MINISTRY OF ENVIRONMENT AND NATURAL RESOURCES
THE REPUBLIC OF KENYA

BASIC DESIGN STUDY REPORT

ON

MERU WATER SUPPLY

IN

THE REPUBLIC OF KENYA

MARCH 2001

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
NIPPON KOEI CO., LTD.
NIHON SUIDO CONSULTANTS CO., LTD.

PREFACE

In response to a request from the Government of the Republic of Kenya the Government of Japan decide to conduct a basic study on Meru Water Supply and entrusted the study to Japan International Cooperation Agency (JICA).

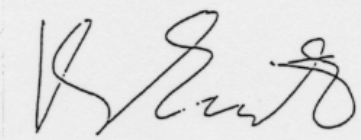
JICA sent to Kenya a study team twice from April 9 to May 28, and from September 5 to Oct 30 in 2000.

The team held discussions with the officials concerned of the Government of Kenya, and conducted a field study at the study area. After the team returned to Japan, further studies were made, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Kenya for their closecooperation extended to the team.

March, 2001



Kunihiko SAITO

President
Japan International Cooperation Agency

March, 2001

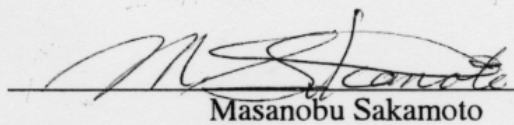
Letter of Transmittal

We are pleased to submit to you the basic design study report on Meru Water Supply in the Republic of Kenya.

This study was conducted by Nippon Koei Co., Ltd. in association with Nihon Suido Consultants Co., Ltd., under a contract to JICA, during the period from March 2000 to March 2001. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of the Republic of Kenya and formulated the most appropriate basic design for the project under the Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,



Masanobu Sakamoto
Project Manager,
Basic design study team on Meru Water Supply
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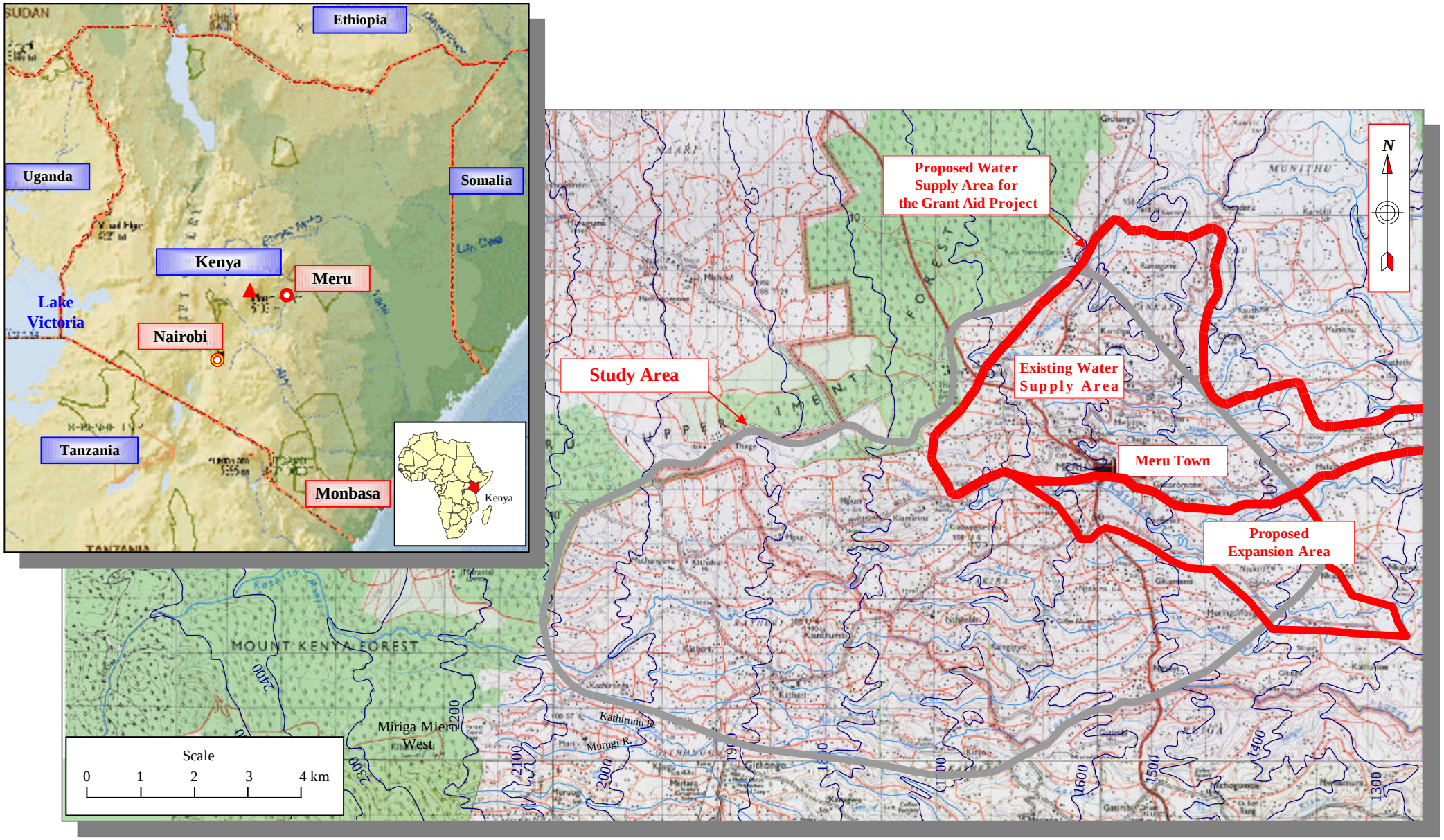
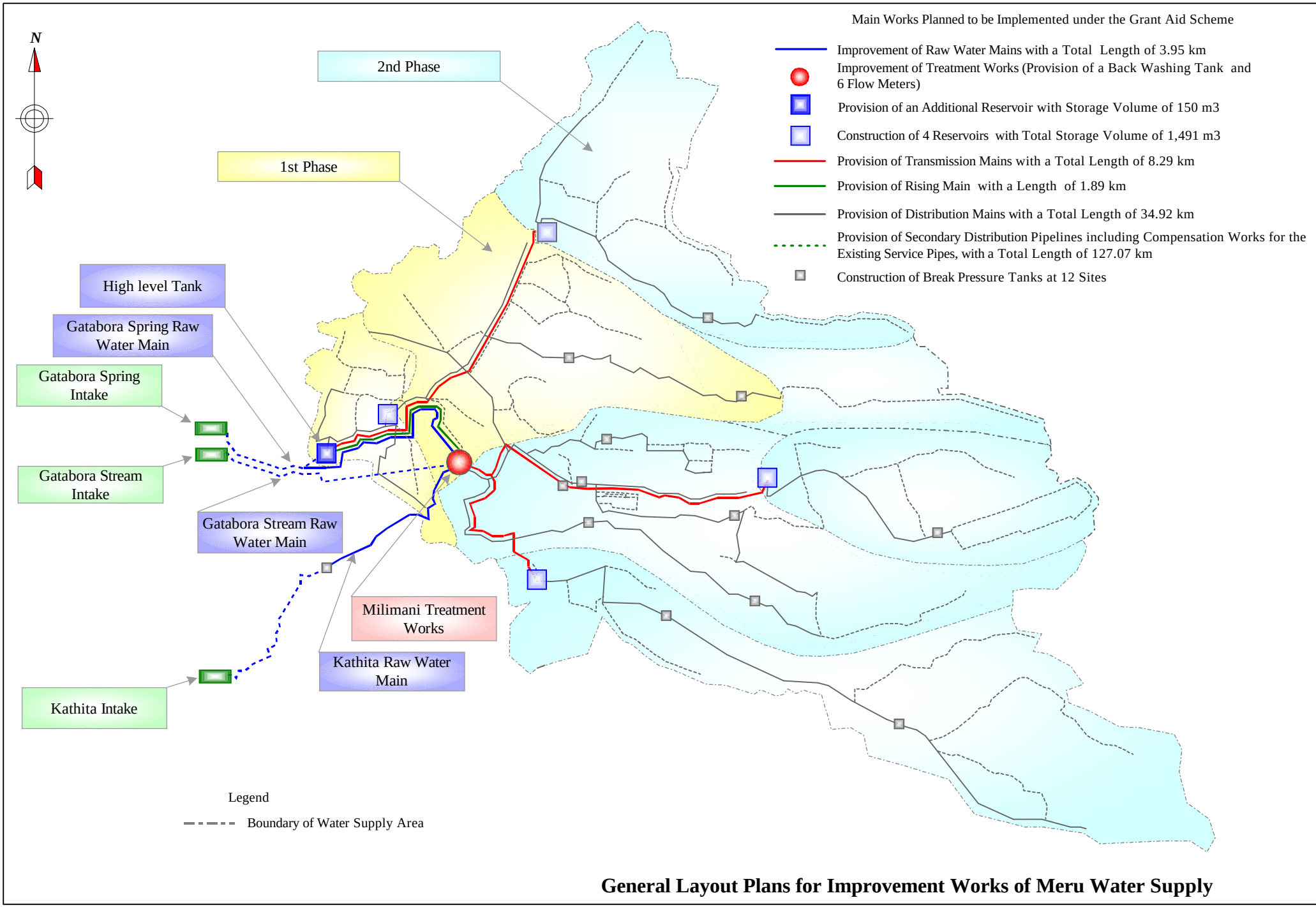


The Study Area



General Layout Plans for Improvement Works of Meru Water Supply

ABBREVIATIONS

(1) Organization

ADB	:	African Development Bank
ASAL	:	Arid, Semi-Arid Lands
BHN	:	Basic Human Needs
CBS	:	Central Bureau of Statistics
DANIDA	:	Danish International Development Agency
DWO	:	District Water Office
FAO	:	Food and Agriculture Organization of the United Nations
FINIDA	:	Finland International Development Agency
GOK	:	Government of Kenya
GTZ	:	Deutsche Gesellschaft fur Technische Zusammenarbeit (German Technical Cooperation Agency)
JICA	:	Japan International Cooperation Agency
MENR	:	Ministry of Environment and Natural Resources
MOH	:	Ministry of Health
MOFP	:	Ministry of Finance and Planning
NWCPC	:	National Water Conservation and Pipeline Corporation
PWO	:	Provincial Water Office
SIDA	:	Swedish International Development Agency
UNDP	:	United Nations Development Programme
NGO	:	Non-Governmental Organization
WHO	:	World Health Organization

(2) Measurement

Area

cm^2	=	Square Centimeters
m^2	=	Square Meters
km^2	=	Square Kilometers
ha	=	Hectares

Volume

cm^3	=	Cubic Centimeters
m^3	=	Cubic Meters
m^3/day	=	Cubic Meters per Day
m^3/h	=	Cubic Meters per Hour
m^3/min	=	Cubic Meters per Minute
m^3/sec	=	Cubic Meters per Second
l or lit	=	Liter
lpcd	=	Liter per capita per day
MCM	=	Million Cubic Meter

Length

mm	=	Millimeters
cm	=	Centimeters
m	=	Meters
km	=	Kilometers

Weight

g	=	Grams
mg	=	Milligrams
mg/l	=	Milligrams per liter
µg/l	=	Micrograms per liter
kg	=	Kilograms
kg/cm^2	=	Kilograms per square centimeter
t	=	Metric ton

Money

US$	=	United State Dollars
JPY	=	Japanese Yen
Ksh	=	Kenyan Shilling

Time

s	=	Second
min.	=	Minute
h	=	Hour

Electric Power

kVA	=	Kilovolt Ampere
kW	=	Kilowatt

Others

per/km^2	=	Persons per Square Kilometer
rpm	=	Revolutions per Minute

Summary

SUMMARY

The Republic of Kenya is located striding the Equator in the eastern part of Africa, surrounded by Ethiopia, Somalia, Tanzania and Uganda. It is a large country with a land area of 583,000 km^2, administratively divided into 8 provinces and 68 districts. Approximately 83% of the total land area (490,000 km^2) is classified as arid and semi-arid regions, where about 25% of the population of 29 million (1999 census) dwell. The economy of Kenya is largely dependent on the two major sectors of agriculture and tourism, which comprise approximately 24% and 52% of GDP on average, respectively. The Republic of Kenya is classified as one of the Least Developed Countries due to its low per capita GDP of US$ 350 in 1998, according to statistical data published by the World Bank. The country's economic growth is presently in a state of deceleration with an annual average growth of GDP during the past 9 years of 2%, compared with the 4.2% growth achieved during the period 1980 to 1990.

In order to improve this sluggish economic situation, the Government of Kenya (GOK), in the 8th National Development Plan (1997 to 2001), clarified its intention to promote industrialization and development of private sectors in addition to stabilization of agriculture. Provision of stable water supplies is indispensable to promote the above objectives and appropriate development of water resources and improvement of maintenance are targets of the water supply sector. In line with this priority, the "National Water Policy" was initiated in 1999 for the purposes of "importance of maintenance (of quality and quantity)", "water development to alleviate poverty", "entrustment to autonomous private sector entities of maintenance phase in urban areas", "provision of maintenance costs through collection of water charges" in addition to "development of water resources to meet demand".

Against this background, the GOK made a request to the Government of Japan (GOJ) in October 1997 to extend grant aid assistance for construction of water supply facilities and rehabilitation of existing water supply facilities and procurement of maintenance equipment for Meru city and the surrounding area (85 km^2). Meru city is situated in Meru Central District, Eastern Province. The request was based on the "Study on the Water Supply for Seven Towns in Eastern Province", a development program study conducted by Japan International Cooperation Agency (JICA) in 1997.

In response to this request, the GOJ decided to conduct a basic design study, and JICA sent a basic design study team during the periods from April 9 to May 28 and September 5 to October 30, 2000. The study team reviewed the contents of the GOK request and the components of the grant aid project to incorporate any changes to the water supply situation that had occurred during the 3 years since the feasibility study on which the request was based was conducted.

The GOK request consisted of construction of a fixed intake weir, with 22,000 m^3 daily intake capacity at the western end of the study area, about 6 km of water transmission pipeline, water purification facilities with 10,000 m^3 daily capacity and a water transmission and distribution mains network of 61.2 km total length. Furthermore, the request included replacement of damaged or broken valves as rehabilitation of the existing supply facilities.

During the first basic design study, studies were conducted on the situation of the water supply sector in Kenya, the existing conditions of the water supply facilities in the city of Meru, changes in the socio-economic situation and the present conditions of Meru Central District Water Office (DWO) of the Ministry of Environment and Natural Resources (MENR). Through these studies, it was found that there was a demand for extension of a public water supply system providing "safe and stable water supply". Furthermore, it was found that the existing facilities were antiquated, prone to leakage and illegal water siphoning, and in need of repairs and rehabilitation following extensive damage caused by the El Nino Rain Disaster of 1997 and 1998. There was also a need for organizational strengthening of the maintenance capabilities of Meru Central DWO. It was also revealed that the MENR was preparing to set up an autonomous management body for the Meru city water supply enterprise as part of organizational strengthening.

Based on the on site studies, the study team decided to divide the study area into four parts based on population distribution and existing conditions of the water supply facilities, namely, 1) existing supply area (including heavily populated areas where gravity water supply from existing facilities is possible), 2) heavily populated areas around Meru city, 3) a rural area north of the Katita River and 4) a rural area south of the Katita River. Furthermore, comparison and analysis of the operational competence between Meru Central DWO of the MENR and the autonomous management body and the facilities requirements for water supply to each area was conducted. The study team prepared a water supply plan in the study area based on the above results.

The existing water supply facilities are approximately 50 years old and are heavily deteriorated and have been seriously damaged by the El Nino disaster. Although Meru Central Water Supply Office of the MENR has received administrative competence improvement measures under the instruction of the MENR, it still has many areas for improvement. Therefore, the basic design principle has been set as staged expansion of the water supply facilities in the study area while maintaining the existing facilities and securing the stable operation of autonomous management body. Following this basic principle, the first phase shall be a prioritized project under grant aid funds comprised of rehabilitation of the existing facilities, partial expansion of the water supply area and strengthening of the operation and maintenance organization. In and

after the second phase, the plan sets out the project for expansion of the water supply area under which the GOK shall construct intake weirs on the upper Katita River, transmission pipelines, water purification plant and water supply main network. The plan is to be carried out in stages according to improvement in operational competence and increase in demand for water in the rural areas.

During the second basic design study, the above water supply plan was described to GOK and GOK judged the plan to be reasonable and justified and accepted the plan as presented. Following the acceptance of the plan, basic design study (topographical survey, soil and geological examinations, site studies) were carried out.

On return to Japan, a basic design was formulated based on the site study results. The basic frameworks for the design of the Project are as follows:

(1) The Project will be comprised of; a) improvement of the existing water supply facilities, b) technical assistance in strengthening of the autonomous management body, and c) provision of equipment and tools for operation and maintenance; in order to realize a sustainable Meru water supply with good water quality and sufficient quantity.

