt Service Ratio (%)
1988	6,840	14.5
1989	6,720	13.5
1990	7,260	13.5
1991	7,280 (prov.)	--

⑩Trade with Japan: (mil. US$)

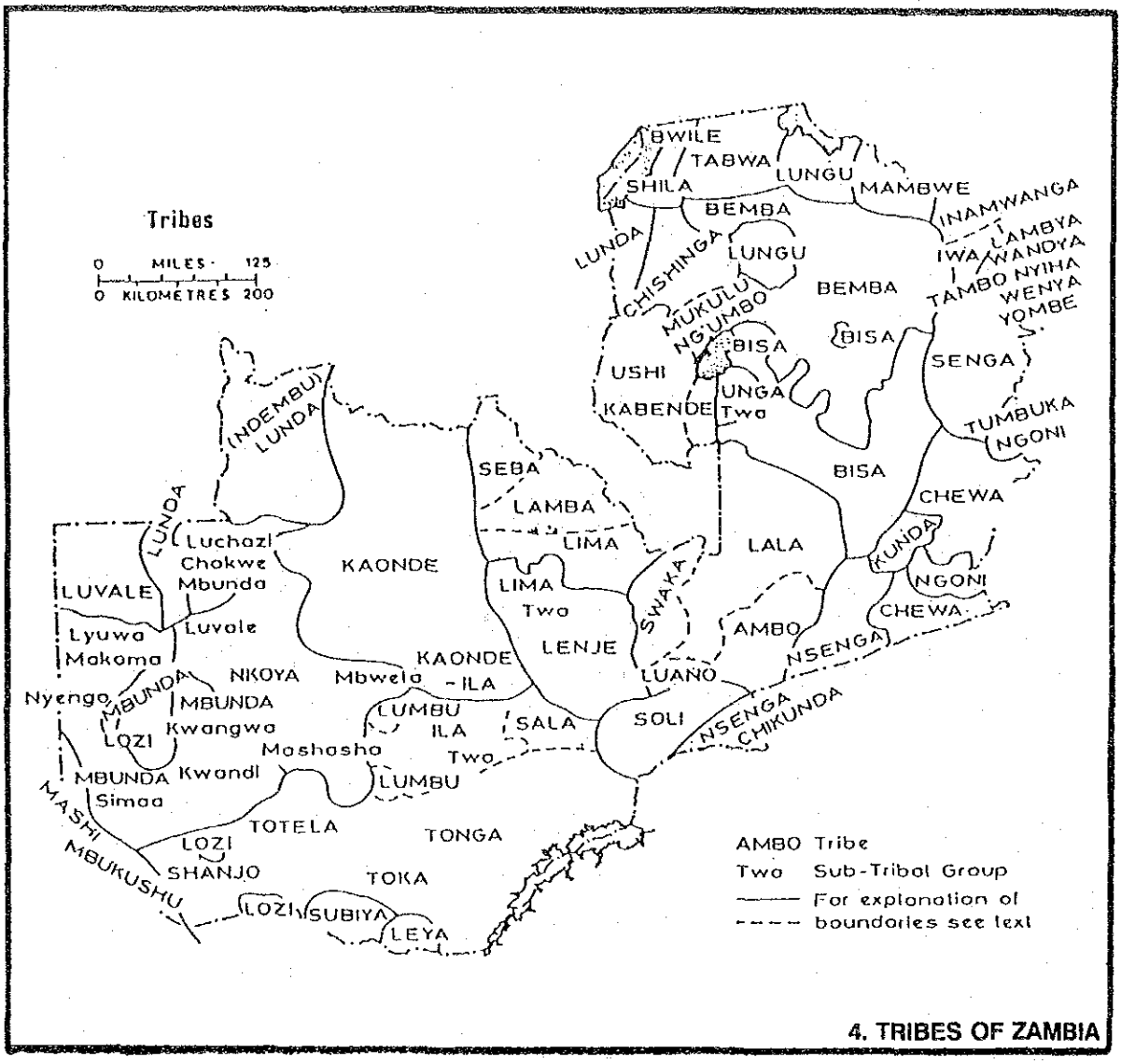
	Import from Japan	Export to Japan
1988	84.0	194.1
1989	107.0	221.6
1990	81.3	168.4
1991	69.6	304.8
1992	51.7	222.6

