11.4 INITIAL ENVIRONMENTAL EXAMINATION

11.4.1 PROJECT DESCRIPTION

(1) Project Title

"The Study on the Rural Water Supply in Tabora Region in the Republic of Tanzania"

(2) Relevant National Plans

Rural Water Supply in Tabora Region is an official development scheme in accordance with:

- Poverty Reduction Strategy Paper 2004-2007
- National Water Policy (2002)
- Water Sector Development Programme (WSDP 2006)

(3) Purpose of the Study

The Study on the Rural Water Supply in the Tabora Region in the Republic of Tanzania (the Study) is to draw appropriate implementation plans of water supply facilities in the Tabora Region, which includes selection of appropriate villages to make the plans and the basic design of the facilities. The aim of the implementation plan is to raise water supply rate of the Tabora Region, which is one of the lowest in the country. The village location and topography are shown in Figure 11.4.1.

(4) The Undertakings of the Two Governments

The CWSD of the MoW is assigned as the counterpart organization by the Government of Tanzania, while the JICA is assigned as the official agency responsible for the implementation of the technical cooperation program of the Government of Japan.

(5) Study Process

The overall schedule of the Study is shown in a flowchart (Figure 11.4.2). The Study was commenced in August 2009 and completed in May 2011.

(6) Means of Water Supply

Types of water supply facilities and the process are as follows.

- "Level-2" facility: Installation of a new borehole and a pump, a water pipe to a surge tank, distribution pipes within the respective village, and to the village's public water taps.
- "Level-1" facility: Installation of a new borehole with a motor or a hand pump at the well, and concrete slab. The typical diagram of the facilities is shown in Figure 11.4.3.
- The Study does not suggest plans of water treatment facilities; however, there may be a case that plans on rehabilitation of existing water supply facilities are suggested.

The number of villages which have first priority is 20. The Number of wells and total length of distribution pipes vary according to a type of distribution of houses in a respective village (Table 11.4.1).

Table 11.4.1 Facility Types for Village Settings

Population to be served	Dwelling type	Type of Water Supply Facility		Maximum Discharge	Well Diameter	No. of Well	Depth
< 2,500	All types*	Level-1 (Hand Pump)		0.72m^3/hour	4"	Depending on the population	80m
2,501 - 3,000	Linear	Level-2	A type	6m^3/hour	6"	1	80m
	Clustered**			6m^3/hour	6"	1	80m
	Concentrated or Mixed			6m^3/hour	6"	1	80m
3,001 - 5,000	Linear		B type	6m^3/hour	6"	2	80m
	Clustered			6m^3/hour	6"	2	80m
	Concentrated or Mixed			6m^3/hour	6"	2	80m

* Including "other" and "Scattered" which has population more than 2500 people
** Scattered groups of houses

(7) Specifications of Level-2 Facility

Specification and function of typical Level-2 facility is shown in Table 11.4.2; and Level-1 facility is shown in Table 11.4.3.

Table 11.4.2 Specifications for Typical Level-2 Facility

1. Time period of water consumption: 6 hours (from 6:00 to 9:00a.m. and 3:00 to 6:00p.m.)		
2. Design Flow Daily average flow Daily maximum flow Hourly maximum flow	Daily average flow = Daily water demand + Distribution losses Daily maximum flow = Daily average flow x 110% Hourly maximum flow = Daily maximum flow / 6 hours	
3. Distribution Losses	25% of Daily average flow	
4. Facilities	Specification	
Intake facilities	Water source	Deep well
	Daily operation hours	Average: 10hours (=600 min) Maximum: 12hours (=720 min)
	Capacity (m^3/min)	Daily maximum flow (m^3/day)/ 10 hour/day
	Type of pump	Submersible pump (Centrifugal pump)
	Power source	Generator (diesel engine with generator)
Transmission Line	Design flow	Daily maximum flow (m^3/day)/ 10 hour/day
	Method of water supply	Pressure flow
	Material of pipes	PVC pipe
	Earth covering depth	0.9 m (minimum)
Storage tank (Distribution tank)	Capacity (m^3)	Daily maximum flow (m^3/day) x 50%(60 or 100 m^3)
	Type of tank	Elevated Tank (10 m)
	Low water level	G.L. +10.50 m
	No. of tank	1 tank / scheme
	Material of tank	Reinforced concrete
Distribution Line	Design flow	Hourly maximum flow
	Method of water supply	Gravity flow
	Material of pipes	PVC pipe
	Earth covering depth	0.9 m (minimum)
Public water point (PWP)	Number of tap per PWP	One tap per PWP
	Maximum number of user	250 persons per tap
	Water head at PWP	5～25 m
	Maximum distance of access	Around 400 m from household

Table 11.4.3 Specifications for Typical Level-1 Facility

1. Design Flow Maximum Discharge	0.72 m^3/hour/borehole (maximum)	
2. Facilities Hand Pump	Specification	
	Water source	Deep well
	Daily operation hours	Average: 10 hours (=600 min) Maximum: 12 hours (=720 min)
	Pump head	90 m (maximum)
	Maximum number of user	250 persons per hand pump
	Maximum distance of access	Around 400 m from household