(2) An improvement plan is required, comprising of; a) measures to present water leakage, b) increase of water supply capacity, c) establishment of water metering system for applying a usage-based water tariff system, and d) improvement of treated water quality.

(3) The formulation of the Project for procurement of maintenance equipment for the autonomous management body shall be comprised of; a) placement of service pipes for maintenance and new branching, 2) maintenance of individual household meters, and 3) selection of necessary equipment to establish water charge billing and collection organization; in order to establish the technical competence of employees by educating and training for maintenance and administration through installation and usage of the procured equipment.

(4) Managers of the management body will be procured from the MENR and/or labor market in Kenya, and their capabilities for operation and maintenance are unknown and will require advice and assistance of specialists. Also, operators of the Meru Central DWO will shift to the new body, but they have low capability for operation and maintenance, taking into account the present situation of the existing facilities, and therefore, required assistance to operate facilities properly. Furthermore, promotion of the Project to residents is indispensable for increasing customers. To improve the management capacity in the new body, the soft component scheme is planned to be executed in the Project.

Based on the basic concept noted above, the following Meru city water supply rehabilitation project was formulated.

(1) Rehabilitation of Water Supply Facilities

Facility	Objective	Project Components
① Katita River Raw Water Main	Leakage prevention	New construction of 1.9 km raw water main (300mm diameter) out of the existing 3.2 km pipeline and replacement and reconstruction of damaged valves and water bridges (total 8 sites)
② Gatabola Spring Raw Water Main	Improvement of water quality	Construction of new raw water main to carry Gatabola water which is presently distributed untreated, to a purification plant (200mm diameter, 2.05 km total length)
③ Treatment Plant	Improvement of Water quality & installation of water metering equipment	1) Addition of elevated back washing tank (77 m^3) 2) Installation of coagulant dosing equipment for purification facility (6 units) 3) Installation of metering equipment (6 units.) 4) Installation of pump control panel (1 unit)
④ Transmission and Distribution Network	Distribution capacity to meet projected water demand for year 2005	1)Construction of transmission pipeline (length 10.18 km) and distribution ponds (5 units., total capacity 1,641 m^3) 2)Replacement of existing distribution pipeline to increase capacity and expansion of the distribution network (length 79.73km) in densely populated area (5 km^2) 3)Return pipeline to service after replacement of existing distribution pipeline (82.26 km)

(2) Procurement of Maintenance Equipment

The equipment and tools required for daily operation and maintenance works are would be provied under the term of the Project. These daily works are; 1) management and patrol for intake facilities, 2) water quality analysis at the treatment works, 3) construction of service pipes, 4) leakage detection, inspection and repairing of pipes, 5) meter reading and installation, and 6) billing and collection. Taking into account these works, the following are the selected equipment and tools:

① Vehicles : One 4WD pick up truck

② Motorbikes : Five 90cc motorbikes

③ Maintenance Equipment : Calibration equipment for flow meter (one each of portable and fixed), one set each of soldering equipment, Drilling Machine and Pipe Cutter

④ Water Quality Testing Equipment : One set each of water sampling bottle, pH-meter, turbidity meter, residual chlorine meter, jar tester

⑤ Leakage Detector : Two sets of pressure gauge

⑥ Household Meter : 2.573 meter sets for non-metered or out-of-order metered households out of 2,842 households presently connected

⑦ Survey Equipment : Horizontal level, staff bar, one set each of steel and nylon tape

⑧ Spare Parts : Sluice valves, float valves, household meters, steel pipes, uPVC pipes, etc.

(3) Soft Component Plan

Operational assistance to the autonomous management body by soft components will be conducted for 24 months. Major assistance components will comprise of; 1) Formulation of business planning at start up, 2) Structuring of administrative organization (accounting system, information administration system, fee structuring, water charges billing and collection system, customer service organization, personnel administration system, etc.), 3) Expansion and enhancement of customer service work (profiling surveys, educational activities in existing and proposed expansion areas for water supply system, organization of local population to control communal water taps.), 4) Monitoring of operations and maintenance, 5) Recommendations relating to continued organizational reform.

JICA dispatched a mission to explain the draft basic design report to the GOK during the period between February 10 and February 24, 2001. The basic agreement was signed and exchanged after the contents of the Project were verified and agreed upon by both parties.

The Project is planned to be executed over a period of 24 months, including detailed design, tendering and contracting, construction and soft component. The Kenyan responsibilities are securing land for pipeline works, clearing of the land and fencing around the constructed facilities.

In connection with the Project implementation, the GOK will bear the total cost of Ksh. 4 million for land acquisition, cutting tree along the road and fencing around facilities (Ksh. 2 million), and start up cost for autonomous management body (Ksh. 2 million).

The executing agency of the Project is the MENR. Implementation of the Project will be administered by the Meru Central DWO under the directions of Director of Water Development. The Meru Central DWO will be the acting agent for the Project. In order to promote the smooth execution of the Project, it is planned that Kenya/Japan Water and Sanitation Program Unit under the MENR will offer technical advice and provide guidance to Meru Central DWO. Management staff and operation and maintenance staff of the autonomous management body will operate the Meru water supply assisted by the soft component.

The benefits from this Project are outlined below:

(1) Improvement of Water Supply Capacity

Meru city suffers from water deficiency caused by deterioration of the water supply system, leakage due to the deterioration, illegal water tapping and increased water demand associated with the increase in population. Since May, 2000 it has been

forced to resort to time rationing, operating only 8 hours per day. A decrease in the development budget has caused delays in expansion of the water supply network and the city is faced with severe water shortages. Implementation of the Project will alleviate the water shortage for the population of 51,000 in Meru and its surroundings, and provide sufficient distribution capacity up to the projected demand for the year 2005.

(2) Improvement in Public Health

The water quality tests conducted during the basic design study detected bacteria and coliform bacillus in the water supply and high turbidity was observed in some areas. During and after implementation of the Project, chemical dosing and chlorine disinfection will be enforced and finally become normal operational procedure. High quality water supply will become possible and the public health will benefit.

(3) Increase in Served Population

The Project will contribute to an increase in the population served from 14,000 at present to 51,000 people (individual connection: 30,600 people, community water supply: 20,400 people) by year 2005.

(4) Establishment of a Sustainable Operation and Maintenance Organization

After implementation of the Project, the high un-accounted for water ratio of 60% will be reduced to 30%. According to the questionnaire survey conducted to potential communal water tap users during the basic design study, willingness to pay has been confirmed. Educational activities included in the soft component will encourage these people to become connected users and increase revenue. The familiarization with maintenance and repair activities by the staff will enable establishment of a sustainable operations and maintenance organization.

The Project will quickly realize the basic human needs of Meru and the surrounding population of 51,000 by providing stable supplies of potable water and will greatly contribute to the future dissemination of public water supply throughout the region. The Project is therefore considered appropriate for implementation under grant aid scheme of Japan.

The following items require due consideration and appropriate implementation to promote the smooth implementation of the Project and enhancement of Project benefits.

(1) Establishment of Implementation Agency and Operation and Maintenance Organization for the Project

The MENR plans to establish the Meru City Water Supply and Sewerage Public Company as an autonomous enterprise for the Project in March, 2001 and to start operations in July, 2001. As one component of the Project, it is planned to strengthen its operational capabilities in order to realize sustainable project operations. In order to meet Project objectives, the company must undertake various preparatory activities between March and July. It is of the utmost importance that the Kenyan authorities responsible carry out these activities in order to ensure the smooth implementation of the project for the best manifestation of its benefits.

(2) Securing of Staff for the Autonomous Management Body

For the autonomous management body to begin operations on scheduled in July, it is necessary to secure highly able staff with the utmost urgency, as they will be responsible setting out management plans for the autonomous management body and for setting out normal procedural rules and summing up procedures based on these plans. An increase in the collection ratio of water charges is an important problem which will directly affect the sustainability of the autonomous management body. Educational and enlightment activities to promote understanding of the commodity charge method to the local population will be an element for the success of the Project.

In the detailed consideration of organization of an autonomous management body, it is strongly hoped that the Kenyan authorities will undertake promptly and correctly the necessary measures, in terms of organization and selection of staff, such as the establishment of a customers service department and meter reading department.

(3) Appropriate Implementation of Kenyan Responsibilities and Budgetary Measures

The implementation of Kenyan responsibilities required for the Project are necessary for the smooth and efficient implementation of the Project. However, under the circumstances where the annual budget of the MENR is being reduced year by year, the use of Counterpart fund for non-project type assistance is extremely important to manage to acquire necessary initial funding for Project implementation and autonomous management body expenses. In the course of implementation, the MENR must take appropriate liaison with the Ministry of Finance to make it possible to release the funds in a timely manner.

Basic Design Report

on

Meru Water Supply in the Republic of Kenya

Table of Contents

List of Tables

List of Figures

Attachments

Appendices

Chapter 1 Background of the Project

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1.1 Background of the Project

The Study on the National Water Master Plan was executed in 1992, to establish the master plan for water resource development and framework for implementation of the projects in sectors of water supply, sewerage treatment, agriculture and irrigation, livestock development and wildlife, hydropower development, and flood control and river improvement. This proposed master plan included the water supply plan in Meru District as one of priority projects, using the surface water of the Kathita River.

The Japan International Cooperation Agency assisted the preparation of the master water supply plan for seven towns in Eastern Province and carried out the feasibility study for Meru water supply in 1997.

The feasibility study recommended developing a new water supply system with the total supply area of 85 km^2, applying gravity method to reduce operation and maintenance costs for the proposed system, with the design horizon of 2005. The proposed system is comprised of an intake weir in the upper Kathita River in the forest reserve area, steel pipe raw water main with a diameter of 500 mm and the length of 6 km, treatment works with a capacity of 10,000 m^3/day, and transmission and distribution mains with the total pipe length of 61.2 km, as shown in Figure 1.1.

The feasibility study, also, emphasized that unaccounted-for-water (UFW) should be reduced and that revenue collection system should be strengthened. To achieve these, it was suggested to; 1) establish metering system of water supply; 2) prepare and execute programme for reduction of UFW; and 3) procure the assistance or support from the third countries for reduction of UFW, strengthening of organization and operation and maintenance.

The Government of Kenya requested the Government of Japan to implement the Project recommended by the feasibility study in September 1997. Also, the Government of Kenya established the initial action plan in 1998 and commenced the works for improvement of operation and maintenance for the existing Meru water supply.

Furthermore, the Kenyan Government commenced preparation of “Water Policy” in 1996, aiming to establish sustainable development of water resources and water supply

in Kenya, and issued it in 1999. The main issues in the policy are; securing finance and staff, promoting participation of private organization and communities into water sector, clarification of role of the Government, review of organization structure for implementation, and introducing appropriate tariff system for re-covering cost. In accordance with the policy, the MENR decided to organize an autonomous management body for Meru water supply.

1.2 Proposed Project for Grant-Aid of Japan

The Government of Japan started this Basic Design Study (the Study) on March 2000, based on the request of the Government of Kenya. It, however, passed three years after completion of the feasibility study, and therefore, twice of field survey has executed in the Study; the first one for review of the feasibility study; and the second one for basic design.

The first field survey was undertaken from April to May in 2000 and the result of the feasibility study was reviewed, focusing on the technical justification of the requested components and sustainability of the Project including operation and maintenance, from the viewpoint of execution of the Grant-Aid of the Japanese Government.

The Meru water supply has provided the services for nine sub-locations with the areas of 26 km^2. There are many problems in the system operation and maintenance such as water leakage from the pipes and broken valves, illegal water abstraction, damages to the water supply facilities due to the heavy rainfall of the El-Nino phenomenon in 1997 to 1998, and so on. These problems have resulted in making the system unreliable and low connection rate in Meru Town.

The residents in the Study Area have developed self-sufficient water supply systems called as Community Water Supply Scheme under administrative and engineering supports of the Ministry of Environment and Natural Resources (MENR), since there are no public water supply system covering all the Study Area, excluding Meru Town.

These systems, however, have serious problems; 1) no water treatment facilities in the system; 2) fluctuation of river flow not enough for water demand during the dry season; and 3) lack of know-how and engineering of operators responsible for operation and maintenance. Therefore, stable and safe water supply has not been achieved even in the community water supply schemes.

The Government of Kenya has rehabilitated the damaged part of the facilities by the

El-Nino phenomenon and improved the performance of operation and maintenance in accordance with the prepared action programme, in order to achieve the objectives of the Project.

The interim result of the activities as of September 2000 indicated that it is strongly required to further make effort on capacity building of staff of the DWO, judging from the present situation on the low collection rate of revenue, poor operation and maintenance technology, and insufficient metering system, even though preparation of block maps of Meru water supply, repair of leakage pipes and gradual improvement of revenue collection rate has been executed by the DWO.

Taking into account these situations, the Study Team prepared the development plan of water supply facilities in the Study Area, comparing the capability of the DWO for operation and maintenance and design scale of required facilities. In comparison studies, the Study Area was divided into four areas.

Through the studies and analyses made for the basic design, it is planned that the improvement works for the existing facilities and strengthening of the management body for Meru water supply should be undertaken by the Grant-Aid Scheme as the first phase project, in order to expand the water supply area to the Study Area.

Also, the new water supply system should be realized by the Government of Kenya after implementation of the proposed first phase project, for the areas surrounding urbanized areas of Meru Town with high population density, and rural areas of Meru Town, in accordance with the population growth in these areas and situation of the planned autonomous management body.

These plans were discussed in the second field survey executed from September to October in 2000, and finally, agreed between both the governments. Based on this agreement, the Government of Kenya revised its request to the Government of Japan to implement the Project consisting of improvement of the existing water supply facilities in Meru Town, provision of operation and maintenance equipment and tools, and technical support for establishing an autonomous managing body for Meru water supply.

Chapter 2 Contents of the Project

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2.1 Objectives of the Project

Large part of residents in and around Meru Town obtain their drinking water directly from the river or other water bodies, which have insufficient water quality and quantity, since the water supply system in this area has been deteriorated and damaged due to lack of know-how and engineering for operation and maintenance of the facilities.

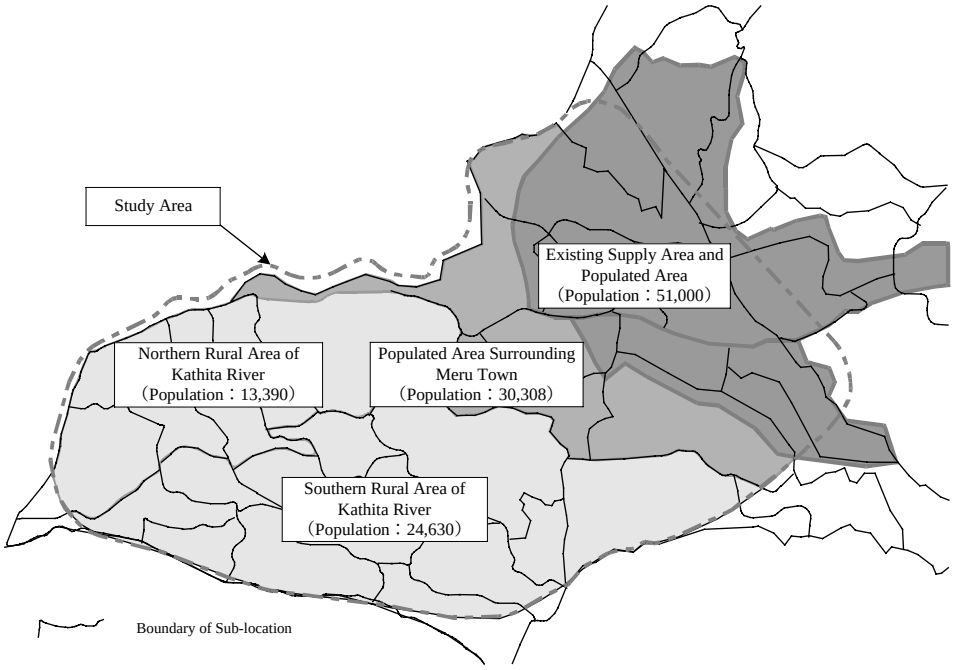
Therefore, improvement and strengthening of the management body for the existing water supply facilities in Meru Town has been one of the essential issues for developing reliable and stable water supply system.

This Project aims to supply safe and stable drinking water to residents by improving the existing water supply facilities and developing distribution network in an area where it is possible to provide water by the gravity system under the current water production capacity.

2.2 Basic Concept of the Project

2.2.1 Basic Considerations for Water Supply in the Study Area

Study Area based on the feasibility study in 1997 is divided into the following four areas, taking into account the population distribution:



The areas, population and water demands of these areas in 2005 are listed as follows:

Areas	Area (km^2)	Population in 2005	Water Demand (m3/day)
(1) Existing supply area and densely populated area	31	50,957	4,485
(2) Populated area surrounding Meru Town	13	22,863	1,528
(3) Northern rural area of Kathita River	18	13,385	657
(4) Southern rural area of Kathita River	30	24,630	1,101

Note: Detail of water demand projection is described in Attachment-4.