⑫Balance of Government Finance: (KWACHA)

	1988	1989	1990	1991	1992
Revenue	5,637	7,885	23,143	42,037	102,498
Expenditure	9,094	10,642	29,926	70,420	124,911
Balance	-3,457	-2,757	-6,784	-27,828	-22,413



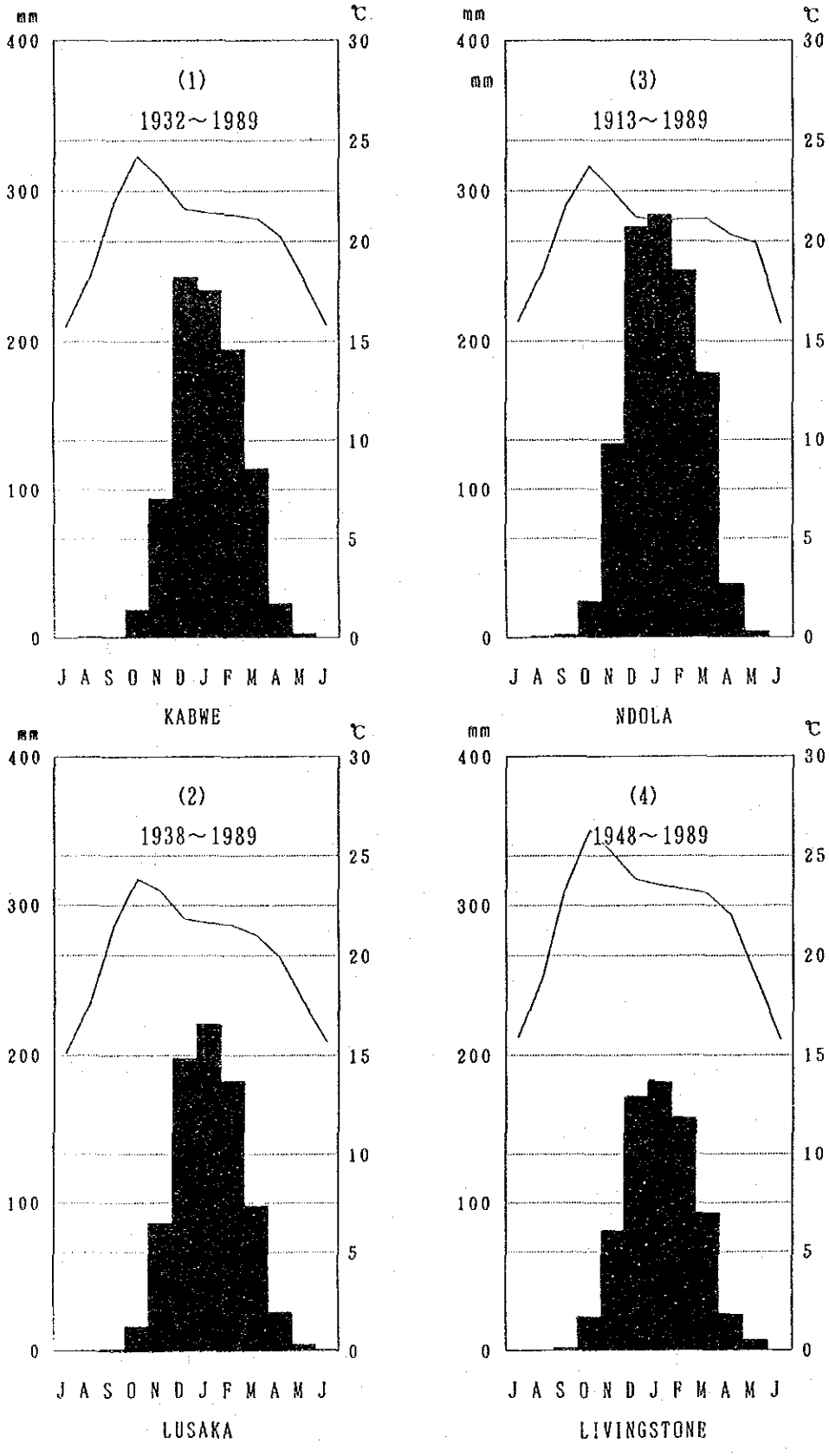
3. ADMINISTRATIVE DISTRICT



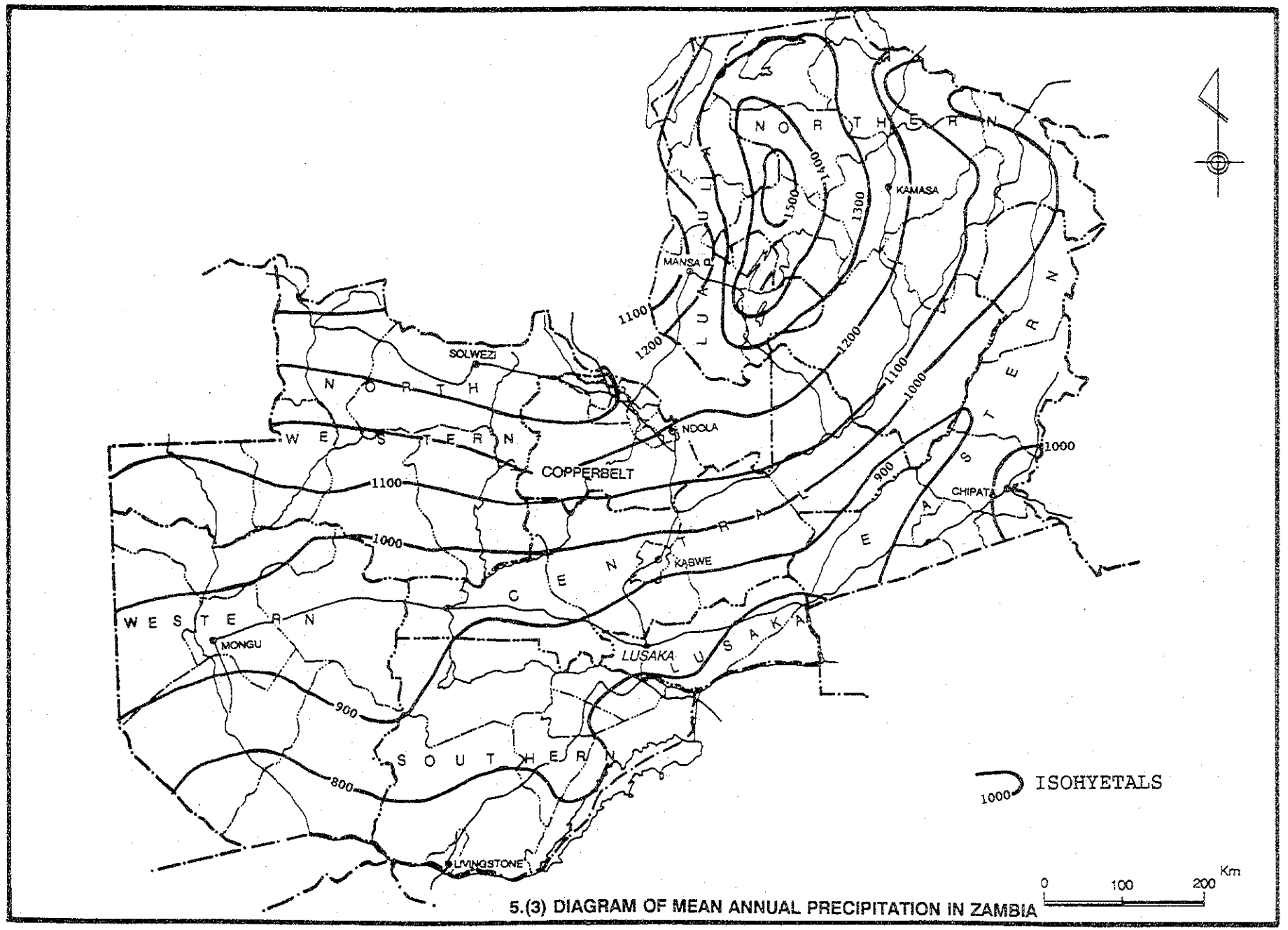
4. TRIBES OF ZAMBIA

5.(1) ANNUAL AVERAGE CLIMATOLOGIC DATA

STATION	ITEMS	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUN.	TOTAL
(1)KABWE	1) PRECIPITATION (mm)	0	1	1	19	94	243	234	195	114	23	3	0	928
(1932-1989)	2) TEMPERATURE (C°)	15.7	18.2	21.9	24.2	23.1	21.6	21.4	21.3	21.1	20.2	18.1	15.8	20.2
	3) RAINY DAYS (days/mon.)	0	0	0	3	11	19	19	17	11	3	1	0	84
	4) HUMIDITY (%)	51	47	41	42	61	75	81	77	77	71	65	55	62
	5) EVAPORATION (mm)	165	215	268	295	173	142	137	115	146	153	157	137	2103