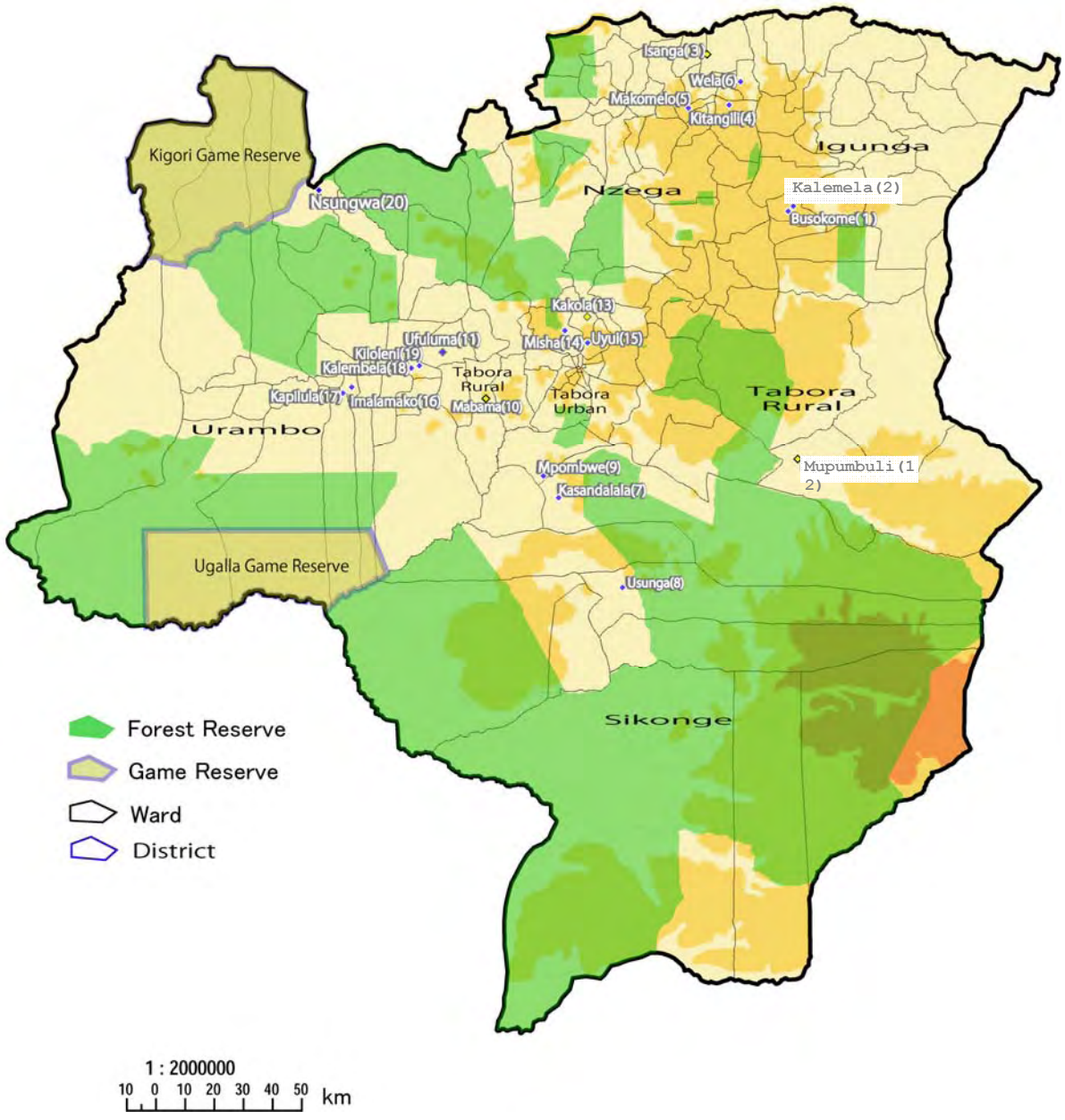

FIGURE 11.4.1 PROJECT SITE MAP

THE STUDY ON RURAL WATER SUPPLY IN TABORA REGION	JICA

Period	Phase	Works in:	Contents of Work	Outcome Report
AUG 2009	Phase 1	Japan	*Preparation	Inception Report
		Tanzania	*Existing data review *Field survey	Progress Report
			*Study on Groundwater development potential *Water demand estimation *Water supply plan formulation *Selection of priority project and villages	
MAR 2010			* Implementation of Initial Environmental Examination	Interim Report
MAY 2010	Phase 2	Tanzania	*Candidate village survey *Detailed groundwater investigation *Confirmation on priority villages *Detail survey of topography and geology *Information gathering on collection of cost, procurement, and conducting of construction works	
			* Technical Assistance for acquiring Environment Permission	
MAR MAR		Japan	*Preliminary Design for priority projects *Formulation of construction and equipment procurement plan *Cost Estimation *Formulation of soft component plan *Evaluation of priority project	
APR 2011		Tanzania	*Discussion on Draft Final Report	Draft Final Report
MAY 2011		Japan	*Preparation and Submission of Final Report	Final Report

Figure 11.4.2 Study Flow

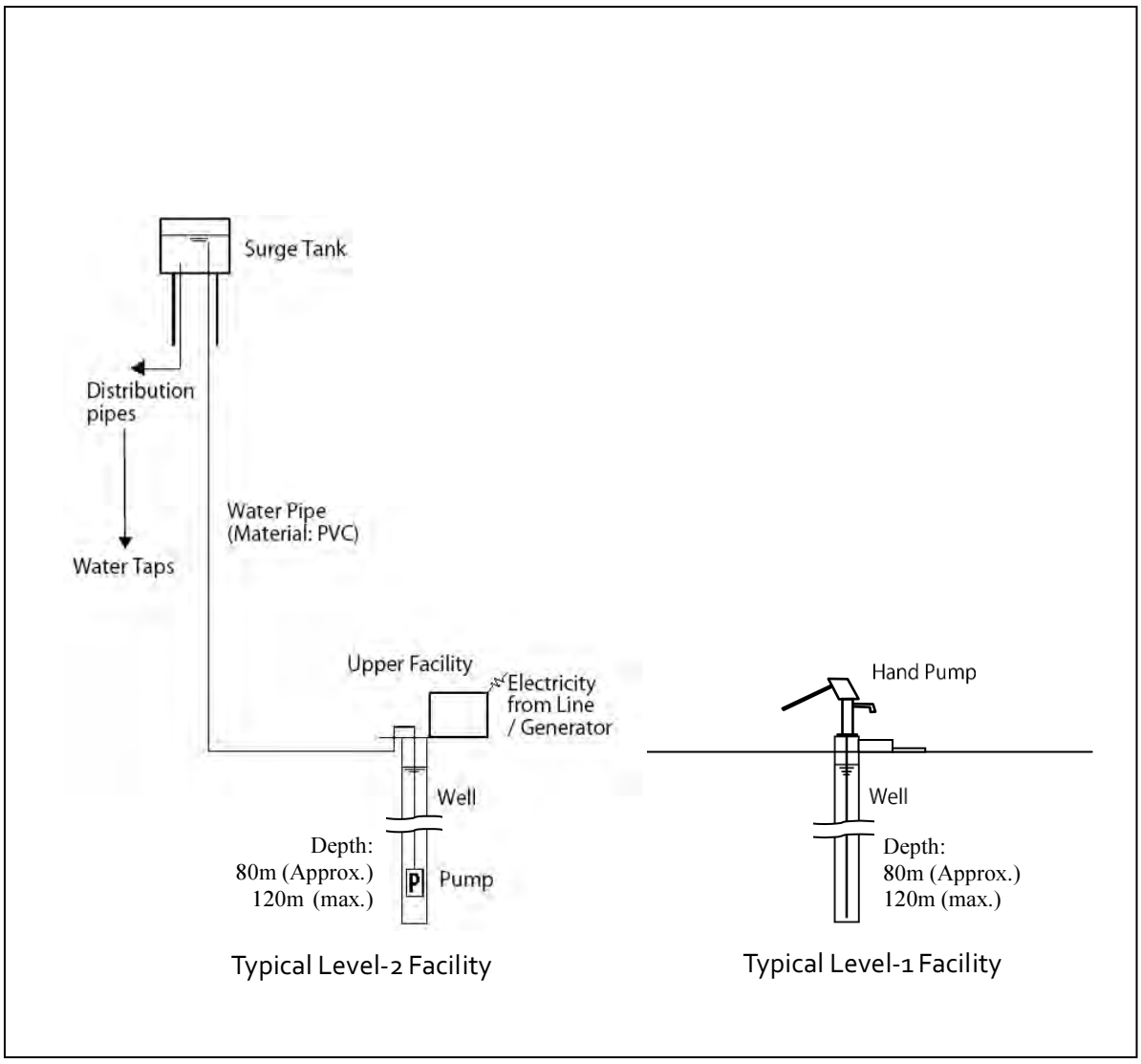

Figure 11.4.3 Typical Water Supply Facilities

11.4.2 SITE DESCRIPTION

(1) Location

Sites were selected from all Districts and Municipality in the Tabora Region: five (5) Districts (Igunga, Nzega, Sikonge, Tabora Rural and Urambo) and one (1) Municipality (Tabora Municipality). 20 villages were selected for priority projects. Selection works was conducted in the course of study.

(2) Distance to the Nearest Residential and/or Other Facilities

Taps are intended to be installed in proximity to residential areas, not further than 400 meters from any household (in accordance with WSDP), in respective towns or villages.

(3) Water Supply Statuses and Characteristics of the Catchment Areas of Tabora Region

The elevation of the Tabora Region is about 1,000 to 1,300 m, and most of the areas are fairly flat. The rivers, flow through the gently sloped topography, and most of them get dried up in June, July, August, and the beginning of September (during the dry season). The river courses, in most cases,

are not linear but flow through a wide area. Those areas are utilized for cultivation and attract farmers for living in the nearby area. In the central part of Tanzania where the Tabora Region is situated, Precambrian Archean plutonic rocks and metamorphic rocks are widely distributed. The possibility of finding abundant ground water is known to be very low in an area with such geologic characteristics. Houses are built in high density in town and village centers; on the other hand, in the rural areas, houses are scattered in wider areas or built in line along the village road. Water supply statuses are as follows.

- Water supply coverage in the region is 49.1% whereas the national goal for 2010 is 65%.
- Among all the water supply systems in the region, 32 out of 51 (62.7%) of Level-2 facilities, and 765 out of 1,431 facilities (53.5%) of Level-1 facilities are not functioning.
- Almost 60% of the population is suffering from water-borne diseases.
- NGOs, such as Africare and WaterAid are working on the water supply sector in the Tabora Region

11.4.3 IMPLEMENTING INITIAL ENVIRONMENTAL EXAMINATION

(1) Environmental and Social Consideration Check List

The environmental and social impact on the specific sites of the proposed Level-1 and Level-2 facilities is assessed by the Study team together with Acting Regional Environmental Officer, Mr. Shadrack Wilson Yomba (Table 11.4.4). Before summarizing the impact, the results of Tanzanian format ESMF was completed, and District Water Engineers of respective Districts confirmed the results. In addition, the JICA format was utilized to check the appropriateness of the project implementation. Regional Water Expert, Mr. Sosthenes Muhibo Lubasa checked aspects of all the items of the format.