Among these four areas, the existing supply area, where is densely populated, need improvement of the existing facilities so as to realize potable and stable water supply in Meru Town. Especially, enlargement of water supply capacity of distribution pipeline is required, in order to meet the increasing water demands in this area.

Other areas need to construct new water supply facilities such as an intake weir, raw water main, treatment works, and transmission and distribution mains, recommended by the feasibility study in 1997.

Whilst, there are essential requirements in operation and maintenance such as improvement of billing and collection system, technical strengthening of operation and maintenance knowledge of staff in the DWO and management body. Furthermore, it is necessary to execute education and marketing for residents of 60,000 in the Study Area, in order to shift water users of community water supply schemes to customers of Meru water supply.

Consequently, this Study concluded that the Grant Aid Project would execute improvement of the existing water facilities in Meru Town as well as strengthening of management body, as the first phase project. Afterwards, the management body would expand the water supply area into other three areas under the assistance of the MENR, as the second phase, based on the accumulated know-how for operation and maintenance in the management body through the first phase project.

Based on this conclusion, the water supply area of the Grant Aid Project is decided to be the existing water supply area and populated areas in the southern part of Kathita River where it is possible to expand water supply area by applying the gravity water supply system.

2.2.2 Basic Principles for Project Planning

The existing water supply facilities have problems on; 1) deterioration of the facilities

due to their age of more than 40 years, 2) damages due to El-Nino phenomenon in 1997/1998, 3) insufficient supply capacity for water demands, and 4) large amount of unaccounted-for-water counted at 65% including water leakage and illegal water abstraction. The Government of Kenya rehabilitates damages induced by the El-Nino phenomenon under the El-Nino Infrastructure Rehabilitation Project.

In management of Meru water supply, the DWO has matters to be solved, such as; 1) low collection rate of revenue, 2) poor know-how and technology for operation and maintenance of facilities, and 3) lack of budget and materials/equipment for provision of flow meters. The MENR decided to transfer an autonomous management body to solve these problems. The management body is scheduled to start services from July 2001. However, after commencement of services, the mentioned issues are remained for this management body.

The water supply plan for Meru Town is prepared under the following concept and principle, taking into account these present situation of Meru water supply:

1) The Project will be comprised of; a) improvement of the existing water supply facilities including expansion of water supply area for effective use of treatment capacity of Milimani water works, b) technical assistance in strengthening of the management body, and c) provision of equipment and tools for operation and maintenance; in order to realize sustainable Meru water supply with good water quality and sufficient quantity.

2) An improvement plan is required to comprise; a) measures for water leakage, b) increase of water supply capacity to cope with the water demands in 2005, c) establishment of water metering system for applying water tariff system in accordance with water amount to be used, and d) improvement of treated water quality.

3) Provision of equipment and tools for operation and maintenance aims to smoothly start these works and to transfer technology to operators of the management body, since the DWO will use their equipment and tools for water supply to other towns and the DWO will not transfer these to the body.

4) Managers of the management body will be procured from the MENR and/or market in Kenya, and their capabilities for operation and maintenance are unknown and will require advice and assistance of specialists. Also, operators of the DWO will shift to the body, but they are poor for operation and maintenance,

taking into account the present situation of the existing facilities, and therefore, it is required to assist them to operate facilities well. Furthermore, propagation of the Project to residents is indispensable for increasing customers. To improve the management capacity in the body, the soft component scheme is planned to be executed in the Project.

2.2.3 Basic Conditions for Project Planning

(1) Target Year for Planning

The design horizon for the Project is set up at the year of 2005, which has been applied for the master plan and feasibility study for Meru water supply.

(2) Water Supply Area for the Project

The water supply area of the Project with the total area of 31 km^2 is comprised of the existing water supply area of 26 km^2, and an expansion area of 5 km^2 where is densely populated area and it is possible to supply water by the gravity flow system and the current treatment capacity of Milimani treatment works.

(3) Population in the Water Supply area of the Project

The water supply area covers whole or part of 15 sub-locations. The population of the Project area is estimated at 51,000 (Individual connection: 30,600 people, Communal water taps or water kiosk: 20,400 people)**,** based on the census data in 1999, as follows:

Sub-locations		Population (person)	
		1999	2005
1	Kaaga	3,546	4,075
2	Mukua	2,273	2,612
3	Njoka	698	802
8	Chungari	804	924
9	Runogone	631	725
27	Nchaure	628	722
29	Magundu	2,863	3,290
30	Lower Igoki	2,010	2,310
31	Gachanka	4,059	4,664
32	Muringa-Ombugi	2,435	1,072
34	Township	4,314	4,957
35	Gakoromone	8,865	10,187
36	Kaaga	6,796	7,809
37	Tuntu	1,085	1,247
38	Upper Igoki	4,841	5,563
合　計		45,847	50,957

Note: Details are given in Attachment 4.

(4) Water Demand for Project Area

The water demands in 2005 is worked out under the assumptions that individual connection would be 100 % for high and medium class houses and 40 % for low class houses in urbanized area, and 60 % in suburb area. Also, it is assumed that other houses without individual water supply will be users for communal water taps or water kiosks to be organized by the Project. The following are the unit water consumption applied for the water demand projection:

Category			unit	Consumption
Domestic water	Rural	Individual connection	l/c/d	60
		Water kiosk	l/c/d	20
	Urban	High class housing	l/c/d	250
		Medium class housing	l/c/d	150
		Low class housing	l/c/d	75
		Water kiosk	l/c/d	20
Institutions	Schools	Boarding	l/c/d	50
		Day school	l/c/d	5
	Administration staff		l/c/d	25
Health facilities	Hospitals	District	l/bed/d	200
		Other	l/bed/d	100
		Out patients	l/patient/d	20
	Dispensary/Health center		m3/day	5
Commercial use	Hotels	High class	l/bed/d	600
		Medium class	l/bed/d	300
		Low class	l/bed/d	50
	Bars		l/day	500
	Shops		l/day	100
Industrial factory			m3/ha/d	20
Livestock			l/c/d	50

Source: MOWD Design Manual, 1986

Based on the mentioned assumptions, the water demand in 2005 is estimated at 4,485 m^3/day, as follows:

Category	Water Demand（m3/day）	
	1999	2005
Domestic water	2,308	3,697
Institutions	140	176
Health facilities	85	105
Commercial use	152	192
Industrial factory	196	246
Livestock	54	70
Total	2,935	4,485

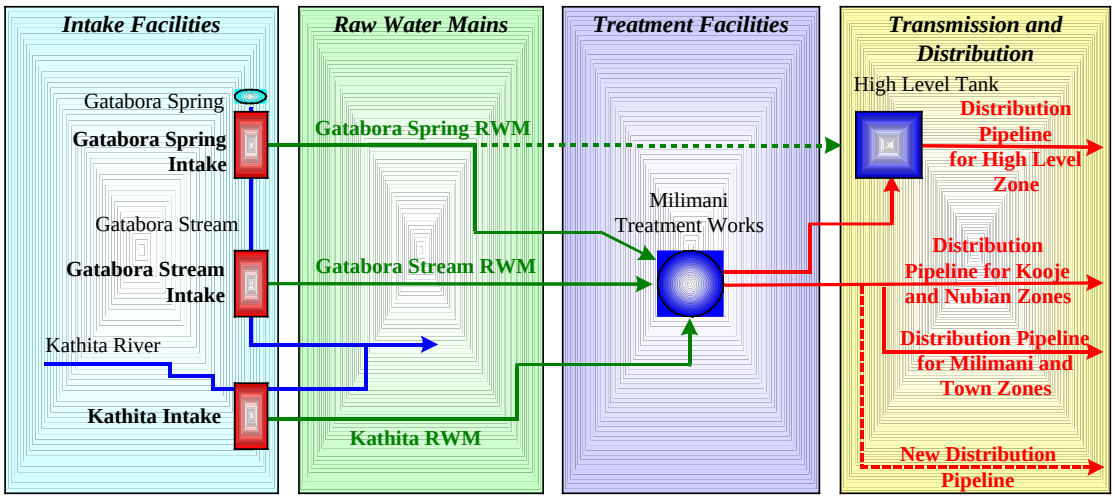
(5) Scope of the Project

(5-1) Improvement Plan of the Existing Facilities

The improvement plan for the existing water supply facilities in Meru Town under the Grant-Aid Scheme is formulated in order to; 1) realize safe and stable water supply in Meru, 2) reduce operation and maintenance costs, and 3) improve revenue collection. The followings are the improvement works for the existing facilities selected for this Grant-Aid Project:

The scope of the Project includes; 1) improvement of the water supply capacity taking into account available water source, treatment capacity after completion of the El-Nino Project, and supply capacity of distribution pipeline network, and 2) to improve treated water quality; avoiding duplication with that of the El-Nino Project, as follows:

Water Supply Facilities in Meru Town



Scope of Works of the Project

• Intake facilities are being sufficiently rehabilitated by the El-Nino Project, and further works are not included into the Grant Aid Project.	• Improvement works of Gatabora Spring RWM for securing water quality • Measures for water leakage from Kathita RWM • Rehabilitation of broken or damaged RWM	• Improvement of facilities for securing water quality • Establishment of metering system in the treatment works	• Improvement of water supply capacity of distribution network, and water supply block • Establishment of metering system in the treatment works • Expansion of distribution pipeline into new area

(5-2) Provision of Equipment and Tools for Operation and Maintenance

Equipment and tools owned by the DWO will not be handed over to the management

body, since the DWO will function as an administrative body of the MENR to manage the water resources and water supply in the Meru Central District. Whilst, the operation and maintenance of Meru water supply is required to be undertaken by the management body for Meru water supply and the equipment and tools are indispensable for this organization.

But, this organization will have a limited budget for procuring these equipment and tools. Under this consideration, it is planned to provide such equipment and tools as behicle, bikes, tools for repairing, water quality testing equipment, tools for leakage detection, flow meters including meter calibrator, and so on.

(5-3) Technical Assistance for Autonomous Managing Body

The MENR decided to transfer an autonomous management body for Meru water supply in order to strengthen management capacity, and it is scheduled to commence the operation by this body on July 2001.

In the past, the management for Meru water supply was transferred to the municipal council of Meru in 1983, but it is reverted to the MENR in 1992. After transferring of management body, most of staff will be procured from the DWO, but there are many issues to be solved; 1) limited knowledge and know-how on managing and operating the autonomous body; 2) establishment of new financial and accounting system; 3) education of engineering technology for operation and maintenance; 4) improvement of revenue collection rate; and 5) execution of measures for UFW reduction.

Strengthening of management capacity and training of staff of body is indispensable, in order to use the facilities to be provided by the Grant-Aid Project, effectively, and to sustain the management body with self-sufficiency. Therefore, technical assistance for this management body is proposed to be included into the Grant-Aid Project, not only during the implementation of the Project, but also during operation and maintenance stage.

(6) Community Water Users as Potential Customers for Meru Water Supply

There are 233 community water schemes possibly included in the Study Area identified by this Study, as shown in Figure 10. Out of those sample candidates, 188 water schemes replied to the questionnaire and 158 water schemes turned out to be inside the Study Area. Obtaining rate of answer against distribution of questionnaire was about 90%.

The principal findings from the results of the 158 schemes inside the Study Area are:

1) Community water scheme users are unsatisfied with quality (93 %) and quantity (96 %) of their community water;

2) Community water scheme users want to use the clean water of the Project by individual connection (94 %) and water kiosk (6 %); and

3) Those probable users are willing to pay initial connection fee (Ksh 1,634 per family on average) and monthly water charge (Ksh 229).

Of the mentioned 188 community water schemes, 40 schemes are located in the water supply area of the Grant-Aid Project. Through the hearing survey, it was identified that the residents in the Project area have intention for connection with Meru water supply system and willingness to pay for water tariff. However, it is necessary to execute several measures for making these potential users to actual customers of Meru water supply smoothly, as follows:

Description		Measures
Review of Water Tariff	Initial connection fee	• Initial connection fees in accordance with location and conditions of house of residents • Establishment of clear rule for calculating fees without inequity or expensiveness for customers to reduce the share of customers as possible
	Water tariff	• Establishment of water tariff system making customers possible to pay
	Communal water tap	• Establishment of water tariff for users of communal water taps, cheaper than that of individual connection
Establishment of Water Metering System	Provision of water meter	• Establishment of full metering system • Selection of such meters as individual meter, communal meter, or meters at distribution points in accordance with conditions of customers, surveying needs of customers, easiness of management, cost, and so on.
Social Development	Cooperation of residents for management	• Cooperation of residents for construction of service pipes for the purpose of reducing initial fee • Cooperation of residents for patrol of pipeline for establishment of self-management system but providing incentive such as reducing water tariff.
	Parallel use of community water supply schemes	• Social awareness that the Meru water supply does not have influence to the community water schemes and that drinkable water without boiling will be distributed with appropriate fee
	Social awareness	• Explanation of the purpose of Meru water supply and discussion about needs of residents for drinking water supply in each sub-location, village or community water supply scheme, and • Management of business plan of body taking into account these needs identified

Description		Measures
	Water kiosk	• Establishment of water kiosk and its management system taking into account location, management method, operation method, and experience of water kiosk system in Meru • To establish above, public participation is essential for sustaining the system
Strengthening of Management Capacity	Establishment of reliable management body	• Establishment of smooth construction system for service pipes and meters, registration system of customers, revenue collection system, application system of connection, and so on
	Cooperation of administrative organization	• Communication and collaboration of administrative agencies such as chief of division, location and sub-location for information management for public relation and marketing
Technical Assistance called as Soft-Component Scheme		• Promoting diffusion of water tap through technical assistance scheme of Grant-Aid of Japan for education of residents, information management, operation of management body, and so on.

2.2.4 Structural Layout Plan for Meru Water Supply

Rehabilitation works for Meru water supply are going on under the El-Nino Project financed by the African Development Bank (AfDB). This project deals with the rehabilitation of the damaged part of four intake weirs, raw water mains, treatment works, and distribution network, and construction of additional two composite units. These works are scheduled to be implemented for ten months from August 2000 to May 2001 by a local contractor.

It is necessary to monitor and confirm the actual features of the El-Nino project, since this Grant-Aid Project is formulated under the condition that the El-Nino project is fully completed based on their plan. Whilst, the El-Nino project increases the treatment capacity of the existing Meru water supply, its distribution network is required to be improved in order to distribute the treated water after implementation of the El-Nino project.

Taking into account the above-mentioned conditions, it is proposed to deal the following works by this Project:

(1) Raw Water Mains

The Gatabora Spring raw water main with a supply capacity of 1,700 m3/day is directly connected with the high level tank, currently, and the stored water in this tank is distributed to water users without any treatment. After completion of the El-Nino Rehabilitation Project, the treated water pumped-up from the treatment works will be mixed with raw water from this conveyance main at the high level tanks. In order to

avoid this mixture of the treated and untreated water, the Gatabora Spring main is planned to be connected into the treatment works by arranging the part of conveyance pipeline.

The Kathita raw water main is comprised of steel pipeline with a diameter of 300 mm and a length of 1,520 m from the intake to the existing break pressure tank located in Giatune Town and uPVC pipeline with a diameter of 300 mm and length of 1,700 m from this break pressure tank to the treatment works. The later part of raw water main has serious problems such as damages caused by deterioration of pipes and water leakage, and therefore, this part is replaced by using steel pipes with the same diameter of the existing pipes. The layout for this replaced pipeline is proposed to be along the existing road to avoid the land acquisition of private lands.

Whilst, rehabilitation works are necessary to be provided for the damaged and broken part of the steel pipeline between the intake weir and the break pressure tank, such as replacement of broken pipes and provision of cover of chambers.

(2) Water Treatment Works

The treatment capacity of 4,810 m3/day will be increased to 6,730 m3/day by provision of new two composite units under the El-Nino project.

The effective capacity of the treatment works is estimated at 4,489 m3/day corresponding to the water demands in the proposed supply areas, under the assumption for operation rule of the treatment works that a direct filtration unit is for stand-by use and that water loss at the treatment works and leakage in distribution network are 5% and 15%, respectively,

(2-1) Construction of Back Washing Tank

The existing back washing tank functions only for the composite units with a capacity of 530 m3/day and direct filtration units with a capacity of 1,183 m3/day. There are no back washing tanks for composite units even for new ones. Therefore, a back washing tank with the storage capacity of 77 m3 is proposed to be constructed for four composite units. The water for back washing is conveyed from the high level tanks through distribution pipes instead of providing executive pipeline.

(2-2) Rehabilitation of Chemical Feeding Facility

The existing chemical feeding facility of the composite units has no dissolving function

for alum. To improve this situation, it is proposed to provide alum tray to the dissolving chambers and to carry out this work by Kenyan side under the technical assistance of Japanese Government. Whilst, the chlorinating facilities are broken or lost and new ones are equipped by the Project.