	6) SUNSHINE DURATION (hr/day)	9.5	10.1	9.9	9.5	6.9	5.5	5.7	5.7	7.1	8.5	9.6	9.2	8.1
	7) WIND VELOCITY (knot)	6.3	6.9	7.0	6.2	4.7	3.1	3.7	3.5	4.4	5.1	5.2	5.6	5.2
(2)LUSAKA	1) PRECIPITATION (mm)	0	0	1	16	86	198	221	183	98	26	4	1	833
(1938-89)	2) TEMPERATURE (C°)	15.1	17.6	21.4	23.8	23.2	21.8	21.6	21.5	21.0	19.9	17.7	15.7	20.0
	3) RAINY DAYS (days/mon.)	0	0	0	3	11	18	20	14	12	4	2	0	84
	4) HUMIDITY (%)	53	47	39	41	58	76	77	72	68	68	61	57	60
	5) EVAPORATION (mm)	158	204	230	267	241	138	171	135	152	171	183	165	2215
	6) SUNSINE DURATION (hr/day)	9.4	9.9	9.9	9.3	7.4	5.5	5.8	6.0	6.6	7.8	8.9	8.8	7.9
	7) WIND VELOCITY (knot)	7.1	7.8	8.3	8.3	6.2	4.8	3.9	4.3	5.1	5.9	5.7	6.4	6.2
(3)NDOLA	1) PRECIPITATION (mm)	0	1	2	24	131	276	284	247	179	36	4	0	1183
(1903-1989)	2) TEMPERATURE (C°)	16.0	18.5	21.8	23.7	22.5	21.2	21.0	21.1	21.1	20.3	19.9	15.9	20.3
	3) RAINY DAYS (days/mon.)	0	1	1	3	12	20	20	19	15	5	1	0	97