Table 11.4.4 IEE Check List

	S/N	Impacts	Const-ruction	Opera-tion	Description
Social Environment	1.	Involuntary Resettlement	D	D	Although the distribution pipes will be laid under land for public use in most of distance, temporary use of limited agriculture land* (w=3m) is required for construction uses. However, the construction works will take place only in dry season, in which there is no cultivation, and the land is recovered to the agricultural land after the construction. Hence the impacts on income means and harvesting will not be expected or negligibly small. Land acquisition will not be necessary; however, if land acquisition would be necessary due to delay of construction works, it is confirmed by village council that substitute agricultural land (with the same size and productiveness) will be provided. It is not difficult to find substitute agricultural land almost every where around the village where grassland and bush are common. *Right of cultivation is not granted from the state government, but admitted as village customary agricultural practice.
	2.	Local economy such as employment and livelihood	D	D	There would be some job opportunity provided to locals by water users' groups. They rather have positive impacts on local economy. Water venders will receive some impacts, but they are not selling drinking water only. There are always demands for their water elsewhere.
	3.	Land use and utilization of local resources	D	D	No adverse impact is expected on land use and utilization of local resources, but positive impacts by installation of water supply facility such as increasing of the land value are expected.
	4.	Local communities and decision-making institutions	D	D	No negative impact is expected on local society. Because formulation of community organizations for operation and maintenance of water supply facilities are planned, and the regulations on amount of water tariff, the collection ways of collection will be determined by the villagers.
	5.	Existing infrastructures and services	D	D	Some traffic disturbances are expected when construction of burying pipes which crosses a village road; however, the impact is minimum because there is almost no paved road in the all the project sites and the works will be done in extremely short period of time.

	S/N	Impacts	Const-ruction	Opera-tion	Description
	6.	The poor/ indigenous/ ethnic minority/ women/ children	D	D	Highly positive impacts are expected for women and children by saving their time for water fetching and spend the time for other productive work.
	7.	Misdistribution of benefit and social cost	D	D	The same with above "4".
	8.	Historical/ cultural heritage	D	D	The sizes of water supply facilities are small; and, it is movable in proximity area so it does not interfere with historical/ cultural heritage.
	9.	Local conflict of interests	D	D	The facility will be managed by village water committee or water users group. According to the District officials, there were no conflict over water supply facilities and therefore no impact on local interest is expected by a new facility.
	10.	Water usage, Water rights, Communal rights	D	D	Since water supply facility will provide water, there would be highly positive impact on water usage of the community. The facility will contribute to the respective village as a whole because the distribution is managed by village water committee or water users group.
	11.	Sanitation	D	D	Water quality is checked by 29 parameters in test drilling phase. The facility allows amount of water supply for sanitation use. It gives highly positive impact to the community health.
	12.	Health Hazards/Risk, Infectious Diseases such as HIV/AIDS	D	D	Public health and sanitation condition will be improved by improving accessibility to clean water. HIV/AIDS problem will not occur at water facility installation work.
Natural Environment	13.	Important/ valuable geographical and geological features/ resources	D	D	There is no such place in Tabora Region. No impact is expected.
	14.	Soil erosion	D	D	No soil erosion is expected by installation and use of water supply facility.
	15.	Amount and quality of groundwater	D	D	There would be no negative impact on quality of groundwater by installation and operation of the facility. Since the facility will be built at the site only with sufficient amount of ground water, verified by analysis by water recovery tests during test drillings, depletion of water in boreholes are not expected
	16.	Amount of natural reservoir/ flow	D	D	For ground water use, since the depth of well is about 80 meters (150m at maximum), draw down has small relationship with surface flow if the topography of Tabora is considered. Therefore extracting deep ground water has almost no impact on the flow rate of river at the surface.
	17.	Coastal zone	D	D	There is no coastal area in Tabora Region.

	S/N	Impacts	Const-ruction	Opera-tion	Description
	18.	Flora, Fauna, Biodiversity	D	D	Game Reserve or Forest Reserve is excluded from the project area (fringe of subject village may across the forest reserve limit in some case). A new installation of water supply facility has positive effect on forest reserve for preventing encroachment of the villagers who might come in to a forest reserve for fetching otherwise.
	19.	Meteorology/ climate	D	D	There is no plan of large scale construction or facility as to give negative impact on the climate.
	20.	Aesthetic landscape	D	D	There will be no large scale facility that may affect surrounding landscape.
	21.	Global warming	D	D	Diesel motor pumps emit CO_2; however, there would be no large scale generators to be installed as to give negative impact on global warming.
Pollution	22.	Air pollution	D	D	There will be some exhaust emission from trucks and machineries during the construction work, and diesel generator emits exhaust gas, which contain SOx and NOx gases, but the size is small and operation period is short. Therefore impacts on air are negligible.
	23.	Water pollution	D	D	Water pollution during construction phase is avoidable with the proper supervision of work. There is no waste water discharge from the facilities during operation.
	24.	Soil contamination	D	D	Falling down of oil some droplets from heavy machineries is expected in during construction phase, which is negligible impact; and there is no soil contamination occurs during operation phase.
	25.	Solid waste amount increase	D	D	Although excavated soil becomes construction waste, it is properly disposed in routine manner. There is no solid waste produced by water supply facility during operation phase.
	26.	Increase of noise and vibration	D	D	Since heavy machineries will be operated during construction phase, noise and vibration will occur; however, the duration is limited. There is no complains reported by neighbors, according to the District officers.
	27.	Ground level subsidence	D	D	The capacities of pump motors are extremely smaller, compare to those causes ground subsidence. There is no case reported from all the districts.
	28.	Offensive odor	D	D	There would be no source of odor at the water supply facility.
	29.	Sedimentation	D	D	There is no sedimentation on river bed or reservoir bed occurred by installation of the water supply facility.
	30.	Increase of Accidents	D	D	There is no circumstances provoke accidents, by installation of the facilities according to all District officials.

Grade:
A: Serious impact(s) is (are) expected
B: Less serious impact(s) is (are) expected
C: Impact not known without further research
Note: Progress of project itself may reveal the impact (further research is not necessary, in this case)
D: Negligible impacts are expected or no impact is expected

(2) The Impact in the Constructional Phase

Although there will be some negative impact, such as heavy machinery noise and CO_2 emission, the work period lasts within a month at a site since the facility has a simple structure and the size is small. Therefore, the impact on the environment during construction is considered to be negligibly small.

Obstruction of traffic may occur if a distribution pipe is to cross a village road; however, the burying works can be done within an hour.

Excavated soil from the borehole could become waste material without proper disposal. The proper disposal of soil is included in the routine construction works.

(3) Impact in the Operational Phase

If deep groundwater is in the form of fracture media type, which is the common form in the Tabora Region, continuous extraction of large volume of groundwater may or may not decrease the groundwater level, depending on the characteristics of the fractures.

11.4.4 CATEGORIZATION

The facilities planned in the Study are likely to have minimal or little adverse impact on the environment and society, according to our environment and social impact survey with a responsible officer of the Tabora Region to all the sites with characteristics of the project site: the Project shall be classified as "Category C".

11.4.5 ALTERNATIVES FOR BOREHOLES

Groundwater development in the Tabora Region is being studied mainly by the Study Team; however, other alternatives are also concerned. The alternatives are: rain harvesting, surface water diversion, construction of a reservoir, recycling of water, and no action. All of the alternatives are technically not applicable, except "no plan", which contradicts national plans. Among them, constructing reservoirs has the most adverse and large-scale impact on the natural and social environment. The reasons for each alternative are shown in Table 11.4.5.

Table 11.4.5 Alternatives for On-Going Plan

	Types of Facility	Issues for Implementation including Environmental Impacts in this Project
Alternative-1	Rain Harvesting	Absolute quantity of rain is much smaller than needed For instance, 1,000 mm of rainfall (average in Tabora Region) is utilized by a family of six (6) under 35 m^2 of roof can collect only 44% of their water needs (25 L/person/day).
Alternative-2	Surface water diversion	There is a period of no rain in Tabora: June, July, August and half of September, according to statistics. Most of the rivers would lose surface flow in the period. The need for water is maximized during this season.
Alternative-3	Construction of	Topography of Tabora Region is remarkably flat in most of the

	reservoir (Dam/Embankment)	area. In general, the embankments in flat areas become long and high compared to the same volume of a reservoir in an "appropriate" dam site. The dam volume becomes increasingly large as the crest length as a consequence, the cost would be high. There are local small scale reservoirs, called *charco* dams The water quality is evaluated low by the residents. The price is 300 Tsh whereas river water is sold at 500 Tsh in Nzega, for example. In addition, the evaporation rate would be high in the shallow and large reservoir some *charcoal* dams are not able to hold water throughout the year (*i.e.* Urambo *Charco* dam). Moreover, the existing lowland in the region is used for agricultural use and living area for the farmers. Relocation works are expected to be extremely difficult and provide little gain for the small volume of the reservoir. Hence it is not a very practical alternative.
Alternative-4	Recycling of water (Purification of Effluents)	A water treatment facility requires frequent maintenance and chemicals for purification, and an operator with appropriate skills on a day-to-day basis. Therefore the operation and maintenance of water purification facilities are deemed not easy for most of the villages technically and financially.
Alternative-5	No Facility	Halting efforts to provide adequate quantity and quality of water contradicts: National Water Policy (2002), Poverty Reduction Strategy Paper 2004-2007, and Water Sector Development Programme (WSDP 2006)

11.5 PRELIMINARY ENVIRONMENTAL ASSESSMENT

Government of Tanzania has prepared sectoral environmental impact guidelines. The Ministry of Water is also trying to conduct environmentally and socially sound projects through implementing the ESMF, described in 11.3.2, since May 2008. A project proponent is obligated to submit a report complying with the guidelines and to receive an approval from the respective office. The Regional Environment Officer and the Study team surveyed all the planned sites after the points were confirmed, and made an ESMF screening report. A monitoring plan, for appropriate operation and maintenance of the facility, was formulated with consent of the Regional Government and District Water Engineers. JICA formatted checklist, was completed by the Regional Water Expert.