(2-3) Metering System

Currently, a master meter is equipped only for the inlet pipe from the Gatabora Stream raw water main. It is indispensable for managing treatment process to measure water amount flowing into pipes, and therefore, it is proposed to provide flow meters at the inlet and outlet pipes of facilities necessary to be monitored.

(2-4) Arrangement of Pipes in the Treatment Works

The inlet pipes of the Gatabora Spring and Stream raw water mains is proposed to be arranged to the direct filtration and small composite units, since water conveyed from these raw water mains has good quality. The inlet pipe of the Gatabora Stream raw water main is re-arranged by the El-Nino project and the other is executed by this Project. When the turbidities of these raw water mains becomes high, the water is necessary to be treated by the composite units.

The water from the Kathita raw water main is planned to flow into the four composite units including new ones.

(2-5) Installation of Control Panel for the Existing Pumping Equipment

There are three treated water reservoirs with storage capacity of 455 m3, 365 m3 and 91m3, respectively. Of these storage reservoirs, two tanks with a capacity of 455 m3 and 91 m3 are utilized for distribution of treated water and the other with a capacity of 365 m3 is for distribution and transmission of treated water to the high level tanks. Based on this arrangement, the existing outlet pipes are replaced by new pipes.

The existing pumping facilities provided by the El-Nino project has no control equipment. Therefore, pressure detecting equipment and flow relay system are provided to control pumping facilities in order to enable operation to carry out at the treatment works site, effectively. The existing transmission pipe with diameter of 100mm has insufficient capacity for increasing water demands and, therefore, needs to be replaced by the Project.

(3) Transmission and Distribution Pipelines

(3-1) Improvement of Water Conveyance Capacity

The existing distribution facilities are three distribution and storage tanks at the treatment works and two high level tanks, and uPVC, asbestos and galvanized iron pipes with a total length of 42 km. Furthermore, these pipes have an age over 20 years to 40 years and are deteriorated.

The El-Nino project has rehabilitated only the damaged pipes with a total length of 1.7 km. Whilst, this project increase the treatment capacity due to construction of two composite units, but distribution capacity of pipeline does not match increased treatment capacity and water demands in 2005.

In order to improve the mentioned situation, the Project plans to replace the existing pipes to cope with the increasing water demands by 2005. Due to this replacement, the existing service pipes require construction works to connect these pipes to the proposed ones.

(3-2) Formation of Appropriate Water Supply Blocks

Distribution network is mainly comprised of two system; Milimani and high level zones. However, since there are no distinct sub-zones within these zones, Meru water supply system have a weakness for accidents of pipeline.

Taking consideration with the mentioned situation and easiness of operation and maintenance, this Project executes further division of water supply blocks for establishing reliable water supply system.

(3-3) Establishment of Metering System

In order to improve billing and collection rate, the existing water meters, which are broken or out of order, are planned to be replaced by the Project, in execution of replacement of service pipes. Of these works, the Japanese side will carry out provision of meter boxes and pipes connecting distribution pipes with these boxes, and the Kenyan side would install water meters to be provided by the Grant Aid.

2.2.5 Plan for Provision of Equipment and Tools for Operation and Maintenance

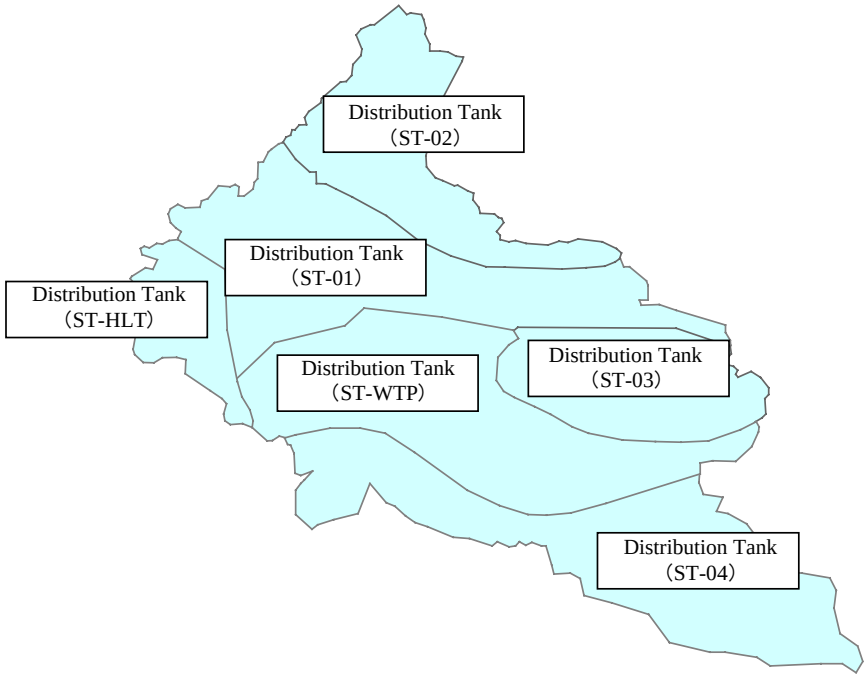
The equipment and tools required for daily operation and maintenance works are selected for provision of those under the Grant-Aid Project. These daily works are;

1) management and patrol for intake facilities, 2) water quality analysis at the treatment works, 3) construction of service pipes, 4) leakage detection, inspection and repairing of pipes, 5) meter reading and installation, and 6) billing and collection.

Taking into account these works, the following are selected equipment and tools:

(1) Vehicle and Motor bikes

One pick-up truck with four-wheel-drive is designed for conveying equipment and materials for provision of service pipes for house connection and patrol of facilities, including patrol of facilities. Five motor bikes with engine displacement of 90 cc is designed for patrol and regular billing and collection of revenue, taking into account six water supply zones.



(2) Equipment, Tools and Material for Operation and Maintenance

Repairing and maintaining meters are indispensable for establishing metering system applying revenue system in accordance with water amount used, and therefore, one set of meter calibrator with movable and fixed types are planned to be provided.

Each one set of electric melting equipment, drilling machine and pipe cutter is selected for provision of service pipes, since numbers of house connection are designed to increase from the current 2,800 to about 6,000 in 2005.

Equipment and material such as sluice valves, air valves, steel and uPVC pipes, and so on are selected for developing new customers at the initial stage of the Project

implementation.

(3) Water quality testing equipment

Water quality testing equipment such as water sampler, pH-meter, turbidity meter, residual chlorine meter and jar tester is common in Kenya. Each one set of these equipment is planned, taking into account sustainable use and supply of chemical materials by the management body.

(4) Leakage detection equipment

The basic design study tried to transfer technology for leakage detection to staff of the DWO during the field survey, using pressure meters. While, they have no experience using other equipment for leakage detection. Therefore, two sets of pressure meters are included into the Project components.

(5) Water meters

Out of the existing meters of 2,842, 90% is broken or out of order. While, it is required to improve revenue collection rate and financial condition of the management body. flow meters of 2,573 with diameters from 1/2 inches to 1.5 inches are planned to be provided so as to achieve this requirement.

(6) Topographic survey equipment

It is important to carry out leveling survey in Meru Town, where hydraulic gradient is steep, and to design pipe network properly. To carry out this survey, each one set of leveling equipment, staff gauge and measuring tape (nylon and steel) are necessary to be provided.

2.2.6 Transferring of Autonomous Management Body

The MENR is separating the operation of urban water supply from direct operation of the MENR, and transferring autonomous bodies for effective development of public water supply, under the water policy. For example, Eldoret Town in Rift Valley Province and Nyeri in Central Province already established the self-sufficient management bodies under assistant of international agencies or donor countries.

The MENR already decided to transfer an autonomous management body for Meru water supply, and is scheduled to register it in March 2001. This management body is planned to be comprised of “Board of Trustee” and “Project Management Unit”. The MENR is considering board members.

Management policy of this body aims at; 1) securing self-sufficiency and independence, 2) establishing metering system and billing system thereby, 3) development customers in accordance with business plan, 4) completeness of payment for customers, 5) developing water supply system to low income residents, 6) securing water quality and quantity of distributed water.

This Project provides technical assistance for design of concrete activities and execution of these through the soft-component scheme of Japan. The assistance will be commenced from July 2001 and executed on; 1) establishment of management system, 2) improvement of customer services, 3) creation of effective billing and collection system, 4) improvement of engineering technology for operation and maintenance, 5) monitoring and review of activities of management body, and 6) recommendation for further strengthening of the management capability.

2.3 Basic Design

2.3.1 Design Concept

(1) Natural Conditions

The proposed supply area has large difference in the altitude ranging from 1,200 m to 1,700 m in east-west direction. Also, there are many small streams running in Meru Town. Therefore, pressure control in the distribution networks needs to be studied and designed carefully. It is necessary to reduce required numbers of break pressure tanks for control of pressure, taking into account multiple use of distribution tanks for this issue.

Construction equipment and machines needs to be selected considering the road conditions in the project sites, since the part of the existing roads, which will be utilized as access roads for construction works, has steep slope.

The Project Area is located in the eastern part of the East African Rift Valley and is wholly underlain by the Precambrian Basement System, but volcanic rocks and sediments from the major eruption of Mt. Kenya mostly covered the area. The geotechnical condition in the Study Area is judged to be good for foundation of structures and pipelines.

Water of the Gatabora and Kathita Rivers are classified into good quality and therefore, it is considered that sedimentation and chlorination will make treated water drinkable. But, the upper reaches of these rivers are being developed for agricultural use. Sheet

erosion in this area may induce increase of turbidities in the river water during the wet season. Taking into account this erosion, improvement of water quality testing and establishment of treatment procedure are required to maintain the good quality of treated water.

(2) Social Conditions

Most of the residents in Meru Town require public water supply with potable and stable supply. Therefore, the proposed water supply system covers whole areas of the existing supply system and the areas which are densely populated in the south of the Kathita River and possible to be supplied by the gravity system. The proposed distribution network needs to be designed under the condition that the service pipes are provided by applicants.

The location of distribution tanks needs to be allocated on government lands such as school or public lands.

It is necessary for effective use of the provide facilities and equipment to change potential users in communities to customers of the Meru water supply and to establish proper water tariff system with incentive for customers.

(3) Engineering Condition

The MENR has issued and utilized its own engineering manual titled as Design Manual for Water Supply in Kenya, 1986. Taking into account the performance of operation and maintenance for the existing water supply facilities, the design should attain easiness of operation of facilities, application of advanced mechanical and electrical equipment and tools, and low cost for operation and maintenance. Furthermore, it is noted that the flow management is indispensable for establishing billing system with metering of used water, and that flow meters should be arranged therefor.

(4) General Conditions in Construction Sector in Kenya

Since independence in 1963, the Government of Kenya has implemented construction works under the financial and technical assistance from the European countries, the former USSR, China, Middle East countries, and so on.

General contractors in Kenya have their own construction equipment, experience of construction works and technology for works. Therefore, labor cost is not always cheaper. Design and construction of important facilities should be executed under

instruction and management of Japanese engineers.

Also, most construction materials are available in Kenya. Procurement of these material is required to pay tax of 18%, but tax for the project under international financial assistance including the Grant-Aid Project is exempted under the law.

(5) General Contractors and Construction Material in Kenya

There are many general contractors registered into the MENR, in civil engineering, architecture, mechanical works, and electrical works. Therefore, these general contractors could possibly be employed as a sub-contractor to reduce the project cost.

Material used for the existing facilities should be applied for design of water supply facilities. Most of material related to water supply projects is available in the market of Kenya, such as steel pipes, uPVC pipes, valves, meters, reinforcement bars, cement, timber, fuel, and so on. Therefore, construction material for Meru water supply project will be procured in the market in Kenya within sufficient quality of material, in order to make operation and maintenance easy.

(6) Operation and Maintenance by Management Body

The executing body for implementation is the Department of Water Development, Ministry of Environment and Natural Resources. Operation and maintenance are undertaken by the self-sufficient management body being established by the MENR.

However, it is indispensable to assist this management body for establishing management system and sustaining self-sufficiency of the body. Also, assistance for marketing is required in order for potential users living in rural and slum areas of Meru Town to become customers of Meru water supply. Soft-component scheme is expected to be effective for these issues.

From this, it is judged to provide Soft-component scheme for the Project in order to assist the management body for Meru water supply, focusing on establishment of management policy, organizing management body and water users into the Meru water supply, education of staff, billing system enabling the body to be self-sufficient, revision of billing system, and so on.

(7) Construction Equipment and Machines

The Project mainly consists of replacement of pipes in the raw water mains,

re-arrangement of pipe network in Milimani treatment works, and improvement of distribution network in the Meru water supply.

These facilities are designed to enable the management body to reduce the operation and maintenance costs. Furthermore, construction materials available in Kenya are planned to be procured as much as possible in order to make procurement of spare parts easy.

2.3.2 Basic Design

(1) General Layout Plan

The general layout plan of the proposed facilities is given in Figure 14, and the main works are described as follows:

(2) Structural Plan

1) Raw Water Main

There are three raw water mains; 1) Kathita system, 2) Gatabora Spring system, and 3) Gatabora Stream system. This Project deals the former two systems, excluding Gatabora Stream raw water main sufficiently rehabilitated by the El-Nino Project.

Construction works for the raw water mains are divided into two part; 1) rehabilitation of existing facilities, and 2) replacement of part of pipelines.

a) Rehabilitation of existing facilities

A survey on the existing facilities identified that the following structures need to be rehabilitated:

Work Items	Main Features
• Rehabilitation of damaged piers of aqueduct	Erosion protection of piers at 1 location
• Replacement of damaged pipes	1 place with length of 10 m and a diameter of 300 mm
• Rehabilitation of damaged pipes	Coating of the existing pipes at 1 places with the length of 88.5 m and diameter of 300 mm
• Rehabilitation of an air valve	Replacement of an air valve with a diameter of 300 mm
• Provision of broken chamber cover	4 chambers

b) Replacement of part of pipelines

Steel pipe is utilized for replacement of uPVC pipes from importance of the raw water mains. The pipelines to be replaced are ones between the existing break pressure tank and the treatment works for the Kathita system, and between the existing air valve chamber and the treatment works for the Gatabora Spring system. In principle, the route of pipeline is laid out along the existing road to avoid land acquisition of private lands. This replacement requires construction works for a new break pressure tank because of replacement in the Kathita system and preparation of chamber cover for the air valve.

Work Items	Main Features
• Kathita raw water main	a) Replacement of existing uPVC pipes with steel pipes of the total length of 1.90 km and diameter of 300 mm between the existing break pressure tank and the treatment works
• Gatabora raw water main	a) Replacement of the existing uPVC pipes with steel pipes of the total length of 2.05 km and diameter of 200 mm between the air valve and treatment works b) Provision of a chamber cover of the existing air valve

2) Milimani Treatment Works

The proposed back washing tank is planned to be constructed at the open space of the Milimani treatment works and have a height of 15 m from the ground to secure the required hydraulic gradient. Chemical feeding equipment is not produced in Kenya and therefore, the imported equipment will be utilized for the works. Flow meters are provided at the inlet and outlet pipes of the facilities to monitor produced and distributed water.