	4) HUMIDITY (%)	52	45	41	43	65	79	82	82	77	71	61	58	63
	5) EVAPORATION (mm)	161	210	245	259	184	139	124	115	146	157	159	147	2046
	6) SUNSHINE DURATION (hr/day)	9.4	9.6	9.4	8.8	6.7	4.8	4.6	4.6	6.1	8.0	9.0	9.0	7.5
	7) WIND VELOCITY (knot)	5.1	5.8	6.5	6.0	4.8	3.9	3.7	3.2	3.5	4.1	4.0	4.6	4.6
(4)LIVINGSTONE	1) PRECIPITATION (mm)	0	0	2	23	81	172	182	158	93	24	7	0	742
(1948-1989)	2) TEMPERATURE (C°)	15.9	18.9	23.5	26.3	25.1	23.8	23.5	23.3	23.1	22.0	18.9	15.8	21.7
	3) RAINY DAYS (days/mon.)	0	0	1	3	11	16	17	15	9	4	1	0	77
	4) HUMIDITY (%)	46	38	32	35	56	70	74	76	67	59	51	50	55
	5) EVAPORATION (mm)	150	196	251	281	217	162	164	136	164	159	158	132	2170
	6) SUNSHINE DURATION (hr/day)	9.8	10.1	9.8	8.9	7.2	5.9	6.4	6.5	7.9	9.0	9.7	9.5	8.4
	7) WIND VELOCITY (knot)	4.6	5.1	5.9	5.7	5.0	3.9	4.3	4.2	4.5	4.3	3.9	4.3	4.6