11.6 ENVIRONMENTAL AND SOCIAL CONSIDERATION SCHEDULE ONWARD

Facility design and their specific locations in priority villages are designated in Phase I and the beginning of Phase II. PEA on each one of the facilities was conducted by the Tabora Regional Secretariat with support of the Study team in accord with ESMF. The report of the PEA was submitted to the EIA division of MoW at the end of November. MoW reviewed the PEA report, and evaluated the project as "Category C". Since EIA process under NEMC is not required for "Category C" projects, further evaluation of environmental impact assessment in Tanzania is waived (Figure 11.5.1).

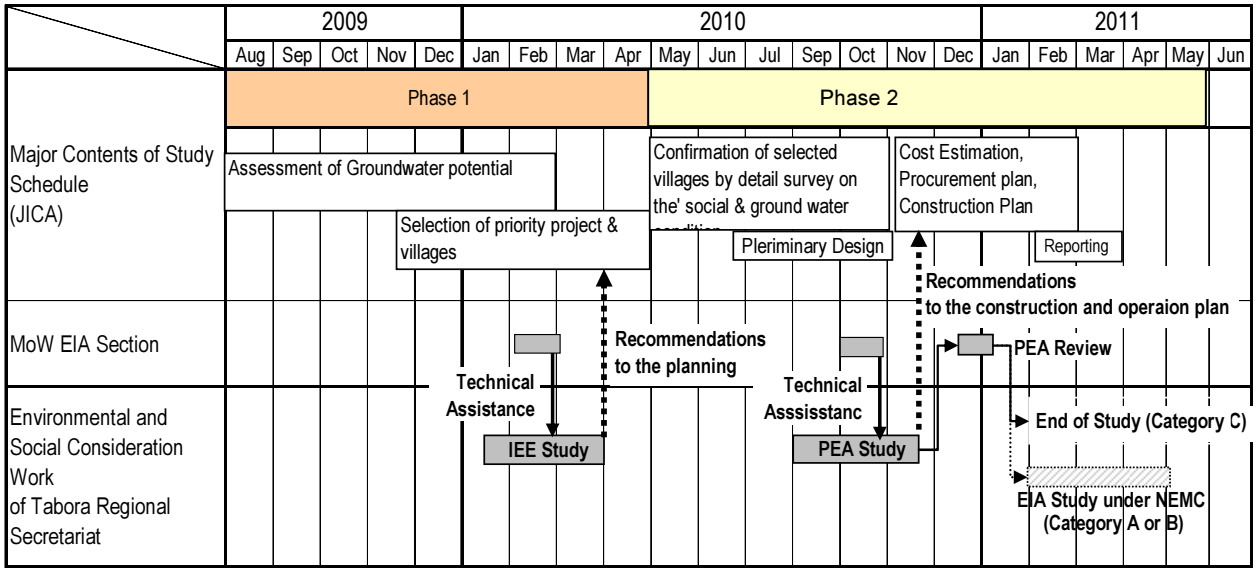

Figure 11.5.1 Environmental and Social Consideration Implementation Schedule

CHAPTER 12 EVALUATION OF PRIORITY PROJECT

12.1 GENERAL

In this Chapter, the Priority Project is evaluated from the view points of (1) economic, (2) financial, (3) institutional and organizational, (4) management and maintenance, (5) political, (6) environmental and social aspects, and (7) technical appropriateness.

12.2 ECONOMICAL AND FINANCIAL EVALUATION

12.2.1 ECONOMIC EVALUATION

Economic feasibility of the priority project is assessed in this section, applying cost-benefit analysis based on the economic cost and benefit converted into the monetary value.

(1) Preconditions of the Evaluation

Factors considered in the evaluation are as follows:

1) The economic cost and benefit were estimated based on comparison of the cases of "with project" and "without project". In the "with project" case, the priority project is implemented in 20 villages and 114 numbers of Level-1 scheme (borehole fitted with hand pump) and 4 numbers of Level-2 schemes (small scale piped water scheme with domestic water points) will be constructed, while in the "without project" cases, it is assumed that the target communities will continue to use existing water sources without improved water supply.

2) The construction period is set in the three-year period to complete entire schemes (Level-1 and -2). Although the project target year is set at 2020, considering the durability of the schemes constructed under the Project, the economic life span of the water supply facilities are determined for 15 years for economic evaluation purposes.

3) The estimated cost and benefit of the priority project were converted from the current market prices which were used for financial evaluation, into the economic prices using the discount rate of 12%.

4) The foreign exchange rates of USD 1.0 = Tsh 1,435 were applied for currency conversion.

5) Net Present Value (NPV), Benefit/Cost Ratio (B/C Ration) and Economic Internal Rate of Return (EIRR) were calculated to be used as the indicators of the economic evaluation.

(2) Economic Cost

Composition considered as the economic costs are listed below:

1) Investment costs for construction works and engineering services, which is estimated on national (local) bases.

2) Replacement cost of pumps, power sources, pump house, raising main, distribution pipe, and domestic water points for Level-1 scheme, as well as hand pump set for Level-1 scheme.

3) Operation, management and maintenance costs, and commission for COWSO management, of which basis of estimation is indicated in the following Tables.

Table 12.2.1 Basis of Operation and Maintenance Cost Estimation for Level-1

Cost	Item	Value（USD）/year
Maintenance Cost	Wage (Caretaker)	150
	Tools	10
	Material	40
	Spare parts	100
	Regular Maintenance of Hand Pump	50
Management Cost	Commission (Treasurer)	100
Replacement Cost		130
	Total	580

Source：Brikke, F (2001), Key factors for sustainable cost recovery, IRC, Netherlands

Table 12.2.2 Basis of Cost Estimation for Operation and Maintenance (Level-2)

Cost	Item	Approximation/Year
Operation Cost	Fuel/Electricity	Consumption in each scheme is estimated, market price (*1) is applied
	Chemical	Consumption in each scheme is estimated, market price (*2) is applied
	Wage and Allowance	
	Operator	100% of mean annual income / person in Tanzania (*3)
	Kiosk Attendant	25% of mean annual income / person in Tanzania (*3)
	Guards	80% of mean annual income / person in Tanzania (*3)
Management Cost	Commission for COWSO	
	Manager	100% of mean annual income / person in Tanzania (*3)
	Treasurer	100% of mean annual income / person in Tanzania (*3)
	Overhaul of Pump	3% of cost for pump
Maintenance Cost	Tools, Supply	10% of construction cost
	Spare parts	
	Regular Pump Maintenance	
Replacement		Construction cost ÷15 years

*1：Unit price of diesel: Tsh/litre, Unit price of electricity Tsh/Unit

*2：Unit price of chemical: Tsh/Kg

*3：Mean Monthly Income 620,136 Tsh/person（Household Budget Survey 2007, National Bureau of Statistics, Tanzania, 2009）

The Table 12.2.3 shows the estimated annual operation and maintenance cost, based on the assumption made in above, for 114 numbers of Level-1 facilities in total and each of Level-2 facility under the project.

Table 12.2.3 Operation and Maintenance Cost of the Priority Project

District/ Municipality	Ward	Village	Capital Cost (USD)	Operation and Maintenance Cost/Year (USD)											O&M Cost / Year (USD)
				Operation Cost					Management Cost				Maintenance Cost	Replace-ment	
				Fuel	Electricity	Operator	Caretaker	Guard	Sub-Total	Manager	Treasurer	Overhaul	Sub-Total			
Nzega	Lusu	Isanga	82,012		1,158	432	1,729	367	3,686	432	432	60	924	6,561	5,467	16,639
Tabora Rural	Kizengi	Mpumbuli	92,316	13,713		432	972	367	15,485	432	432	132	996	7,385	6,154	30,021
	Mabama	Mabama	142,119		2,932	432	2,161	367	5,892	432	432	219	1,083	11,369	9,475	27,820
Tabora Munic.	Kakola	Kakola	94,033	15,999		432	1,621	367	18,419	432	432	132	996	7,523	6,269	33,206
Sub-Total for Level 2			**410,480**	**29,712**	**4,090**	**1,729**	**6,482**	**1,469**	**43,482**	**1,729**	**1,729**	**542**	**3,999**	**32,838**	**27,365**	**107,686**
114 Number of Leval 1			**3,990,000**										**1,600**	**39,900**	**14,820**	**56,320**
Total			**4,400,480**	**29,712**	**4,090**	**1,729**	**6,482**	**1,469**	**43,482**	**1,729**	**1,729**	**542**	**5,599**	**72,738**	**42,185**	**164,006**

(3) Economic Benefit

As the economic benefit of the project, three factors listed below were considered. Findings from the detail socio-economic survey (JICA, 2009) and village inventory survey (JICA, 2009) as well as existing document and literature were utilized in making assumptions for conversion of the project effects into monetary value. The estimated economic benefit in annual per capita amount is indicated in Table 12.2.4.