Work Items	Main Features
a) Provision of additional back washing tank	1 no. with a storage capacity of 77 m3
b) Rehabilitation of chemical feeding facilities	6 nos. at composite units
c) Provision of flow meters	• 2 nos. at inlet pipe of Gatabora Spring and Stream raw water mains • 1 no. at inlet pipe of Kathita raw water main • 2 no. at outlet pipes of the treated water reservoirs • 1 no. at outlet pipe of the rising main
d) Re-arrangement of pipe network in the treatment works	• Re-arrangement of pipe network • Connection of the inlet pipe of the Gatabora Spring raw water main with direct filtration units • Replacement of the inlet pipe of the Kathita raw water main with composite units
e) Control equipment for pumping-up	• Provision of pressure detecting equipment and flow relay system

3) Transmission and distribution pipelines

The design works are based on the guideline titled as " Design Manual for Water Supply in Kenya (Ministry of Water Development, 1986)". The applied standards for design are described as follows:

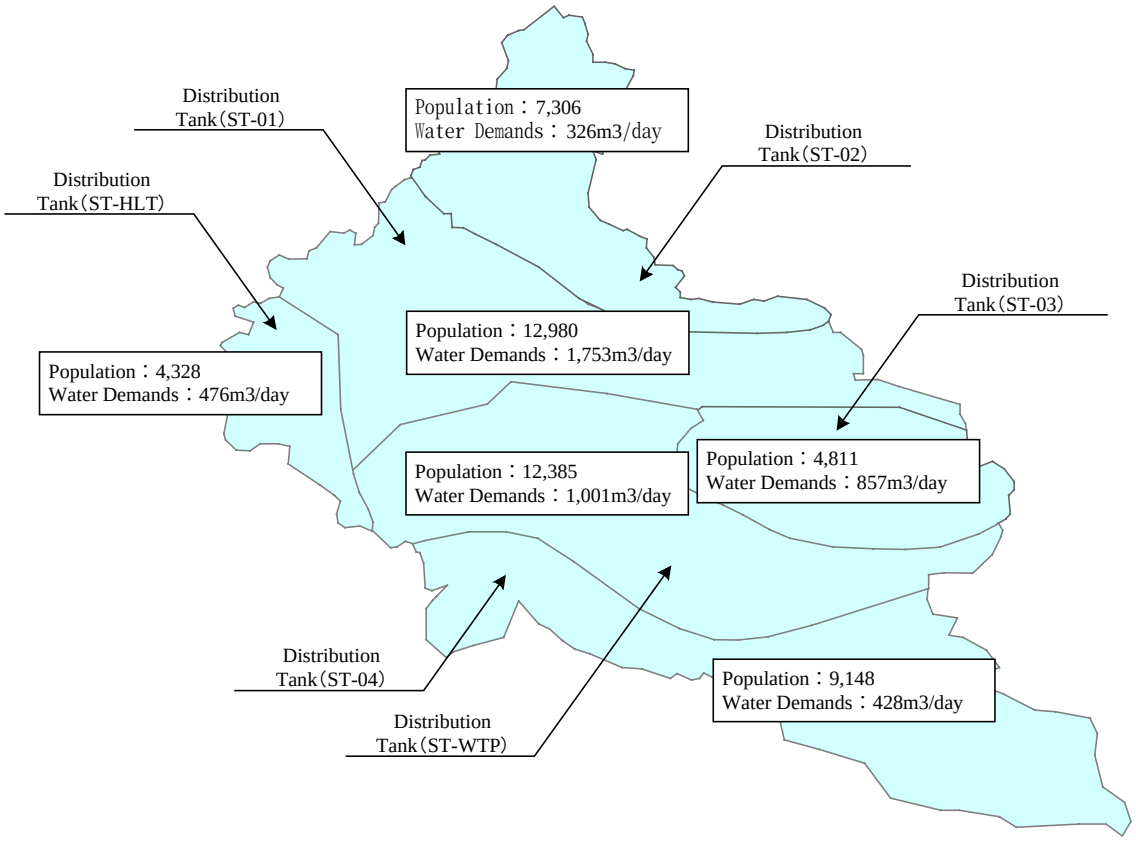
a) Design standard

Design Factors	Engineering Values
a. Peak factor for distribution pipes	2.0
b. Friction loss of pipes	Roughness coefficient of 0.1 for uPVC pipe and 1.0 for steel pipe, based on the equation of Colebrook-White
c. Water pressure	1) Urban area : 0.1 Mpa in min. 1.0 Mpa in max. 2) Rural area : 0.15 Mpa in min. 1.0 Mpa in max.
d. Fire hydrant	Water amount of 10 l/s for 2 hours are added into the distribution tanks
e. Storage capacity of distribution tanks	Water amount corresponding to water demand for 12 hours
f. Storage capacity of break pressure tanks	Water amount corresponding to average flow for more than two minutes

b) Basic Design

b-1) Transmission and distribution system

The Project aims to realize reliable water supply system by providing appropriate water blockage system. The five water tanks are constructed newly, and these tanks including the existing ones form six water blocks. The water demands in these water blocks are shown as follows:



To establish stable water supply system, five distribution tanks are provided in order to form a blockage supply system. The required storage volumes are given as follows:

Code Name	Location	Required Storage Volume (m3)	HWL (m)	LWL (m)	Structure Type
Existing Tank 1	Milimani WTP	455	—	—	Under-ground type
Existing Tank 2		91	—	—	Under-ground type
Existing Tank 3		189	—	—	Under-ground type
ST-HLT (Existing)	High Level Tank	150	+1754.5	+1752	Elevated Steel Tank (L8m x B8m x H2.5m)
ST-HLT (New)		88	—	—	Ground Type
ST-01 (New)	Kinoro Primary School	877	+1719.0	+1716	Semi-ground type (L18m x B16.4m x H3m)
ST-02 (New)	Meru High School	169	+1658.5	+1656	Elevated Steel Tank (L9m x B8m x H2.5m)
ST-03 (New)	O&M Center of MOPW	210	+1511.0	+1508	Semi-ground type (L18m x B8m x H3m)
ST-04 (New)	Irinda Primary School	211	+1637.0	+1634	Semi-ground type (L18m x B4m x H3m)
Total		2,440			

Of these tanks, elevated type structure is applied for tanks of ST-HLT and ST-02 to

maintain the design hydraulic head in each water supply block.

b-2) Pipe material

The raw water main and transmission mains including the rising main are important for stable water supply and therefore, the steel pipes are proposed to be utilized for construction, in order not to avoid illegal abstraction and to reduce leakage loss from pipes.

The distribution network is designed to be constructed by using uPVC pipes in principal. However, the pipes along the main road, where the construction works is predicted to induce traffic congestion, are designed to be steel pipes.

b-3) Classification of main and secondary pipes

The main pipes are defined as ones with a diameter of more than 90 mm and the secondary ones have a diameter of 63 mm. The secondary pipes are designed under the condition that 90% of houses are located within distance of 500 m from it.

The length and material of the pipes are tabulated as follows:

Classification of Pipes	Material	Diameter (mm)	Length (m)
Transmission Main	Steel	100	7,080
	Steel	200	1,210
Rising Main	Steel	200	1,890
Sub-total			10,180
Distribution Main	uPVC	90	14,530
	uPVC	110	15,240
	uPVC	140	3,560
	Steel	150	330
	Steel	200	1,260
Sub-total			34,920
Secondary Distribution	uPVC	63	44,810
Total			89,910

This replacement of the existing distribution pipes needs compensation works for connecting the existing service pipes with the replaced one. The replacement is designed to use uPVC pipes with a diameter from 20 mm to 50 mm as follows:

Classification of Pipes	Material	Diameter (mm)	Length (m)
Tertiary pipes connected with secondary pipes	uPVC	40A	43,000
Service pipes connected with tertiary pipes	uPVC	20A	39,035
	uPVC	25A	135
	uPVC	40A	90
Total			82,260

These lengths are estimated on the basis of water supply block maps and inventory of

water meters prepared by the DWO, and topographic maps with a scale of 1 to 2,500. The length of service pipes of 5m per tap in urban area and 30 m per tap in rural area is applied.

Numbers of water meters and classification are given in the following table:

Water Supply Block	No. of Existing Meters	Diameter				Length of Service Pipe (m/tap)
		13A	20A	25A	40A	
Kaaga	249	249	—	—	—	5
Kaithe/Ask	242	239	2	1	—	30
Kooje	341	341	—	—	—	5
Thimangiri	255	252	2	1	—	30
Town	454	431	15	8	—	5
Maize Control.	197	197	—	—	—	30
Gakoromone	409	409	—	—	—	5
Nubian	308	302	2	1	3	30
Millimani	387	384	2	1	—	5
Total	2,842	2,804	23	12	3	

Required numbers of bending pipes for the main pipelines are based on the topographic maps with a scale of 1 to 1,000. Those for secondary and tertiary pipes are estimated by multiplying a rate (m per one bending pipe) with length of these pipes. Also, it is assumed that four numbers per connection are estimated to be necessary for connecting works.

The required bending pipes are listed as follows:

Distribution Mains	Diameter	Phasing	Length (m)	90 °	45 °	221/2 °	11.25 °
	140mm	First Phase	2,240	0	0	0	20
	110mm		5,740	1	32	15	64
	90mm		900	0	0	0	15
	140mm	Second Phase	1,320	0	23	1	11
	110mm		9,500	1	16	10	130
	90mm		13,630	4	68	36	230
Secondary Pipes (63mm)			Length (m)	90 °	45 °	221/2 °	11.25 °
		First Phase	14,860	2	49	21	164
		Second Phase	29,950	5	100	43	334
		Total	44,810	7	149	64	498
Tertiary Pipes (40mm)			Length (m)	90 °	45 °	221/2 °	11.25 °
		First Phase	17,339	3	58	25	193
		Second Phase	25,661	4	86	37	285
		Total	43,000	7	144	62	478
Service Pipes	Diameter		Length (m)	90 °	45 °	221/2 °	11.25 °
	20mm	First Phase	9,316	2,632	—	—	—
	25mm		33	8	—	—	—
	40mm		0	0	—	—	—
	20mm	Second Phase	29,720	8,676	—	—	—
	25mm		103	40	—	—	—
	40mm		90	12	—	—	—

b-4) Break pressure tank

Break pressure tanks are provided along the transmission and distribution mains to keep the maximum pressure within 1.0 Mpa. In design of break pressure tanks, multiple use of distribution tanks are considered for reducing the required numbers of break pressure tanks.

Break pressure tanks along the secondary pipeline for water distribution are designed under the assumption that the maximum hydraulic head is at 1.5 Mpa, which corresponds to design pressure of pipes. As a result of application of this assumption, there is no requirement of break pressure tanks. However, it is noted that the DWO or the autonomous management body should provide the break pressure tank, when they would expand their water supply area. As a result, the twelve tanks are planned to be constructed by the Grant Aid Project, as follows:

Classification of Pipes	Material	Diameter (mm)	Number of Break Pressure Tank
Distribution Main	uPVC	90	5
	uPVC	110	5
	uPVC	140	1
	Steel	100	0
	Steel	200	0
Sub-total			11
Transmission Main	Steel	100	1
	Steel	200	0
Rising Main	Steel	200	0
Sub-total			1
Total			12

b-5) Depth of earth covering

Depth of earth covering for pipes is set up at more than 0.6 m. Soil layer within 1 m from the ground surface is formed by clay with silt or fine sand in general. N-value there is ranging from 6 to 10 at boring sites made by basic design study.

Based on these data, pipes are directly provided on bottom surface of excavated trench and covered with sand material with a thickness of 10 cm. Back-filling will be provide on the sand, using excavated material.

b-6) Joint of pipes and thrust blocking

Welded joint is applied for steel pipes and thrust blocking is not provided for steel pipe. Coupling type joint with rubber ring is provided for uPVC pipes and thrust

blocking is required for this pipes.

b-7) Sluice valve

Sluice valves are provided at the following points along transmission and distribution mains, in order to control flow for the purpose of operation and maintenance, pressure testing, dis-infection, and so on:

a. Beginning and terminal points of pipeline, inverted siphon, aqueduct, drainage pipe, and so on.
b. Upstream and downstream part of branch points of pipeline
c. Connection pipes of different pipelines
d. Interval of 1 to 3 km.

Along the secondary distribution pipes, sluice valves are planned at branch and end points.

Based on the above criteria, the following valves are provided:

Pipelines	Diameter (mm)								Total
	300	200	150	125	100	90	63	50	
I. Raw Water Main	3	5	―	―	6	―	―	―	14
II. Transmission Main	―	6	―	―	15	―	6	12	39
III. Distribution Pipeline	―	9	1	25	45	51	65	53	249
合 計	3	20	1	25	66	51	71	65	302

b-8) Air valves

Air valves are designed to have a structure which enable it to automatically discharge and absorb air, and provided at the following points:

a. Convex point of pipeline,
b. Interval of 300 m to 500 m along the pipeline,
c. Beside of sluice valve with higher altitude in case that pipeline has no convex between sluice valves,

Location of sluice valves for tee and branch point from the main pipe is decided at similar elevation of the main pipes, but air valves are provided when it is difficult to do it.

Diameter of air valve is determined at 25 mm, taking into account economic efficiency. The followings are issues considered for design of air valves:

a. Gate valve with handle or cock is provided between air valve and pipe, In order to make repairing easy.

b. Air valves are not equipped for secondary pipes, since air in the secondary pipes is commonly discharged from water taps connected with the secondary pipes. Also, fire hydrant is utilized as an air valve when new pipes are provided or at fulfillment or draining-out of water in the pipes. However, it is required to provide air valve at aqueduct.

c. The applied maximum pressure is 1.5 Mpa.

d. Vertical position of air valve is set up at the highest point of valve chamber in order to absorb stored water in chamber.

Based on the above criteria, the following 65 valves are installed by the Project:

Pipelines	Diameter（mm）						計
	300	200	150	125	100	80	
I. Raw Water Main	3	1	－	－	－	－	4
II. Transmission Main	－	3	－	－	10	－	13
III. Distribution Main	－	2	1	8	19	18	48
Total	3	6	1	8	29	18	65

b-9) Blow-off pipe

Blow-off pipes is provided at the following points for discharging out water in cleaning and disinfection:

a. Rivers or drain ditches at the lowest point of pipeline,

b. Lowest points between valves, where it is possible to drain out water,

c. Appropriate point for drainage, and

d. Terminal point of pipeline.

Diameter of blow-off pipe is designed at one third or one fourth of main pipes, taking into account the following issues:

a. Provision of sluice valve for drain pipe,

b. provision of drainage chamber between drain pipe and drainage channel in case of drainage channel higher than the bottom of drain pipe,

c. Provision of protection works at outlet of drain pipe, and

d. Provision of thrust blocking for special fittings.

b-10) Fire hydrant

Fire hydrant is provided at two sites, which are junction and branch of the existing road in urbanized area. These fire hydrants, also, are designed to have a function as drainage pipe.

b-11) Expansion and flexible pipe

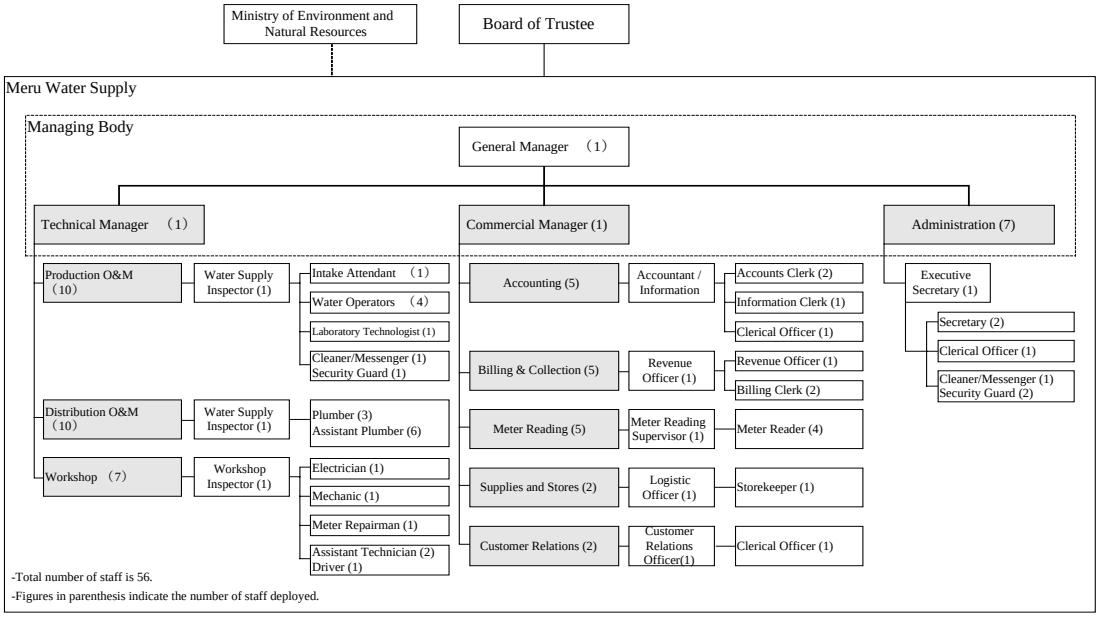
Expansion and flexible pipe are not provided along the proposed pipelines, since geological conditions along the proposed pies have N-value of 6 to 10 and land subsidence is not required to be considered.

Basic design drawings based on this are attached into this report.

2.4 Organization for Implementation

The implementation agency for the Project is the Department of Water Development under the MENR, the counterpart agency at the construction site is the Meru Central District Water Office (DWO) and the counterpart for the soft-component scheme is the management body to be transfered.

The management body is decided to be established by applying type of company with the board of trustees. Organization framework for this management body is as follows:



During the construction stage, it is necessary to implement the construction works in parallel with operation and maintenance of the existing water supply facilities, and to communicate between these organizations.