5.(2) MEAN ANNUAL TEMPERATURE AND RAINFALL



5.(3) DIAGRAM OF MEAN ANNUAL PRECIPITATION IN ZAMBIA

APPENDIX - 2 MINUTES OF DISCUSSIONS

(1)BASIC DESIGN STUDY

(2) DRAFT FINAL REPORT EXPLANATION STUDY

(1) BASIC DESIGN STUDY

MINUTES OF DISCUSSIONS
BASIC DESIGN STUDY ON THE URGENT WATER SUPPLY PROJECT IN SATELLITE AREA OF LUSAKA IN THE REPUBLIC OF ZAMBIA

In response to a request from the Government of the Republic of Zambia, the Government of Japan decided to conduct a Basic Design Study on The Urgent Water Supply Project in Satellite Area of Lusaka (hereinafter referred to as "the Project").

JICA sent to Zambia a study team, which is headed by Mr. Yoshikatsu NAKAMURA, Director, First Basic Design Study Division, Grant Aid Study and Design Department, JICA, and is scheduled to stay in the country from September 5 to September 30, 1993.

The team held discussions with the officials concerned of the Government of Zambia and conducted field surveys at the study area.

In the course of discussions and field surveys, both parties have confirmed the main items described on the attached sheets. The team will proceed to further works and prepare the Basic Design Study report.

Lusaka, September 10, 1993

Mr. Yoshikatsu NAKAMURA
Leader
Basic Design Study Team
JICA

Mr. Willie SHAWA
Acting Managing Director
Lusaka Water and Sewerage Company

Mr. M. C. Soko
Director
National Commission for Development Planning

Mr. Abel MKANDAWIRE
Board Chairman
Lusaka Water and Swerage Company

ATTACHMENT

1. Objective

The objective of the Project is to develop clear potable water necessary for the urgent use for satellite area in Lusaka city, by means of constructing water supply facilities.

2. Project Site

The site of the Project is the following compounds with the priority order in George Complex, the location of which is shown in Annex 1:

1) George
2) Soweto
3) Chikolokoso
4) Desai
5) Paradise
6) Lilanda Site 5
7) Kizito

3. Executing Agency

Lusaka Water and Sewerage Company is responsible for the administration and execution of the Project in collaboration with Lusaka Urban District Council .

4. Items Requested by the Government of Zambia

After discussions with the Basic Design Study team, the following items were finally requested by the Zambian side:

Construction of central water supply systems, which are composed of

1) boreholes as the water source
2) elevated storage tanks
3) distribution pipe-lines
4) standpipes and drainage
5) disinfection equipment

However, the final items of the Project will be decided after further studies.

5. Japan's Grant Aid Systems

(1) The Government of Zambia has understood the system of

Japanese Grant Aid explained by the team.

(2) The Government of Zambia will take necessary measures, described in Annex 2, for smooth implementation of the Project, on condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

6. Schedule of the Study

(1) The consultants will proceed to further studies in Zambia until September 30, 1993.