Table 12.2.4 Estimated Economic Benefit

Item (Benefit)	Annual Amount / Capita (USD)	Percentage	Assumption
Time Saved for Fetching Water from Existing Source	45.1	80.0%	1) In order to obtain water from existing source 1.0 hour/day/household and 3.5 hours/day/household is spent in rain season (6 months) and dry season (6 months) respectively. 2) 50 percent of average household income (Tsh 180,000 or USD 125 / month) is applied to convert the time saved to money value (USD 125 X 50% / 20 working days / 8 hours= USD 0.39/hour/household). 3) Average household population is 7.0 persons (Socio-Economic Survey, JICA 2010) 4) USD 1.0 is equivalent to Tsh 1435.
Increase in Water Quantity to be Used	5.3	9.4%	1) Current average amount of water consumed for domestic use is 240 litre / household, while 40 percent of community demand additional 80 litre / household (Socio-Economic Survey, JICA 2010). 2) Amount of Willingness to Pay (WTP) for improved water supply service is Tsh 0.54 / litre (Socio-Economic Survey, JICA 2010) 3) Average household population is 7.0 persons (Socio-Economic Survey, JICA 2010) 4) USD 1.0 is equivalent to Tsh 1435.
Cost Saved in Medical Expense due to Public Health Improvement	6.0	10.6%	1) Tsh 10,000 /month /household is spent for medical care. 2) Average household population is 7.0 persons (Socio-Economic Survey, JICA 2010) 3) 50 percent of medical expense will be saved. 4) Average household population is 7.0 persons (Socio Economic Survey, JICA 2010). 5) USD 1.0 is equivalent to Tsh 1435.
Total	56.4	100%	

1) Time saved from fetching water from the existing water sources

According to the detailed socio-economic survey (JICA, 2010), target communities mostly rely on traditional water sources such as unprotected shallow well and dam/pond/stream. The survey also revealed that, in order to obtain water from traditional sources, a household spends in average in a day one (1) hours for six (6) months in rain season and 3.5 hours for six (6) months in dry season and other six (6) months in rain season in a year. The value of time saved by a household consequent to the improved water supply facilities is estimated by applying the mean household monthly income in the target communities obtained through detailed socio-economic survey (JICA, 2010), which amounts at Tsh 150,000 to 200,000, thus approximating at Tsh 180,000 for estimation purpose.

2) Increase in water quantity to be used by the users

In case that the improved water supply schemes are constructed by the project, it is expected that the volume of water supplied from the improved scheme and consumed by the target communities will increase. The value of this benefit is estimated from the amount of WTP of communities towards water demand for domestic use that can be satisfied by improved water supply schemes. Detailed socio-economic survey (JICA, 2010) indicates that current mean amount of water consumed per household amounts to 240 liter/day and 40% of households demands additional 40

liter/day/household, while mean amount of WTP for improved supply scheme is estimated at 0.41 Tsh/liter and Tsh 0.66 for Level-1 and Level-2 facility respectively, thus approximated at Tsh 0.54 for estimation purpose.

3) Cost saving for medical expense due to improved health status

According to the detail socio-economic survey (JICA, 2010) mean medical expenditure is 100,000 Tsh/household/month. The study assumed that 50% of the present medical expenditure will be saved, due to improved access to the safe water resulting in improved health status of households.

(4) Results of the Economic Analysis

As summarized in Table 12.2.5 below, NPV and B/C ratio indicate that the economic benefit will exceed the cost in case that the project is implemented. Moreover, EIRR is estimated at 18%, which suggests that the implementation of the project is economically viable. Table 12.2.6 shows flows of the economic cost and benefit during the evaluation period of the project.

Table 12.2.5 Summary of Results of the Economic Analysis

NPV	B/C Ratio	EIRR
USD 3,762,466	1.77	18%

Table 12.2.6 Economic Cost and Benefit Flow

Unit: USD

Year		Target Population	Cost (C)			Benefit (B)				(B)-(C)	Discount Rate: 12%		
			Capital Cost	O&M Cost (Inc. Replacement)	Sub-Total	Time Saved	Increase in Water Quantity	Decrease in Medical Expenditure	Sub-Total		Cost	Benefit	NPV
0	2012	29,773	440,048		440,048				0	-440,048	440,048	0	-440,048
1	2013	30,952	2,640,288	82,003	2,722,291	698,406	164,619	184,237	1,047,262	-1,675,029	2,430,617	935,056	-1,495,561
2	2014	32,180	1,320,144	82,003	1,402,147	726,121	171,152	191,548	1,088,821	-313,326	1,117,783	868,001	-249,781
3	2015	33,460		164,006	164,006	755,009	177,961	199,169	1,132,139	968,133	116,736	805,834	689,098
4	2016	34,795		164,006	164,006	785,123	185,059	207,113	1,177,295	1,013,289	104,229	748,192	643,964
5	2017	36,186		164,006	164,006	816,518	192,459	215,395	1,224,371	1,060,366	93,061	694,741	601,680
6	2018	37,637		164,006	164,006	849,251	200,175	224,029	1,273,455	1,109,449	83,090	645,172	562,081
7	2019	39,150		164,006	164,006	883,382	208,220	233,033	1,324,635	1,160,630	74,188	599,198	525,010
8	2020	40,727		164,006	164,006	918,976	216,609	242,423	1,378,008	1,214,002	66,239	556,554	490,315
9	2021	40,727		164,006	164,006	918,976	216,609	242,423	1,378,008	1,214,002	59,142	496,923	437,781
10	2022	40,727		164,006	164,006	918,976	216,609	242,423	1,378,008	1,214,002	52,805	443,682	390,876
11	2023	40,727		164,006	164,006	918,976	216,609	242,423	1,378,008	1,214,002	47,148	396,144	348,997
12	2024	40,727		164,006	164,006	918,976	216,609	242,423	1,378,008	1,214,002	42,096	353,700	311,604
13	2025	40,727		164,006	164,006	918,976	216,609	242,423	1,378,008	1,214,002	37,586	315,804	278,218
14	2026	40,727		164,006	164,006	918,976	216,609	242,423	1,378,008	1,214,002	33,559	281,968	248,409
15	2027	40,727		164,006	164,006	918,976	216,609	242,423	1,378,008	1,214,002	29,963	251,757	221,794
16	2028	40,727		164,006	164,006	918,976	216,609	242,423	1,378,008	1,214,002	26,753	224,783	198,030
Total			4,400,480	2,460,084	6,860,565	13,784,590	3,249,131	3,636,327	20,670,048	13,809,484	4,855,043	8,617,509	3,762,466
											B/C Ratio		1.77
											EIRR		18%

12.2.2 FINANCIAL EVALUATION

Full cost recovery for operation and maintenance is one of the most significant concerns in the scheme management. Alike similar rural water supply project that is implemented under grant aid schemes, the priority project under the Study does not aim at recovery of capital cost through charging water fee from user communities. Therefore, while in the financial analysis capital cost is excluded from the financial cost, it rather put emphasis on the sustainability and financial feasibility of the supply scheme after implementation, assessing financial benefit (i.e. scheme income through water fee collection) and financial cost (i.e. operation and maintenance cost, replacement cost, contingency, and risk for inflation).

(1) Preconditions of the Evaluation

Factors considered in the evaluation are as follows:

1) The financial cost and benefit were also estimated based on comparison of the cases of "with project" and "without project".

2) The construction period is set in the three (3)-year period to complete entire schemes (Level-1 and -2). Although the project target year is set at 2020, considering the durability of the schemes constructed under the Project, the economic life span of the water supply facilities are determined for 15 years for financial evaluation purposes.

3) The financial cost and benefit of the priority project are based on market prices, thus including cost to cope with inflation and contingency, using the discount rate of 12%.