An autonomous body for Meru Water Supply is going on under the responsibility of Ministry of Environment and Natural Resources, based on the following schedule:

Preparation Works		2001年																													
		3				4				5				6				7													
1	**Registration of Trust Fund**																														
1.1	Gazettement of Legal Notice			▼																											
2	**Registration of New Managing Body**																														
2.1	Selection of Trustees			▼																											
2.2	Issuance of Certificate of Incorporation						▼																								
3	**Asset / Debt transfer confirmation**																														
3.1	Decision as to whether fixed assets are transferred										▼																				
3.2	Decision as to transfer of current assets and arrears			▼																											
3.3	Decision as to transfer of current liabilities			▼																											
4	**Confirmation of Initial financing**																														
4.1	Confirmation of availability of Counterpart Funds	▼																													
4.2	Confirmation of source of initial working capital				▼																										
5	**Preparatory works to make the Body operational**																														
5.1	Legal preparation for undertakership										▼																				
5.2	O&M handover (including manuals)																▼														
5.3	Financial/Commercial setup (including manuals)																														
5.3.1	Billing and collection system										▼																				
5.3.2	Accounting system										▼																				
5.3.3	Budgeting system										▼																				
5.3.4	Supply, store, procurement procedures										▼																				
5.4	Institutional setup																														
5.4.1	Deployment plan and Job description																														▼
5.4.2	Salary and fringe structure																														▼
5.4.3	Information system										▼																				
5.4.4	Personnel evaluation system																														▼
5.4.5	Transfer or recruitment of top management team																▼														
5.4.6	Transfer or recruitment of general staff																▼														
6	**Legal appointment as water undertaker**																▼														

▼ Event deadline　　Event

Chapter 3 Implementation Plan

Chapter 3 Implementation Plan

3.1 Construction Plan

3.1.1 Concept for Construction Works

(1) Principles

The Project is implemented on the basis of the following principles, under the Grant-Aid of the Japanese Government:

1) The Ministry of Environment and Natural Resources (MENR) is responsible for execution of the Project.

2) At the agreement of Exchange of Note for the implementation of the Project between Government of Japan and Kenya, the MENR will commence preparation works including formulation of organization consisting of the Department of Water Development (DWD), the Meru Central District Water Office (DWO) and an management body for Meru water supply who is scheduled to be registered.

3) After agreement of Exchange of Note for the implementation of the Project between Government of Japan and Kenya, a consulting firm of Japan will make a contract for detailed design, preparation of tender documents, assisting tendering works and construction supervision for the Project. A consultant and the MENR will start the soft-component scheme for strengthening of a management body in parallel with detailed design.

4) The Japanese general contractor will make a contract for construction works with the MENR, and the Japanese consultant will supervise construction works.

5) The Project management office will be built up by the contractor at the current open space of the DWO.

6) The MENR will transfer the construction site to the contractor, after completion of land acquisition.

7) After completion of construction works, responsibility for operation and maintenance will be handed over to the MENR.

8) After one year of defect liability period, the MENR, the consultant and the contractor will execute inspection for the constructed facilities.

(2) Procurement of Contractor

The MENR has managed contractors by preparing the registration system of those contractors with type and scale of contractors, and has executed own construction works or those financed by international agencies, using this registration system.

Japanese contractor executing this Project works, consisting of civil and pipeline works, is planned to employ the Kenyan contractors as sub-contractor under material supply of the Japanese contractor.

(3) Japanese Engineers of Contractor

Japanese engineer of the contractor will cover engineering field of elevated tank, electrical and treatment works. Also, three Japanese civil engineers in total will be dispatched for management of construction works of structures and pipelines, as well as a manager and an accountant.

3.1.2 Particular Consideration on Construction Works

(1) Tax Exemption

The MENR is responsible for the procedures of tax exemption for procurement of construction material and other required works. Whilst, it is required for the consultant and contractor to understand the law and regulation of the Government of Kenya in order to smoothly execute the Project works.

(2) Permission Required for Construction Works

The MENR is responsible for taking permission from the related agencies or organization, since the construction works will be undertaken along the public and private roads and lands in Meru Town. The consultant and contractor will prepare necessary information for taking permission and submit those to the MENR.

(3) Environmental Issues

Since the construction works of the Project will be undertaken in the urban area of Meru Town, such environmental impacts during construction stage as noise, dust, traffic accident and/or congestion due to transportation of construction material and equipment are possible to be induced.

To minimize these impacts, the contractor prepares persons leading traffics, necessary limitation of traffic speed under discussion with municipal office and police in Meru Town, and truck with water tank for sprinkling roads. Especially, for securing safety on traffic, the employees of the contractor will be trained about regulation and rule on driving and the contractor will hold regular internal and external meeting on security.

3.1.3 Demarcation of Construction Works between Japanese and Kenyan Sides

(1) Japanese Side

1) Detailed design and preparation of tender documents
2) Construction works for the proposed facilities

(2) Kenyan Side

1) Land acquisition for construction works for distribution tanks, break pressure tanks, and part of pipelines,
2) Cutting of trees required for construction of the pipeline and compensation for it,
3) Installation of meters to be provide by this Project, supply of chemical material for water quality testing, provision of treated water for testing of constructed pipes, electric supply for pumping equipment at testing of the rising main and control panel, arrangement of water supply during switching the existing pipes to new constructed pipes, and so on,
4) Provision of storage or places for equipment and tools for operation and maintenance,
5) Ensuring all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under Grant-Aid,
6) Provision of counterpart personnel for execution of soft component scheme, and
7) Application for taking permission for construction works by own expense.

3.1.4 Construction Supervision

(1) Detailed Design and Preparation of Tender Documents

After agreement of Exchange of Note, the MENR will make a contract with a

consultant, and the consultant will commence the detailed design and preparation of tender documents, based on detailed discussion about design works and implementation schedule with the MENR. The following are the necessary works to be undertaken:

1) Additional survey and investigation

   a) Topographic survey and geotechnical investigation for distribution tanks and river crossing structure sites, and

   b) Survey for confirmation of procurement of material and equipment

2) Detailed design

   a) Design of the proposed water supply facilities

   b) Design of distribution tanks and river crossing structures, and

   c) Preparation of construction schedule and cost estimate based on the result of detailed design.

3) Preparation of tender documents

   a) Preparation of tender drawings, and

   b) Preparation of tender documents.

Publication for pre-qualification of applicants will be made on daily newspaper related to construction and/or economic sectors in Japan. These preparatory works will be made by the consultant. Tender documents will be distributed to the qualified contractors.

The proposal of the contractors will be received by the consultant and opened by the consultant with the staff of the MENR. The proposal will be evaluated by the consultant and the MENR, immediately after opening of the proposal. The contract document will be drafted and finalized by discussion with the selected contractor.

(2) Construction Supervision

After agreement of the contract with the contractor, team leader of the consultant will discuss the implementation schedule with the contractor, and report the result of the discussion to the MENR.

After commencement of construction works, the resident engineer of the consultant will stay at the site and carry out supervision for construction works. The resident engineer will also report the progress of construction works to the JICA Office and MENR at Nairobi, regularly. The consultant will dispatch specialists for treatment works and pipeline, timely, in order to supervise the construction works.

The consultant will make the maximum efforts for smooth execution of construction works as planned and qualified works. The following are the major issues of the supervision works:

1)	Approval of construction drawings	:	Evaluation and approval of construction and shop drawings, permission of construction works, material, specification of equipment and machinery and so on,
2)	Supervision of construction works	:	Instruction for construction schedule, grasping the progress of works, shop inspection for material, and other required works,
3)	Approval for payment	:	Issuance of certificate for payment and completion of works, and
4)	Inspection at the end defect liability period	:	Inspection for the constructed facilities.

3.1.5 Procurement of Construction Material and Equipment

(1) Construction Material

Available material in Kenya will be utilized as much as possible. Construction material, which are not available in Kenya, insufficient in quality and specification, or not stable in supply amount and prices, will be procured from a third country or Japan. Taking into account easier operation and maintenance, the British standard will be applied for procurement.

1) Common material

Cement, aggregate, form material, reinforcement bar, and steel material are available in Kenya.

2) Pipe material

Regarding steel pipe with a diameter of 100 mm to 300 mm and uPVC pipe with a diameter of 20 mm to 200 mm, ones with the British Standard in size and are available in Kenya.

3) Valve, expansion and flexible pipes

Available material in Kenyan market are imported from many countries and produced under many kinds of specifications and quality. Those are limited in kind of diameters and quantities.

Thus, these valves, expansion and flexible pipes will be procured from the third country or Japan.

4) Joint and coupling

From same reason as valve, expansion and flexible pipes, these materials will be procured from the third country or Japan.

5) Chemical feeding equipment

This equipment will be imported from Japan, since this equipment is not produced in Kenya.

6) Control panel for pumping facilities

This equipment is made by assembling on the basis of order and required functions and there is no standardized equipment. Parts of this equipment have been imported under many kinds of specifications. It is necessary for use of these parts to execute many testing such as pressure test, isolation test, and sequence analysis, and to check reliability of these parts.

Consequently, control panel with international standard is proposed to be imported from Japan.

7) Water meters

Water meters from a third country will be procured by the Project, since there are no meters manufactured in Kenya.

8) Equipment for water quality analysis

There are no manufacturers of this equipment in Kenya and imported ones are available in Kenya, but stocks are significantly limited. From the view point of quality and timely deliveries of equipment, standardized product in third country or Japan will be procured.

9) Elevated distribution tank made of steel

Elevated distribution tank made of steel is commonly used in Kenya, and produced by local companies, but there is a problem on quality, especially on leakage due to manual coating. To improve quality of elevated steel tank, it recommended applying galvanizing method for coating of steel panels made in Kenya.

10) Aqueduct

Steel pipe beam produced in Kenya will be procured for the Project.

The following construction materials are available in Kenya:

Material	Kenya	Japan	Third Country	Reason
Material related to intake weir	○			Available in Kenya
Material related to raw water main	○			Available in Kenya
Material related to treatment works	○			Available in Kenya
Steel pipe for water supply	○			Available in Kenya
PVC pipe for water supply	○			Available in Kenya
PE pipe for water supply	○			Available in Kenya
Equipment for water supply	○			Available in Kenya
Steel material	○			Available in Kenya
Reinforcement bar	○			Available in Kenya
Sand and gravel	○			Available in Kenya
Cement	○			Available in Kenya
Concrete admixture	○			Available in Kenya
Form	○			Available in Kenya
Timber	○			Available in Kenya
Alum	○			Available in Kenya
Chlorine agent	○			Available in Kenya
Soda ash	○			Available in Kenya
Fuel	○			Available in Kenya
Oil and fat	○			Available in Kenya
Coating material	○			Available in Kenya

(2) Construction Equipment and Machinery

General contractors in Kenya have their own equipment and machinery excluding special ones, and there are dealers selling imported equipment, but there are no leasing companies in Kenya. However, it is possible to lease equipment from contractors.

The construction equipment and material will be procured by lease agreement with contractors in Kenya.

The following table summarizes the availability of construction equipment in Kenya:

Equipment	Specification	Classification			Procurement Method
		Kenya	Third Country	Japan	
Back-hoe	0.4, 0.2, 0.1m^3	○			Lease
Bulldozer	15t	○			Lease
Dump truck	4t	○			Lease
Truck with crane	4t	○			Lease
Truck with crane	15t	○			Lease
Plate compactor	80 to 100kg	○			Lease
Concrete mixer	0.1m^3	○			Lease
Motor type concrete vibrator		○			Lease
Reinforcement bar bender	up to 32mm	○			Lease
Air compressor	3.7 to 6.9 m^3/min	○			Lease
Water lorry	6KL	○			Lease
Passenger car	1600/2000cc	○			Lease
4WD car	Land cursor	○			Lease
Pick up truck	1t	○			Lease
Engine generator	15 to 200KVA	○			Lease
Engine welder	230 to 350A	○			Lease
Submersible sand pump	2” to 4”	○			Lease
Concrete hand breaker	20kg	○			Lease
Pick hammer	8kg	○			Lease
Electric tools		○			Lease
Chain block	2 to 15t	○			Lease

3.1.6 Implementation Plan for Soft-component Scheme

(1) Background

The 8th National Development Plan aims to enable peoples to access safe and stable water supply system. Based on this national plan, Development Plan of Meru Central District for a period from 1997 to 2001 gives the first priority on the improvement of Meru water supply. However, the project has not been implemented due to lack of finance and the Government of Kenya requested the Government of Japan to assist the

implementation of the project under the Grant-Aid Scheme.

The JICA, responsible agency for Grant-Aid, judged that the DWO had capability not enough to realize self-sufficient and sustainable operation of Meru water supply, even if the facilities are rehabilitated by the Grant-Aid Scheme. Also, the JICA concluded to assist the implementation of the Project under the condition that an autonomous body should be transferred before the commencement of the Project.

Under this background, the soft-component scheme is proposed to be executed in the Project, for the purpose of capacity building of an autonomous management body.

(2) Objectives of the Soft-component Scheme

The objectives of the scheme are to strengthen management capability of the management body and to supply safe and stable treated water in the Project Area.

(3) Goal of the Soft-component Scheme

1) Management system of the body

- Establishment of operation and management system,
- Improvement of connection rate to Meru water supply,
- Improvement of revenue collection amount and rate, and
- Sustainment of self-self-sufficiency of the management body.

2) Operation and maintenance

- Reduction of UFW by replacement of the existing deteriorated pipeline,
- Realization of water supply with good quality and sufficient quantity
- Improvement of technology in installation, reading and repairing of water meters, and
- Improvement of quality of treated water by provision of appropriate chemical feeding facilities by the Project.

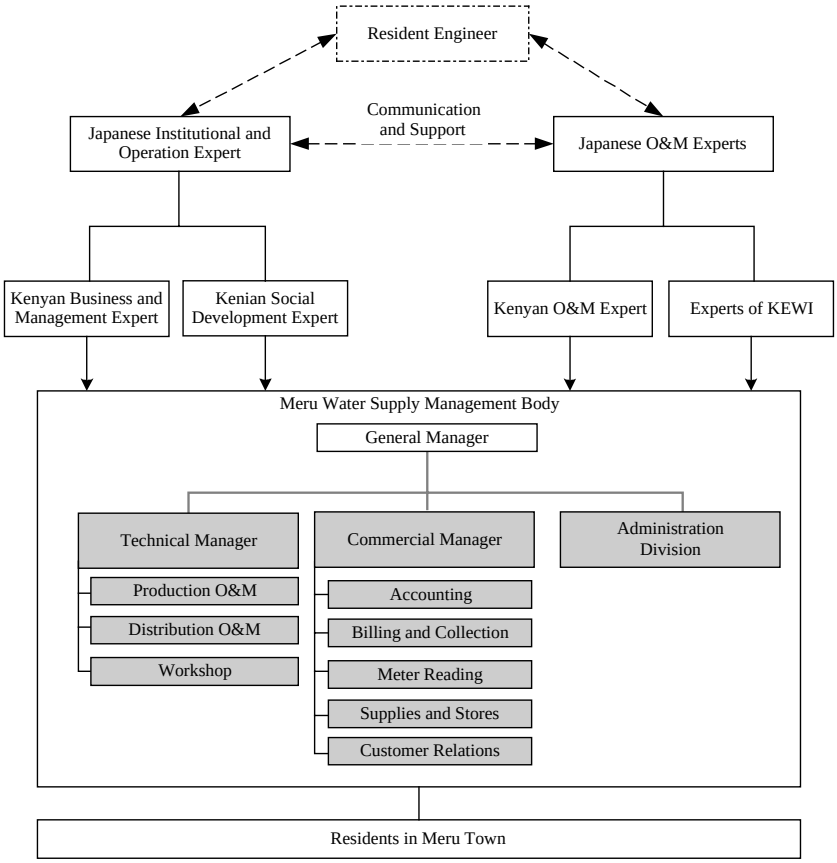
3) Improvement of sanitary condition in Meru Town

- Drinkable water supply with a reasonable price, and
- Decrease of water-borne decease.

(4) Activities

1) Organization

Organization structure for implementation of soft component scheme is shown in the right-hand figure.



2） Activities

The followings are the main issues of the activities to be executed by the soft-component scheme:

2-1) Management of progress of activities

This soft-component scheme requires combining many local resources such as local consultants, the Kenyan Water Institute, and others, and managing these resources, effectively and timely. To perform this requirement, Japanese consultant for organization and operation is planned to be responsible for this role.

2-2) Support for establishment of management system

A general manager, a technical manager, a commercial manger, and administration manager are expected to be employed from specialists in these sectors, but they are not always active and effective at the initial stage for realization of self-sufficient management body. Therefore, it is necessary to input an expert, who has experience with operation of water supply companies or companies in other sectors, to assist these managers.

Also, the scope of soft-component scheme assists the management body in preparation of documents such as business plan, financial plan, job description, and so on, which are indispensable for operation of the body. It is necessary to carry out this work under proper advice of Japanese expert and Kenyan institutional and financial experts.

It is necessary for operating the management body to organize systems for accounting, information management, revenue, customers relationship, personnel affairs, and so on. Especially, it is required to review the current revenue system including invoicing of water tariff and revenue collection and to implement new revenue system for developing new customers. To achieve this requirement, it is necessary to input supports of the soft-component scheme.

The mentioned support is planned to be made by a Kenyan consultant for operation and management, taking into account supply area and served population, numbers of staff, and business plan in Meru water supply.