(2) JICA will prepare the draft report in English and dispatch a mission in order to explain its contents around December, 1993.

(3) In case that the contents of the report is accepted in principle by Zambian side, JICA will complete the final report and send it to the Government of Zambia by March, 1994.

7. Other Relevant Issues

(1) Both side recognized the importance to establish an inhabitants-organization under the guidance of City Councilor and LWSC in each section area in George Complex for the proper use of the water supply facilities completed by the project.

The guidance shall cover how to

a) collect the water tariff set up by LWSC

b) maintain the facilities properly with the help of LWSC

c) educate the inhabitants to keep clean the surroundings of the facilities, and

d) protect the facilities from vandalism.

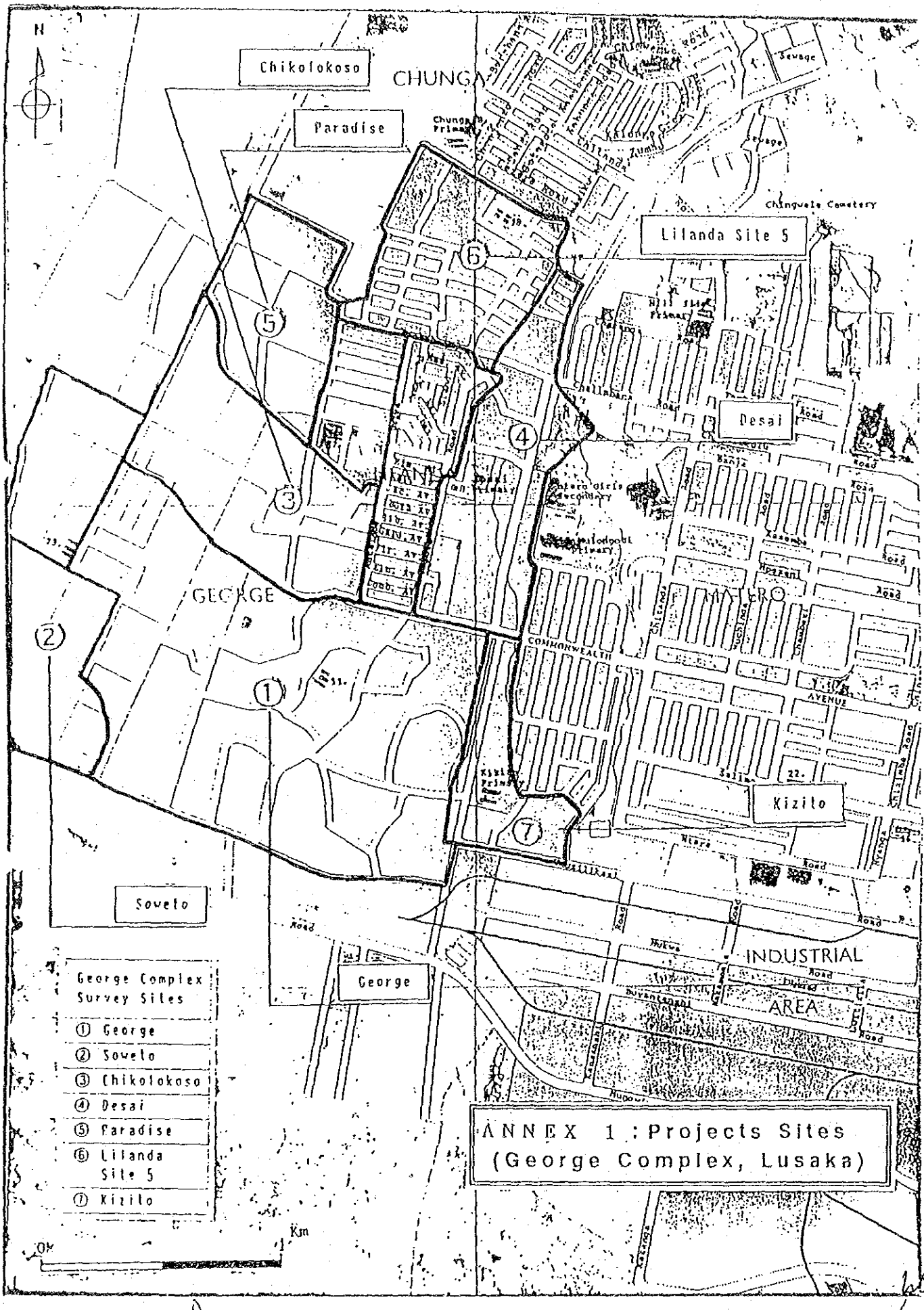
(2) Zambian side agrees to deploy LWSC personnel and to subsidize the running cost of the Project in case required for the good maintenance of the completed facilities.