4) The foreign exchange rates of USD 1.0 = Tsh 1,435 were applied for currency conversion.

5) NPV and B/C Ratio were calculated to be used as the indicators of the financial evaluation.

(2) Financial Cost

Composition considered as the financial costs are listed below:

1) Investment costs for construction works and engineering services are excluded from financial cost, assuming the priority project is implemented under grant aid schemes.

2) Operation, management and maintenance costs, of which basis of estimation is indicated in the following Tables.

3) Replacement cost of pumps, power sources, pump house, raising main, distribution pipe, and domestic water points for Level-1 scheme, as well as hand pump set for Level-1 scheme.

4) Inflation and risks are included in financial cost as such USD 6.6 per hand pump facility in Level-1 schemes and 5% of replacement cost for Level-2 scheme.

Table 12.2.7 Basis of Operation and Maintenance Cost Estimation for Level-1

Cost	Item	Value（USD）/year
Maintenance Cost	Wage (Caretaker)	150
	Tools	10
	Material	40
	Spare parts	100
	Regular Maintenance of Hand Pump	50
Management Cost	Commission (Treasurer)	100
Replacement Cost		130
Inflation and Risks		6.6
	Total	586.5

Source：Brikke, F (2001), Key factors for sustainable cost recovery, IRC, Netherlands

Table 12.2.8 Basis of Cost Estimation for Operation and Maintenance (Level-2)

Cost	Item	Approximation/Year
Operation Cost	Fuel/Electricity	Consumption in each scheme is estimated, market price (*1) is applied
	Chemical	Consumption in each scheme is estimated, market price (*2) is applied
	Wage and Allowance	
	Operator	100% of mean annual income / person in Tanzania (*3)
	Kiosk Attendant	25% of mean annual income / person in Tanzania (*3)
	Guards	80% of mean annual income / person in Tanzania (*3)
Management Cost	Commission for COWSO	
	Manager	100% of mean annual income / person in Tanzania (*3)
	Treasurer	100% of mean annual income / person in Tanzania (*3)
	Overhaul of Pump	3% of cost for pump
Maintenance Cost	Tools, Supply	10% of construction cost
	Spare parts	
	Regular Pump Maintenance	
Replacement		Construction cost ÷15 years
Risks and Inflation		5% of replacement cost

*1 : Unit price of diesel: Tsh/litre, Unit price of electricity Tsh/Unit

*2 : Unit price of chemical: Tsh/Kg

*3 : Mean Monthly Income 620,136 Tsh/person (Household Budget Survey 2007, National Bureau of Statistics, Tanzania, 2009)

The Table 12.2.9 shows the estimated annual financial cost, including operation and maintenance cost as well as replacement cost and contingency cost, based on the assumption made in above, for 114 numbers of Level-1 facilities in total and each of Level-2 facility under the project.

Table 12.2.9 Financial Cost of the Priority Project

District/ Municipality	Ward	Village	Capital Cost (USD)	Operation and Maintenance Cost / Year(USD)											O&M Cost / Year (USD)	Replacement Cost /15 yrs	Contingency Cost /
				Operation Cost						Management Cost				Maintenance Cost			
				Fuel	Electricity	Operator	Caretaker	Guard	Sub-Total	Manager	Treasurer	Overhaul	Sub-Total				
Nzega	Lusu	Isanga	82,012		1,158	432	1,729	367	3,686	432	432	60	924	6,561	11,172	82,012	273
Tabora Rural	Kizengi	Mpumbuli	92,316	13,713		432	972	367	15,485	432	432	132	996	7,385	23,866	92,316	308
	Mabama	Mabama	142,119		2,932	432	2,161	367	5,892	432	432	219	1,083	11,369	18,345	142,119	474
Tabora Munic.	Kakola	Kakola	94,033	15,999		432	1,621	367	18,419	432	432	132	996	7,523	26,937	94,033	313
Sub-Total for Level 2			**410,480**	**29,712**	**4,090**	**1,729**	**6,482**	**1,469**	**43,482**	**1,729**	**1,729**	**542**	**3,999**	**32,838**	**80,320**	**410,480**	**1,368**
114 Number of Leval 1			**3,990,000**										**1,600**	**39,900**	**41,500**	**222,300**	**741**
Total			**4,400,480**	**29,712**	**4,090**	**1,729**	**6,482**	**1,469**	**43,482**	**1,729**	**1,729**	**542**	**5,599**	**72,738**	**121,820**	**632,780**	**2,109**

(3) Financial Benefit

The amount of water fee collected from the user communities are only the source of income for the scheme management regarded as financial benefit. WTP and ATP is carefully examined in the Study. As it is observed in Chapter 8, WTP of the target communities are lower than the de-facto standard of Tsh 1.0 per liter, amounting at Tsh 0.41 and 0.66 per liter for Level-1 and Level-2 facility respectively (detail socio-economic survey, JICA 2010). However, it also revealed that, setting water fee at Tsh 1.0 per liter and assuming their water consumption at 25 liter/day/capita by average of seven (7) household members, ratio of expense for water in total household income amounts to 2.5 to 3.5%, which is less than the limit of 5% to assure their ATP for water. The rate of water fee shall be set with ATP, thus, in the financial assessment in the Study, unit water price is set in the same manner at Tsh 1.0 per liter, assuming the consumption of 25 liter/day/capita. The

analysis is also made, assuming that 80% of user communities pays water fee consuming 25 liter/day/capita.

(4) Results of Financial Evaluation

The Table 12.2.10 shows flow of financial cost and benefit over the project evaluation period. As it is shown in the table, amount collected as water fee exceeds significantly the cost of management, operation and maintenance as well as replacement of the water supply scheme with contingency, with estimated financial B/C rate at 1.26 and NPV amounting USD 236,742 on the assumption that 80% of user community consume 25 liter/day/capita and made payment for water fee set at 1.0 Tsh/liter. Thus, it can be concluded that the priority project could generate financial surplus, thus financially viable, in running and management of the scheme with realistic revenue collection ratio.

Table 12.2.10 Financial Cost and Benefit Flow

Unit: USD

Year		Target Population	Cost (C)					Benefit (B)	(B)−(C)	Discount Rate: 12%		
			Capital Cost	O&M Cost	Replacement Cost	Contingency	Sub-Total			Cost	Benefit	NPV
0	2012	29,773					0		0	0	0	0
1	2013	30,952		61,085		2,116	63,201	78,728	15,527	56,429	70,293	13,863
2	2014	32,180		61,085		2,116	63,201	81,852	18,651	50,383	65,252	14,868
3	2015	33,460		122,170		2,116	124,286	170,216	45,930	88,464	121,157	32,692
4	2016	34,795		122,170		2,116	124,286	177,006	52,720	78,986	112,490	33,504
5	2017	36,186		122,170		2,116	124,286	184,084	59,797	70,523	104,454	33,931
6	2018	37,637		122,170		2,116	124,286	191,463	67,177	62,967	97,001	34,034
7	2019	39,150		122,170		2,116	124,286	199,158	74,872	56,221	90,089	33,868
8	2020	40,727		122,170		2,116	124,286	207,183	82,897	50,197	83,678	33,481
9	2021	40,727		122,170		2,116	124,286	207,183	82,897	44,819	74,712	29,893
10	2022	40,727		122,170	317,365	2,116	441,651	207,183	-234,469	142,200	66,707	-75,493
11	2023	40,727		122,170		2,116	124,286	207,183	82,897	35,729	59,560	23,831
12	2024	40,727		122,170		2,116	124,286	207,183	82,897	31,901	53,179	21,277
13	2025	40,727		122,170		2,116	124,286	207,183	82,897	28,483	47,481	18,998
14	2026	40,727		122,170		2,116	124,286	207,183	82,897	25,431	42,394	16,962
15	2027	40,727		122,170	317,365	2,116	441,651	207,183	-234,469	80,688	37,851	-42,837
16	2028	40,727		122,170			122,170	207,183	85,012	19,929	33,796	13,867
合計			0	1,832,554			2,499,021	2,947,150	448,129	923,352	1,160,093	236,742
									B/C Ratio			1.26

12.3 INSTITUTIONAL AND ORGANIZATIONAL EVALUATION

Institutional and organizational setup proposed in the Study shall be evaluated taking into consideration on relevance, effectiveness and efficiency, and sustainability of the said institutional framework.