2-3）Customer service

Technical support for installation of service pipes

The management body will replace all the existing meters, which are not functioning, with new meters to be provided by the Project. In parallel with this work, leakage and necessity of improvement for these service pipes are required to be investigated. Also, it is required for the body to cope with increase of customers and its service pipes. Furthermore, service pipes are expected to be installed by customers under the technical supervision of the management body.

In order to cope with these works, the soft-component scheme will input Japanese and Kenyan engineers to prepare design and construction manual and to train staff of the management body through on-the-job works

Survey on the existing customers in Meru Town

The existing customers are not classified into categories such as commercial shops, factories, apartment, and individual houses. All the customers are defined as common user and the same revenue system has been applied for these customers. Information on customers are indispensable, in order to establish a new system.

Social survey in expansion areas

It is necessary to estimate potential users for making these potential users to customers in the expansion areas. To perform this work, collection of information on residents such as income, current water resource for drinking, and so on is necessary for planning.

Public participation and education in expansion area

It is expected that most of residents in this area, who has taken water from the community water supply schemes, will change their drinking water source from it to tap water of Meru water supply after completion of the Project.

In order to realize this expectation, a pamphlet describing merit of using tap water, revenue system, and so on will be prepared and distributed to these residents, as well as education to these residents through discussion with staff of the management body.

Organizing residents for communal use of tap water in expansion area

It is considered that communal use of a water tap is more realistic than individual use in Meru Town. To expand this type of customers, it is necessary to establish grouping of residents, to prepare the rules for communal use including revenue collection, and to instruct residents in operation and maintenance of taps, meters, and pipes.

Organizing residents for water kiosk in expansion area

It is considered that some residents in the expansion area may require water kiosk supply system. However, the water kiosk system have several problems on water leakage due to inappropriate operation and maintenance, personal use ignoring the rules, expensive water charge, etc. In order to mitigate these problems, it is required to prepare the agreed rule or regulation between residents for use of water kiosk system.

2-4） Operation and Maintenance

Technical transfer to operators of Meru water supply system

A general manager and a technical manager are expected to be employed from specialists in water supply sectors, but they are not always active and effective at the initial stage for realization of self-sufficient management body. Therefore, it is necessary to input an expert, who has experience with operation of water supply companies or companies in other sectors, to prepare operation manual, and to assist these managers.

Staff training on technical aspect

It is required for operators to have know-how and technology for integrated operation and maintenance. Training course of the KWI on operation and management technology will be effective to train staff of the management body and will be held

once a year. Issues for training are; 1) operation of pumping facilities; 2) chemical feeding facilities; 3) leakage detection by using pressure meter; 4) installation and management of water tap; 5) inspection of water meters; 6) operation and maintenance of pipeline; and 7) water quality analysis.

Especially, the KWI has already opened these courses. Actual contents of the courses will be discussed in detail with the Japanese experts.

2-5） Monitoring on Operation of Management Body

The soft-component scheme will implement monitoring the operation situation of the management body such as; 1) finance and accounting; 2) customer services; 3) revenue system; and 4) operation and maintenance of facilities; following to initial instruction and education stage.

2-6） Direction of Strengthening of Management Body and Issues to be Executed

In final stage of the soft-component scheme, the experts will prepare the final report including evaluation of performance on operation and maintenance of the management body, and recommendation on direction of strengthening of management body and issues to be executed.

4） Implementation Schedule

The soft-component scheme shall be executed for 24 months. Major support work of planned activities are as shown in the under mentioned table.

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Work Items	Assistance at Setting-up of Management Body									Engineering and Operational Support for Extention of Supply									O&M for Constructed Facilities					
	Education of O&M Technology									Monitoring and Evaluation of Performance of Management Body, and Recommendation on Firther Strengthening														
	Improvement of Billing and Collection, including Meter Installation																							

(5) Output of Planned Activities

Output of the planned activities in the soft component is summarized in Table 3.1, together with responsible divisions.

Figure 3.1 shows implementation schedule for the soft-component plan for the Project.

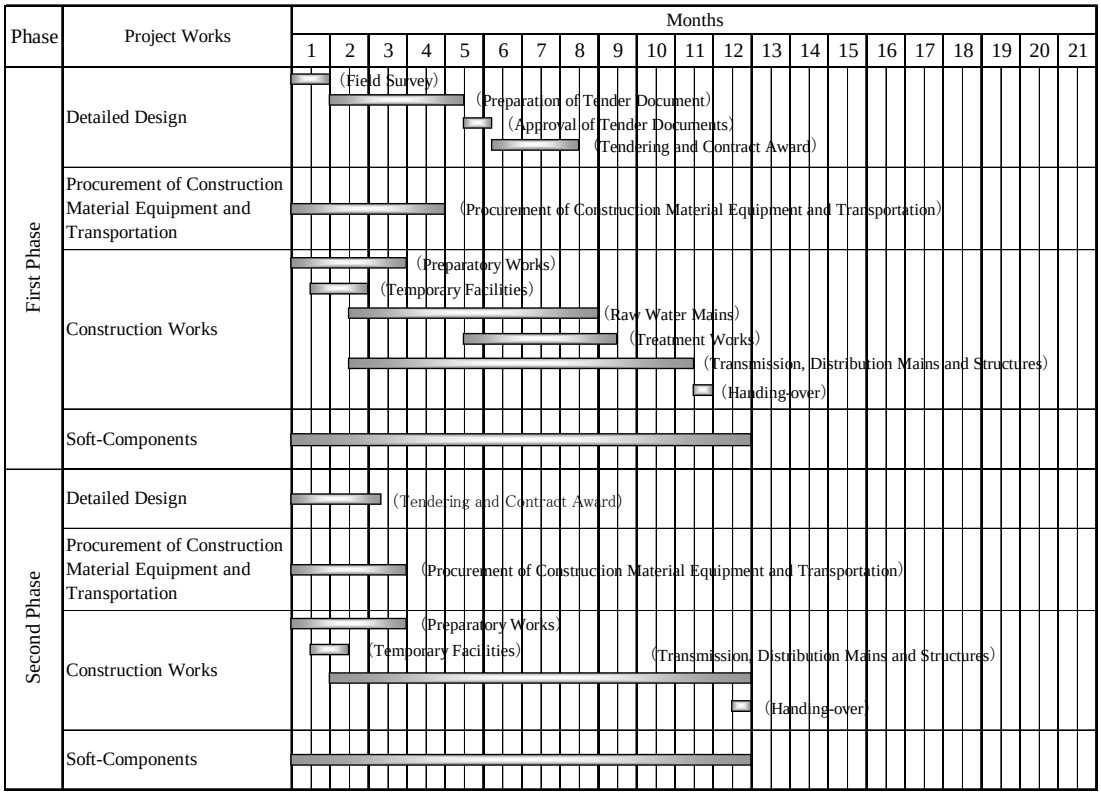
3.1.7 Implementation Schedule

(1) Implementation Schedule

This Project will be executed by dividing into two phases; the first phase for construction works of the raw water mains, the treatment works, and transmission and distribution pipelines in the high level zone; the second phase for transmission and distribution pipeline of the other supply zones. The soft-component scheme will be executed for 24 months from detailed design stage until operation and maintenance period. The required months for each work are as follows:

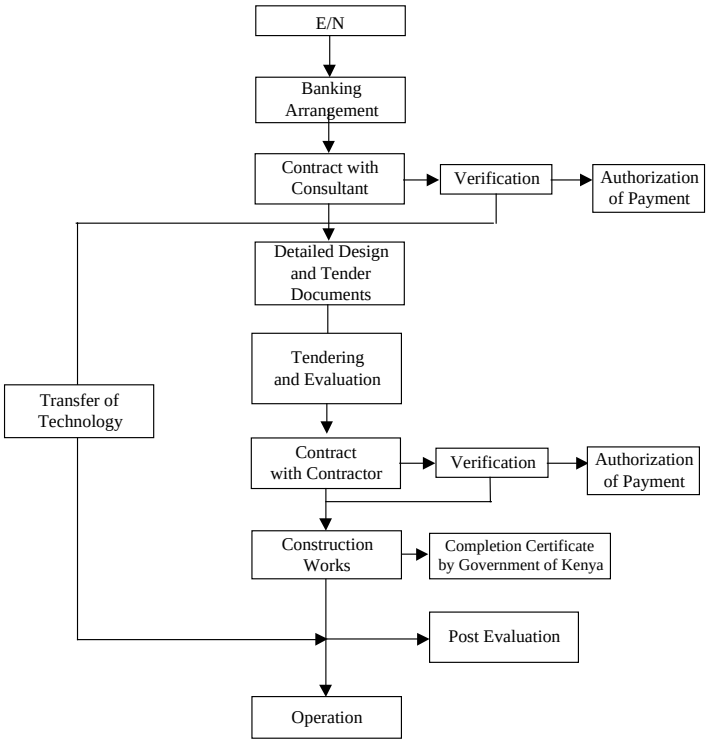
Description	First Phase	Second Phase
Detailed Design	4.0months	—
Tendering	3.0 months	3.0 months
Construction works	10.5 months	12.0 months
Performance testing	0.5 months	0.5 months
Soft-component scheme	12.0 months	12.0 months

Based on the Grant-Aid System, the work schedule of the Project is prepared as follows:



(2) Implementation Procedures in the Grant-Aid System

This Project will be implemented on the basis of procedures in the right side figure.



3.1.8 Undertakings of the Government of Kenya

Undertakings of the Government of Kenya are drafted as follows:

(1) Provision of data and information required for implementation of the Project,

(2) Securing of land for execution of construction works of the Project,

(3) Opening of an account in the name of the Government of Kenya in an authorized foreign exchange bank in Japan, and issuance of authorization of payment,

(4) Exemption of Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts,

(5) Accordance of Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified contracts,

(6) Ensuring all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant-Aid,

(7) Permission required for implementation of the Project,

(8) Use of the facilities constructed and equipment purchased under the Grant-Aid properly and effectively and assignment of staff necessary for operation and

maintenance, as well as bearing all the expenses other than those covered by the Grant-Aid,

(9) Operation and maintenance of facilities and equipment after completion of the Project, and

(10) A burden of the expenses other than those of the Government of Japan, as follows:

1) Cutting of trees for construction works of the proposed pipeline and compensation,

2) Installation of meters to be provide by this Project, supply of chemical material for water quality testing, provision of treated water for testing of constructed pipes, electric supply for pumping equipment at testing of the rising main and control panel, arrangement of water supply during switching the existing pipes to new constructed pipes, and so on,

3) Provision of storage or places for equipment and tools for operation and maintenance,

4) Provision of counterpart personnel for execution of the soft-component scheme,

5) Obtaining permissions from agencies concerned for construction works, and

6) Land preparation for construction works of the Project.

3.2 Required Financial Arrangement of the Government of Kenya

The required cost for the Government of Kenya under the Grant-Aid of Japan is estimated as follows:

Description		Application	Thousands Sh
1.	Land acquisition	Land acquisition and compensation for total area of 310 m^2 per 10 break pressure tanks	73
		Land acquisition for distribution tanks, storage yards, and project office at public school ground or lands, including open space of DWO	Permission from the related agencies
		Public roads for construction of pipes	Same as above
		Spoil bank	Same as above
2.	Cutting trees along the roads	Permission of owners and costs for cutting of trees and compensation	300
3.	Installation of water meters	Securing of responsible counterpart and technicians of new management body	O&M cost
4.	Construction works	Fences around break pressure tanks and distribution tanks	1,650
5.	Soft component	Starting up cost for autonomous management body	2,000
		Total	4,023

3.3 Operation and Maintenance Cost

The MENR has transferred an autonomous management body with the Board of Trustee for Meru water supply until March 2001. This management body will be responsible for operation and maintenance for the constructed facilities and provided equipment.

The operation and maintenance costs for Meru water supply are estimated, including future increase of staff, treated water production and its cost, as follows:

Cost Items	Operation and Maintenance Cost (thousands Sh)					
	2000	2001	2002	2003	2004	2005
Income						
Revenue	9,112	17,576	19,153	22,096	25,240	28,723
Rental Charge		48	576	1,230	1,575	1,768
Total of Income		17,624	19,729	23,326	26,815	30,491
Expenditures						
Personnel	4,719	8,111	11,503	11,848	12,204	12,570
Electricity	37	1,476	2,915	3,003	3,093	3,400
Chemical	355	2,063	3,772	3,885	4,002	4,401
Mobile	633	416	200	206	212	219
Material	978	1,089	1,200	1,236	1,273	1,311
Meter	0	0	0	6,190	1,379	1,379
Others	0	490	980	1,318	1,108	1,164
Interest	0	0	0	483	725	242
Total of Expenditures	6,722	13,645	20,570	28,170	23,996	24,686
Balance	2,390	3,979	-841	-4,844	2,819	5,805

Chapter 4 Project Evaluation and Recommendation

Chapter 4 Project Evaluation and Recommendation

4.1 Project Effect

The Project aims to supply tap water for the Project Area with good quality and sufficient quantity through improvement and expansion of the existing water supply facilities and creation of self-sufficient management body for Meru water supply.

The effect of the Project is planned as follows:

(1) Improvement of Water Supply Capacity

Meru city suffers from water deficiency caused by deterioration of the water supply system, leakage due to the deterioration, illegal water tapping and increased water demand associated with the increase in population. Since May, 2000 it has been forced to resort to time rationing, operating only 8 hours per day. A decrease in the development budget has caused delays in expansion of the water supply network and the city is faced with severe water shortages.

Implementation of the Project will alleviate the water shortage for a population of 51,000 in Meru and its surroundings, and provide sufficient distribution capacity up to the projected demand for the year 2005.

(2) Improvement of Public Health in Meru Town

According to water quality analysis for tap water, fecal coliform and bacteria were identified from samples taken, and high turvidity was also detected.

Chemical dosing and chlorination are planned to be carried out completely during implementation and operation and maintenance period of Project, with transferring these technologies to operators of the management body through the soft component scheme. Therefore, hygiene conditions in Meru Town are expected to be improved by this good quality of treated water supply by Meru water supply.

(3) Increase in Served Population

The Project will contribute to an increase in the population served from 14,000 at present to 51,000 people (individual connection: 30,600 people, community water supply: 20,400 people) by year 2005.

Also, the Project will support the Government to transfer the autonomous management body for Meru water supply, through the proposed soft-component scheme under the Grant Aid of Japan. This autonomous body should further improve the water supply condition in the Study Area by realization of development of water supply facilities planned by this Study.

(4) Establishment of Sustainable Meru Water Supply

The MENR is carrying out preparatory works for establishment of the Meru Water Supply and Sewerage Services as an autonomous management body by July 2001. This body will operate and maintain the existing water supply facilities in Meru Town. This body is assumed to procure most of staff from the staff of DWO, who has insufficient technology and know-how for operating the existing water supply facilities. Therefore, services to be provided by the body may satisfy needs of customers in Meru Town.

These situations of the management body need technical support to establish self-sufficient body with well-organized staff for operation and maintenance of the water supply facilities. Taking into account this need, the Study has proposed the implementation of the soft component scheme in the Project.

After implementation of the Project, the high un-accounted for water (UFW) of 65 % will be reduced to 30 %. Hearing survey carried out in the Study identified willingness of the community water supply schemes in the Study Area to pay for tap water with drinkable and stable water. This survey also identified that the residents had expensed Ksh. 500/month on average for boiling their community water for drinking. Based on the survey result, it is expected that they could pay water tariff converting part of boiling cost to payment for water, and that operation and maintenance costs would be covered by the revenue from the customers in Meru Town.

From the above-mentioned, sustainability of Meru water supply will be secured by revenue to be collected.

4.2 Recommendation

The Project will contribute to realization of drinkable and stable water supply to peoples of 51 thousands in the Project Area, as one of basic human needs, as well as diffusion of public water supply. Therefore, the Project is desired to be implemented by the Grant Aid Scheme of Japan.

Furthermore, the following will make the implementation of Project smooth and effective:

(1) Execution of Preparatory Works for Establishment of Meru Water Supply and Sewerage Services

The MENR is planned to transfer operation and maintenance of water supply facilities to Meru Water Supply and Sewerage Services, which is scheduled to transfer in March 2001 and start services in July 2001.

Technical support of the Project is scheduled to start in July 2001 and therefore, the MENR has been requested to complete the preparatory works for transferring the management body for Meru water supply. This becomes one of key issues for smooth and effective implementation of the Project under the Grant Aid Scheme.

(2) Securing of Staff on Autonomous Management Body

The management body, which is scheduled to start services in July 2001, needs employment of managers of the management body. They have important roles such as decision making in preparation of business plan at initial stage, and giving instruction and direction to their staff in daily operation, and so on. Improvement of revenue collection rate dominates sustainability of the Project. As one of measures for completely achieving this target, awareness and understanding of residents for the Project, especially billing and collection based on metering system, is essential and therefore, education for these residents are one of important activities of the Project.

During the preparatory works of the MENR, it is required to establish organization structure of the management body taking into account these important activities and to secure appropriate staff and budget in the management body.