(3) Zambian side secure the proper sites for the boreholes located away enough not to be contaminated by the surroundings, and persuade the inhabitants to provide enough land spaces for the construction of water tanks and standpipes inside the complex.

(4) Both sides agreed that the highest priority is given to the construction of the water supply facilities at the public

institutes such as schools and clinics in the Complex.

(5) Zambian side shall provide the electric power line up to the boundary of the each recommended installation site.



ANNEX 1 : Projects Sites
(George Complex, Lusaka)

ANNEX 2.

Necessary measures to be taken by the Government of Zambia on condition that Japanese Grant Aid Assistance is extended to the country:

1. To provide data and information necessary for the Project,

2. To secure the land for the projected facilities,

3. To clear and level the land for the projected facilities prior to commencement of the construction,

4. To undertake incidental outdoor works such as gardening, fencing, gates and exterior lighting within and around the facilities,

5. To construct access road to the site prior to commencement of the construction,

6. To bear the commission to the Japanese foreign exchange bank for the banking services based upon the banking arrangement,

7. To exempt taxes and to take necessary measures for custom clearance of the materials and equipment brought for the Project at the port of disembarkation,

8. To exempt Japanese nationals from custom duties, internal taxes and other fiscal levies which may be imposed in Zambia with respect to the supply of the products and services under the verified contracts,

9. To bear all the expenses other than those to borne by the Grant, necessary for the construction of the facilities as well as for the transportation and installation of the equipment,

10. To operate and maintain properly the facilities constructed by the Project.

(2) DRAFT FINAL REPORT EXPLANATION STUDY

MINUTES OF DISCUSSIONS

BASIC DESIGN STUDY
ON
THE URGENT WATER SUPPLY PROJECT IN SATELLITE AREA OF LUSAKA
IN
THE REPUBLIC OF ZAMBIA
(CONSULTATION ON DRAFT FINAL REPORT)

In September 1993, the Japan International Cooperation Agency (JICA) dispatched a Basic Design Study team on the Urgent Water Supply Project in Satellite Area of Lusaka (hereinafter referred to as "the Project") to the Republic of Zambia, and prepared the draft final report of the study through discussions, field survey, and technical examination of the results in Japan.

In order to explain and to consult the Zambian side on the components of the draft final report, JICA sent to Zambia a study team, which was headed by Mr.Itaru MINAMI, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, and stayed in the country from January 9 to 15, 1994.

As the result of discussions, both parties confirmed the main items described on Attachment, Annex 1 and Annex 2.

Lusaka, January 14, 1994

Mr. Itaru MINAMI
Leader,
Draft Final Report
Consultation Team,
JICA

Dr. Remy L. DE JONG
Managing Director,
Lusaka Water and
Sewerage Company

Mr. Mike C. SOKO
Director,
National Commission for
Development Planning

Mr. Abel MKANDAWIRE
Board Chairman,
Lusaka Water and
Sewerage Company

Mr. Wynter KABIMBA
Town Clerk,
Lusaka City Council

Mr. Nelson J. MAPALA
Permanent Secretary,
Ministry of Local
Government and Housing

ATTACHMENT

1. Japanese Grant Aid System

The Government of Zambia has understood the system and the procedures of Japanese Grant Aid as explained by the team.