Institutional and organizational framework, proposed in the Institutional Plan (Chapter 7), is formulated considering its relevance to the set-up as envisaged by the National Water Sector Development Strategy (2006) and decentralized setup under Local Government Reform Strategy (2002). As emphasized by the National Water Sector Development Strategy, the following issues are mainstreamed into the principle in formulating Institutional and Organizational Plan of the Study; 1) Government's role will be limited to co-ordination, policy and guideline formulation, and regulation, 2) Regulatory and executive (i.e. service provision) functions will be separated, 3) Responsibility for executive functions will be decentralized to the lowest appropriate level, whilst balancing consumer representation/participation with economies of scale, 4) Regulatory function will be further separated from the prioritization and allocation of capital investment funds, 5) Autonomous entities will be established to manage water supply and sewerage services.

Relevance, efficiency, and sustainability is considered and the relevant key issues are incorporated into Institutional Plan of the Study, in particular the followings; 1) current and future institutional setup formulated under Water Policy (2002) and National Water Sector Development Strategy (2006), 2) decentralized functional responsibilities of each stakeholders in the water supply service delivery as set in the sector policy and strategies, 3) transition of the role of MoWLD from service delivery to the one of policy making, monitoring and regulation, 4) strategy to enhance COWSOs, which shall be legal entity, to own and manage water supply schemes, and 5) current approach to

increase private sector participation and contracting-out in the service delivery to increase efficiency and competency in the scheme running.

Formation of COWSO, which shall be autonomous legal entity and vested with ownership of the scheme management, establishment of DWST/MWST that provides technical guidance to the COWSO and conducts monitoring and regulation activities of COWSO and service providers, and introduction of contracting-out setting that enhance efficiency and competence in the scheme management, are all in line with the national strategies and aimed to ensure effectiveness, efficiency, and sustainability of the water supply service.

In addition to those, effectiveness, efficiency, and sustainability of the institutional and organizational setup in the scheme management is further ensured with the Management, Operation and Maintenance Plan, as explained more detail in the following section.

12.4 MANAGEMENT AND MAINTENANCE EVALUATION

Effectiveness and efficiency in the scheme management would be achieved through decentralizing of functions and responsibilities in management of the scheme to the lowest appropriate institution, developing capacity of COWSO and DWST/MWST in their technical and administrative skills, and enhancing private sector participation in operation and maintenance.

In the formation of COWSO, either WUA or WUG is recommended in the Institutional Plan. Those COWSO management options guarantee the legal status to own and manage the water supply scheme with development of regulations and by-laws. Where it deems necessary, education package for capacity building of COWSO on operation and maintenance is provided to enhance its competence and effectiveness in the management of the water supply scheme.

DWST/MWST, which is formed at district and municipality level among the departments involved in water development (district planning officer, water engineer, community development officer, health and sanitation officer, etc), ensures provision of technical guidance and monitoring to COWSO.

In order to make those institutional and organizational frameworks functional in effective and efficient manner, the Operation and Maintenance Plan also consider capacity development of each institution in their respective functions and responsibilities. Capacity Building Plan, formulated under the Management, Operation and Maintenance Plan, is developed with the main packages of; 1) advocacy and consensus building, 2) capacity building of DWST/MWST, 3) capacity building of COWSO, and 4) promotion of personal hygiene and sanitation practices. Implementation of these whole activities will create environment favourable to the introduction of proposed institutional framework composed of COWSO management, and DWST's technical guidance and monitoring, all of which would increase effectiveness and efficiency of the water supply scheme management.

12.5 EVALUATION FROM VIEWPOINT OF POLICY

MoW intends to increase water supply coverage to 74% in 2015 and 90% in 2025 in the rural area where water supply schemes are less developed. Although the Project is not a project by the basket fund under WSDP, the Project will assist WSDP to attain the target by implementation of the water supply plan formulated in the Study in the same manner of WSDP' concept. Therefore, implementation of the Project will contribute to realize the policy of MoW.

12.6 ENVIRONMENTAL AND SOCIAL EVALUATION

As described in Chapter 11, PEA on each one of the facilities is conducted by the Tabora Regional Secretariat with support of the Study team in accord with ESMF. The report of PEA was submitted to EIA division of MoW at the end of November. MoW reviewed the PEA report, and evaluated the project as "Category C". Since EIA process under NEMC is not required for

"Category C" projects, further evaluation of environmental impact assessment in Tanzania is waived.

12.7 TECHNICAL APPROPRIATENESS

The construction of the Priority Project are composed of drilling works, earthworks, pipe works, concrete works, mechanical/electrical works, deep well drilling and miscellaneous works. These works requires no special techniques. These will be carried out by conventional methods and machineries widely applied in Tanzania. Equipment and materials required for the Priority Project are generally procured in Tanzania, although some of them are imported from abroad such as EU countries, South Africa and Japan.

The evaluations of the technical appropriateness are examined on each component of the Priority Project. The results are shown in Table 12.7.1.

Table 12.7.1 Evaluation of Technical Appropriateness of Water Supply Plans

Item	Facility/Type	Evaluation Item	Evaluation of Approproateness
Intake (Level-2)	Deep well	Generator, Submersible pump	Easily inported: Appropriate
		Water quality	Treatment facility is not required: Appropriate
		Operation and maintenance	Easy: Appropriate
Intake (Level-1)	Deep well	Drilling of deep well	DTH and mud rotary method: Appropriate
		Casing/screen pipe	Easily purchased: Appropriate
		Hand pump	Easily purchased: Appropriate
		Operation and maintenance	Easy: Appropriate
Distribution Tank	Elevated Tank	Construction works	Conventional construction method: Appropriate
		Materials	Easily purchased: Appropriate
		Maintenance	Easy: Appropriate
Transmission and Distribution Lines	PVC・HDPE pipe	Installation	Conventional installation method: Appropriate
		Materials	Easily purchased: Appropriate
		Maintenance	Easy: Appropriate

CHAPTER 13 GIS AND DATABASE

13.1 GENERAL

In order to formulate the rural water supply plan, the socio-economic conditions, availability of water sources and environmental aspects are essential matters. Furthermore, the socio-economic conditions, the water resources conditions and the environmental conditions of the study area are always changing. Therefore, it is necessary to have reference to the latest reliable information on the rural water supply plan, and approach it from several different angles. The database for rural water supply planning is being processed using the above considerations in the Study. Again, it is carried spatial analysis out using various data by the Geographic Information System (hereafter referred to as "GIS") as well.

In this Chapter, the design of the created database and the analyses by GIS is described.

13.2 GIS AND DATABASE FOR THE STUDY

13.2.1 CONCEPT OF THE GIS AND DATABASE

Not only should the database system be accessed and deal with smoothly for the purposes of data collection, but also it is important to update the dataset periodically. Recently, most organizations have started to collect more detailed information to improve their database system since the requirement for water supply planning has shifted to a village level basis. Although the various kinds of information such as, socio-economic conditions, water resource conditions and environmental conditions are gathered and compiled into the database system, the other way around, the problem of an uncontrolled database are caused by utilizing database system under the lack of versatility software and a complicated system. Therefore, in the Study, the database was created by only MS-Excel as .xml format, based on the above concept.

Also, it is easier to understand a lot of data in the database by utilizing GIS for the spatial analyses, visually and sensuously, thus necessary for analyses from a multi-aspect perspective of the existing water supply scheme inventory survey and the socio-economic survey for the formulation of the water supply planning in the project by using GIS.

13.2.2 DESIGN OF THE GIS AND DATABASE

The collected data of the inventory survey and the socio-economic survey are classified into two (2) categories for each MS-Excel file; "Existing Water Supply Scheme Inventory Survey" and "Socio-Economic Survey", of which contents are listed in Table 13.2.1. Also, it adds new constructed wells by donors to the "Existing Water Supply Scheme Inventory Survey" database as updating. Basically, the database of the inventory survey was created that user can deal with easily and update periodically. Thus, it is only used the "Auto-filter" to filtrate what you want to see an information from the database and "Find" to search data quickly after users put highlight on an aiming column. Both functions are included in the toolbar in the MS-Excel file. In addition, for updating the database in the future time, it is only added rows or columns when users put new or updated information into the database, which is considered based on the easy user interface.

In the GIS data folder "Tanzania_arc1960", the data files for creating maps and results of analysis such as tables, polygons, polylines and point data are stored as shape files and dbf file. The folder of the "Map_file" stores "mxd" format data, which is possible to be opened and seen by Arc GIS software, powered by the ESRI, Inc.. Not only have base map files been saved in the folder, but also the study team prepares three (3) kinds of the resulting maps by the GIS analysis. 1) The groundwater potential map is created by the collected data from the existing reports, data sheets, data from the existing water supply inventory survey and the result of drilling wells by the Study

Team that were only used them if those data were available for the information of water level, yield and well depth. 2) It is added various information into the groundwater potential map to design the hydrogeological map. 3) It is combined the data of the simplified water quality analysis on the field and the results of water quality analysis for being drilled well by the Study Team into the verified water quality analysis in the laboratory to show the water quality distribution map for fluoride, pH and electric conductivity. The design of the GIS data folder is shown in Figure 13.2.1.