(3) Proper Implementation of Obligation of Government of Kenya and Provision of Budgeting

Proper execution of obligations of the Government of Kenya is indispensable for smooth implementation of the Project. However, annual budget for development of water supply facilities in the government has been decreased and therefore, the Counterpart Fund is one of prospective budgets for implementation of the Project and initial operation of the management body.

During implementation of the Project, the MENR is requested to coordinate with the Ministry of Finance and Planning and to timely use this Fund for the Project.

Tables

Table 3.1 Output for Planned Activities in Soft Component Scheme

Activities	Responsible Section	Contents of Activities	Output and Reports	Input
a) Management of progress of activities	• General manager and managers	• Accumulation of know-how on provision of criteria and evaluation of management	• Report	• Japanese Institutional and financial Expert
b) Support for establishment of management system	• General manager and managers	• Accumulation of know-how on Long- and short-term business plan	• Business plan	• Japanese Institutional and financial Expert • Kenyan Institutional Expert • Kenyan Operation and Financial Management Expert
• Accounting • Information • Water tariff • Billing and collection • Customer services	• Accounting • Billing and Collection • Meter reading • Supplies and stores • Customer relations	• Preparation of accounting note and balance sheet of management body • Establishment of database for customer's information • Preparation of inventory of material and equipment • Establishment of regular meter reading • Timely execution of billing and collection • Establishment of water tariff system • Smooth execution of connection of new customers • Reduction of required time for solving problems	• Manual • Accounting note • Customer's information note • Inventory of material and equipment • Inventory of facilities • Water tariff system • Invoicing Records • Collection records • Inventory of new customers	• Japanese Institutional and financial Expert • Kenyan Operation and Financial Management Expert • Kenyan Institutional Expert • Kenyan Public Participation Specialist
• Personal affairs	• Administration	• Securing numbers of staff required for O&M • Execution of evaluation of performance of staff	• List of staff • Evaluation report on staff	• Kenyan Operation and Financial Management Expert
c) Customer Services				
• Social survey in expansion area	• Customer relation • Meter reading	• Increase of customers	• Regulation of communal use of water tap	• Kenyan Public Participation Specialist
• Survey on classification of existing customers	• Customer relation • Meter reading	• Establishment of database for customer's information	• Report	• Kenyan Public Participation Specialist
• Education and public participation of residents	• Customer relation • Meter reading	• Public awareness on necessity of public water supply facilities	• Pamphlet	• Kenyan Public Participation Specialist
• Organizing residents for communal use of water tap	• Customer relation • Meter reading	• Increase of communal water taps	• Regulation of communal use of water tap	• Kenyan Public Participation Specialist
• Organizing residents for use of water kiosk system	• Customer relation • Meter reading	• Increase of water kiosk	• Regulation of use of water kiosk	• Kenyan Public Participation Specialist
d) Operation and maintenance				
• Technical support for technical managers • Preparation of O&M manuals for intake, raw water main and treatment works • Instruction and recommendation for O&M for intake, raw water main and treatment works	• Production O&M	• Planning and execution of O&M • Accumulation of know-how and technology on O&M of intake, raw water main and treatment works • Accumulation of know-how and technology on water treatment	• O&M plan • O&M manual	• Japanese O&M Expert (Water Supply Facilities)
• Technical support for technical managers • Preparation of O&M manuals for distribution network • Instruction and recommendation for O&M for pipeline • Instruction for design and construction of service pipes	• Distribution O&M	• Planning and execution of O&M for distribution network • Accumulation of know-how and technology on distribution pipes • Execution of design, construction and O&M with appropriate manner • Accumulation of technology on repairing meters	• O&M plan • O&M manual	• Japanese O&M Expert (Water Supply Facilities)
• Training course on operation of pumping facilities	• Production O&M	• Improvement of technology for operation of pumping facilities	• Training Report	• KEWI expert
• Training course on chemical feeding facilities • Training course on water quality analysis	• Production O&M	• Improvement of technology for treatment works	• Training Report	• KEWI expert
• Training course on leakage detection	• Distribution O&M	• Improvement of technology for leakage detection	• Training Report	• KEWI expert
• Training course on installation and management of water tap • Training course on inspection of water meters • Training course on O&M of pipeline	• Distribution O&M	• Improvement of technology for transmission and distribution	• Training Report	• KEWI expert
e) Monitoring of Management Body				
• Operation situation • Customer services • Water tariff • Operation and maintenance of facilities	• General manager and managers	• Evaluation of yearly and semi-yearly target	• Business plan • Annual report	• Japanese Institutional and financial Expert • Kenyan Operation and Financial Management Expert • Japanese O&M Expert • Kenyan O&M Expert
f) Direction of strengthening of management body and issues to be executed	• General manager and managers	• Preparation of long- and mid-term business plan	• Long- and mid-term business plan	• Japanese Institutional and financial Expert • Kenyan Operation and Financial Management Expert • Japanese O&M Expert • Kenyan O&M Expert

Figures

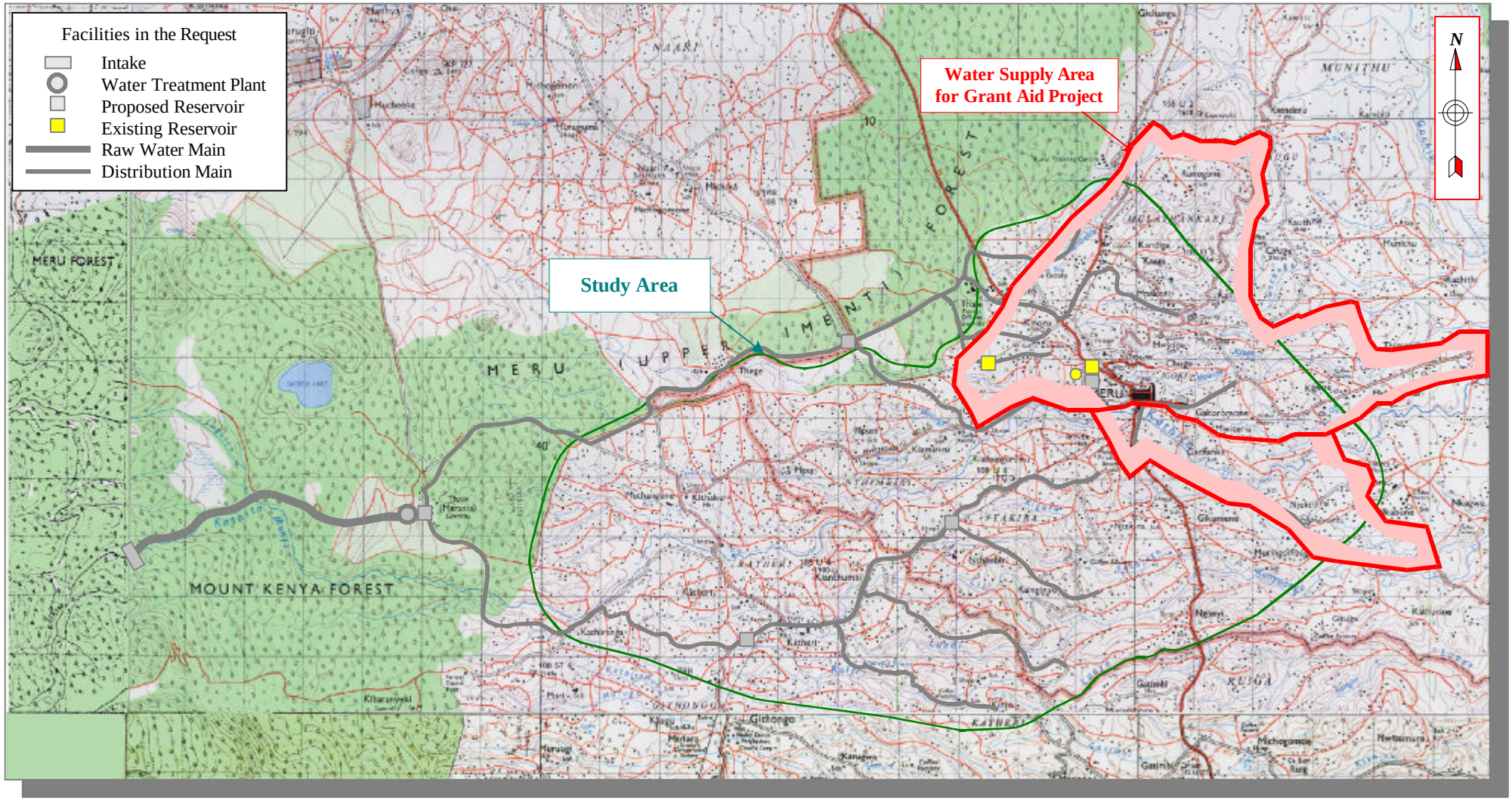


Figure 1.1 Location Map of Originally Requested Project

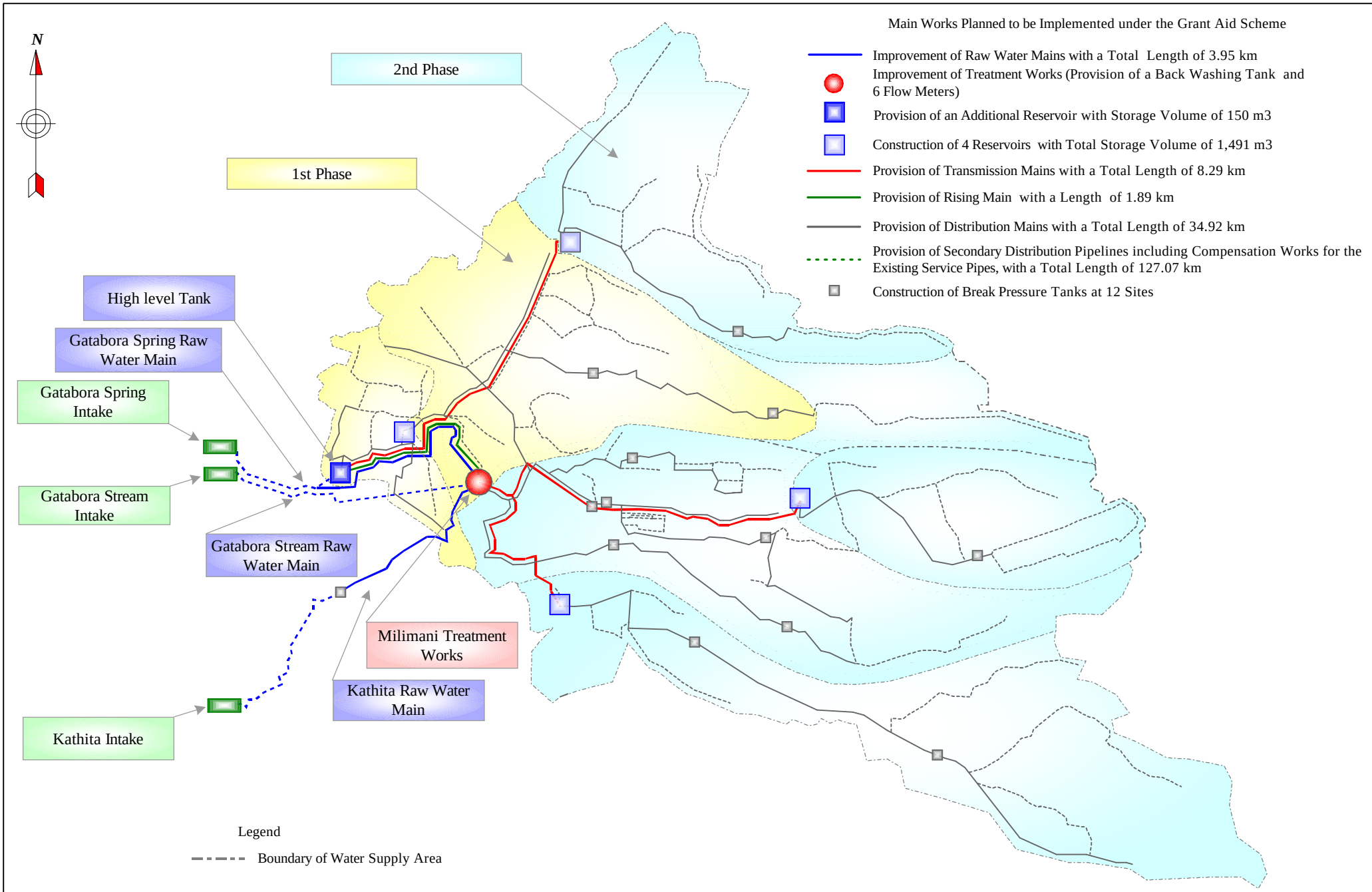
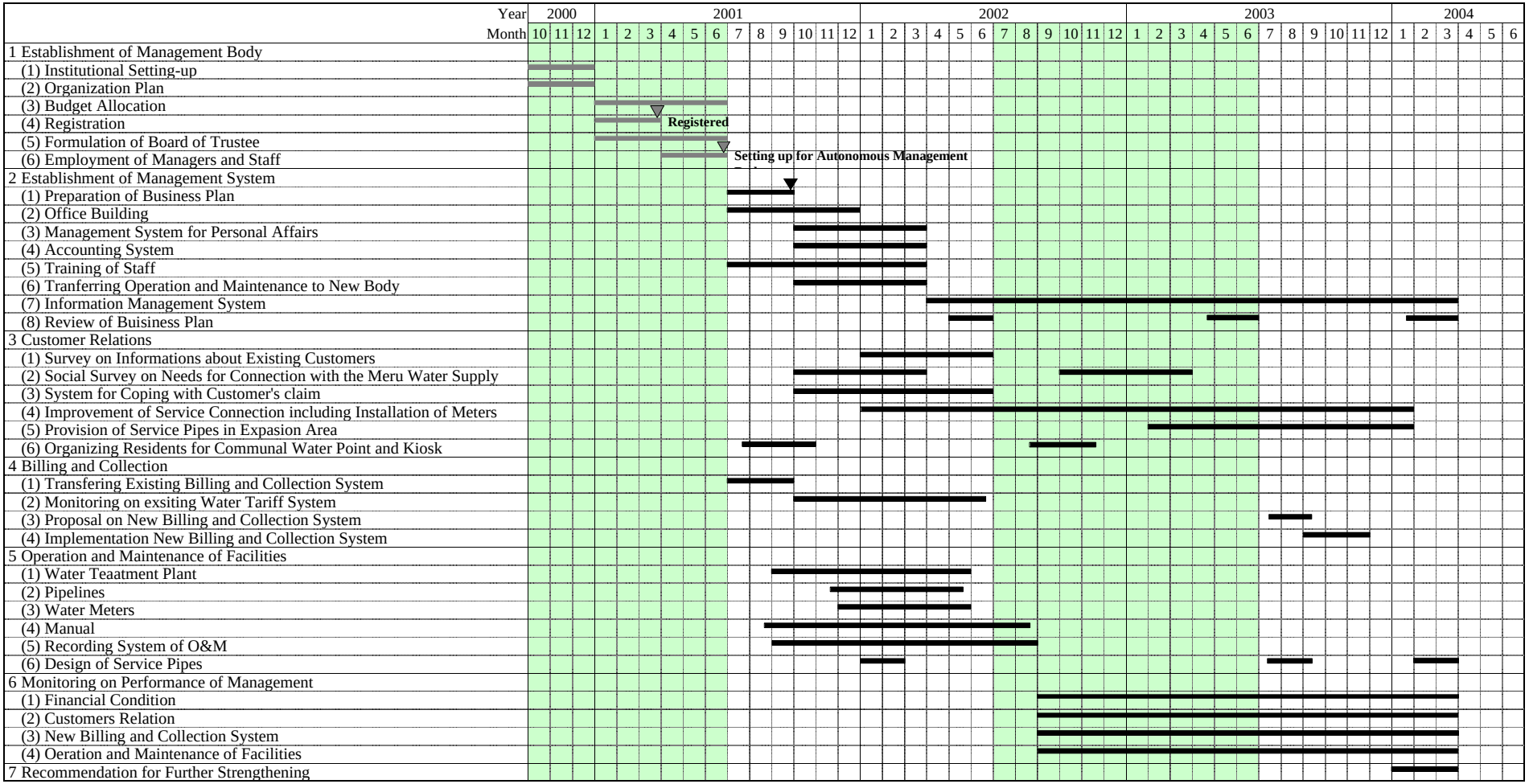


Figure 2.1 General Layout Plans for Improvement Works of Meru Water Supply

Transferring Autonomous Schedule of Management Body and Implementation Plan of Soft-component



Note: Under-mentioned expert shall be input for assistance to the autonomous management body properly.

1. Japanese Institutional and Operation Expert
2. Japanese O&M Expert (Water Supply Facilities)
3. Kenyan Operation and Financial Management Expert
4. Kenyan Institutional Expert
5. Kenyan O&M Expert (Water Supply Facilities)
6. Kenyan Social Development Expert

Figure 3.1 Implementation Plan for Soft-component Scheme