2. Contents of the Draft Final Report

The Government of Zambia has agreed in principle to the proposals contained in the Draft Final Report.

3. Operation and Maintenance Plan

Both sides have agreed that the principles to operate and maintain the water supply facilities constructed under the Project will be as follows:

(1)the establishment of a proper organization to manage the water supply service in George Complex by LWSC,

(2)the introduction of an independent profit system to the organization mentioned above,

(3)promotion of public relations on the Project in George Complex.

4. Undertakings to be born by the Government of Zambia

The Government of Zambia will take the necessary measures on condition that the Japanese Grant Aid is extended to the Project. The measures consist of general undertakings (Annex-1), which are generally obligated to the recipient country of the Japanese Grant Aid, and of specific undertakings (Annex-2), which are peculiar to the Project. The Government of Zambia will implement the undertakings under monitoring and in consultation with Japanese consultant and the JICA Zambia Office.

5. Further Schedule of Japanese Side

The team will make the final report in accordance with the confirmed items , and send it to the Government of Zambia around March 1994.

ANNEX 1. (General Undertakings)

Necessary measures to be taken by Government of Zambia on condition that Japanese Grant Aid is extended :

1. To obtain, clear and level the sites for the Project, and secure access prior to commencement of the construction,

2. To undertake incidental outdoor works such as gardening, fencing, gates and exterior lighting in and around the sites,

3. To provide incidental facilities for telephone lines and drainage outside the site,

4. To provide general furniture for the sites,

5. To bear commissions to Japanese foreign exchange bank for the services based upon the banking arrangement,

6. To exempt taxes and to take the necessary measures for customs clearance of the materials and equipment purchased under the Grant,

7. To exempt Japanese nationals employed on the Project from customs duties, internal taxes and other fiscal levies which may be imposed in Zambia with respect to the supply of the products and services under the verified contracts,

8. To bear all the expenses, other than those covered by the Grant, necessary for the Project,

9. To operate and maintain properly the facilities constructed and the equipment procured under the Grant.

Annex 2. (Specific Undertakings)

Specific measures for the Project to be taken by Government of Zambia:

1. To establish the appropriate organization to manage the Project,

2. To establish an efficient accounting system for the operations,

3. To establish an efficient working system between the LWSC and the Section organization,

4. To determine a rational financial plan based on reasonable rates,

5. To make a consumer's list based on voluntary registration,

6. To remove the water supply service charge from the Site and Service Charge, and to notify the people accordingly,

7. To promote continuously the public relations about water supply service and public health,

8. To cover the expenses of tasks 1 to 7, and to complete these tasks 1 to 6 before the start of water supply service,

9. To submit quarterly financial reports of George division to the JICA Zambia office until the end of the Project.

APPENDIX-3 LIST OF STUDY TEAMS MEMBER

Basic Design Study Team		
Yoshikatsu NAKAMURA	Team Leader	Director for First Design Study Division, Grant Aid Study and Design Department, JICA
Yoshitaka HAMANAKA	Water Supply Planner	Japan Techno Co., Ltd.
Naoki TAIRA	Hydrogeologist	Japan Techno Co., Ltd.
Yusuke ANDO	Operation & Maintenance Planner	Japan Techno Co., Ltd.
Hitoshi OCHAI	Water Facility Planner	Japan Techno Co., Ltd.

Draft Final Report Explanation Study team		
Itaru MINAMI	Team Leader	Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs
Kei JINNAI	Grant Aid	First Design Study Division, Grant Aid Study and Design Department,JICA
Yoshitaka HAMANAKA	Water Supply Planner	Japan Techno Co., Ltd.
Yusuke ANDO	Operation & Maintenance Planner	Japan Techno Co., Ltd.