Table 13.2.1 List of Contents in each MS-Excel Sheet

Name of File		Contents of data	Remarks
1	Existing water supply scheme inventory survey	-Information of the respondent -Detailed information of hand pumps > General Information > Located Information (GPS Coordinate) > Well Information > Hand pump Information > Water Quality > Repairing History -Detailed information of piped water supply schemes (PWSS) > General Information > Located Information (GPS Coordinate) > Well Information > Motorized Information > Water Tank Information > Pipeline Information > Public Water Points Information > Operating Status of Piped Water Supply Schemed > Water Quality > Repairing History	It is based on the result of the existing water supply scheme inventory survey, which has been carried out from September to November in 2009.
2	Socio-economic survey	-Village located information -Information of the respondent -Population and household information -Economic status -Health and sanitation -Information of social services -Present status of water supply -Operation and maintenance of existing water supply facilities	It is based on the result of the socio-economic survey, which has been carried out from September to November in 2009.

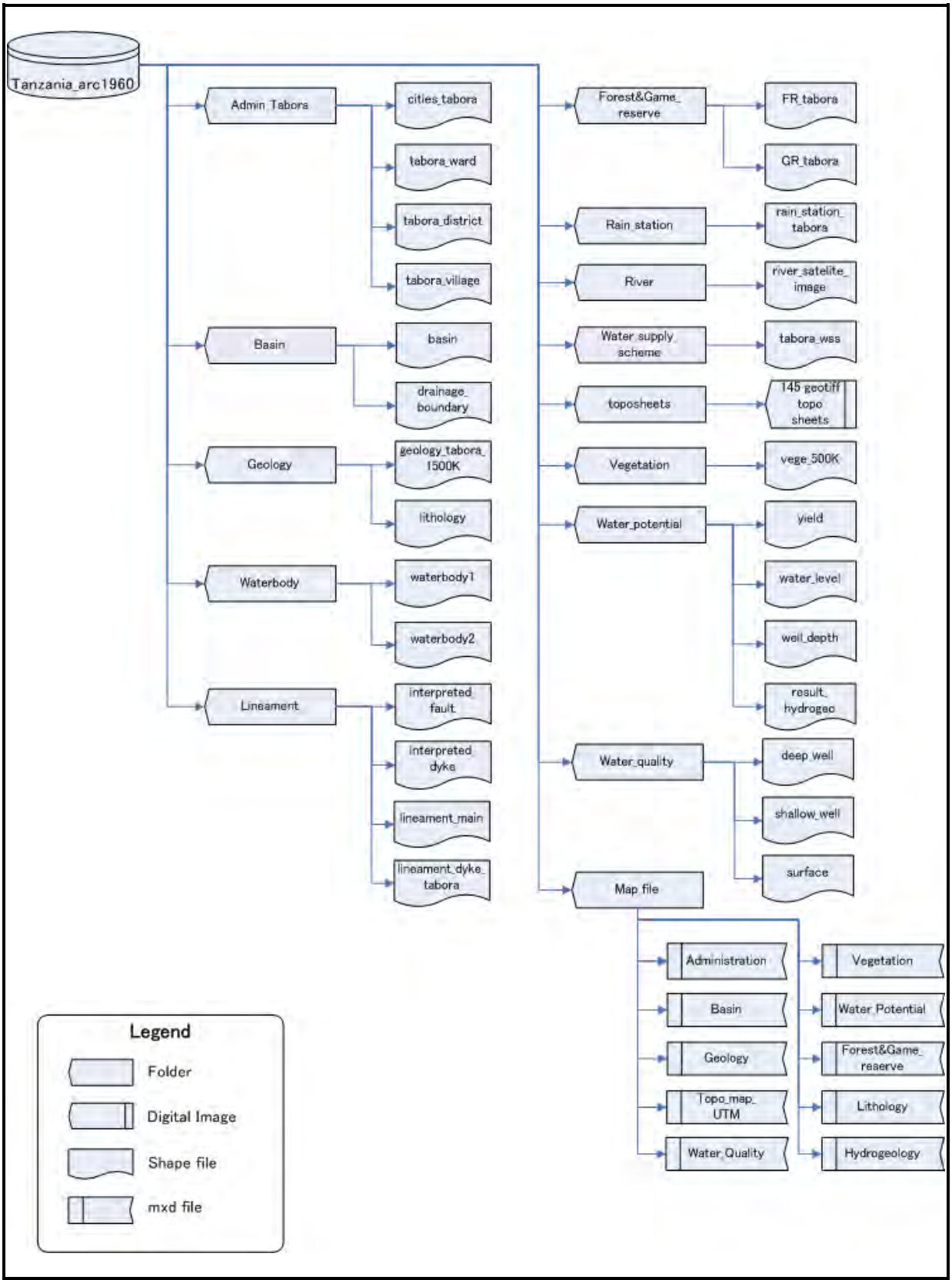

FIGURE 13.2.1 DESIGN OF THE GIS DATA FOLDER

THE STUDY ON RURAL WATER SUPPLY IN TABORA REGION	JICA

13.3 DATA OF GIS FOR THE ANALYSIS

13.3.1 GENERAL

To obtain the advantages of GIS technology, preparation of maps and the spatial analysis are carried out by the latest version of the ArcGIS in the Study.

13.3.2 COLLECTED AND CREATED DATA BY GIS

(1) Base Map and Fundamental Data

For the formulation of the water supply plan, the administrative boundaries such as regional boundary, district boundary and ward boundary are fundamental data in the GIS. In the study, above those data are already updated and utilized by the GIS local area section in the Ministry of Water (hereinafter MoW), thus this section shall be provided to the study team for the project; however, in addition, most of the digital maps such as vegetation, geology, and the other kinds of maps in the Tabora Region are not dealt with in the section and the other offices, only paper based maps, formed on previous administrative boundaries, are available at the Lake Tanganyika Basin Tabora branch office and some other existing reports. Therefore, the study team prepared the digital format through next two (2) steps, which are 1) to collect the digital image of data as jpeg and geo-tiff files. If a digital image is not available, scanning a map from a paper-base to digital, 2) to digitize the digital image map by using ArcGIS. The collected and created base maps and data in the study are listed in Table 13.3.1 below.

Table 13.3.1 List of Base Data

Name of Data		Source	Data Type
1	Region boundary (tabora_district)	Obtained the shape file of entire Tanzania area from the GIS rural section of the MoW, and extracted only Tabora Region data.	Shape as polygon
2	District boundary (tabora_district)	Obtained the shape file of entire Tanzania area from the GIS rural section of the MoW, and extracted only Tabora Region data.	Shape as polygon
3	Ward boundary (tabora_ward)	Obtained the shape file of entire Tanzania area from the GIS rural section of the MoW, and extracted only Tabora Region data.	Shape as polygon
4	Cities in Tabora (city_tabora)	Obtained the cities' point data of entire Tanzania area from the GIS rural section of the MoW, and derived only Tabora Region data from it.	Shape as point
5	Geologic map (geology_tabora_1500k)	Digitized from the 1:1,500,000 scale geologic map in "Tanzania Tabora Rural Integrated Development Project Land Use Component Land Unit Atlas".	Shape as polygon
6	Vegetation map (vege_500k)	Digitized from the 1:500,000 scale land use and vegetation map.	Shape as polygon
7	National forest map (FR_tabora), (GR_tabora)	Digitized from the 1:500,000 scale administration bounrdaries map in Tabora.	Shape as polygon
8	Waterbody in Tabora Region (waterbody1)	Extracted and digitized lakes, dams and reservoirs from the 145 sheets of 1:50,000 scale topographic map.	Shape as polygon

(2) Resultant Data and Data by the Existing Reports

The location data of the villages with specific village information, the locality of hand pumps and piped water supply schemes, and the distribution of fluoride, pH and electric conductivity in the Tabora Region are obtained as point data by the result of the socio-economic survey, the existing water supply scheme inventory survey, the water quality analysis in the laboratory, the result of drilling wells and the existing reports. The explanation of the exported point data is described in Table 13.3.2 in below.

Table 13.3.2 List of Point Data from the Result of the Surveys

Name of Data		Description	Data Type
1	Village location (tabora_village)	Location data of 547 villages in the entire Tabora Region are filed with the detail information of each village.	Shape as point
2	Location of water supply facility (tabora_wss)	1587 numbers of water facilities in Tabora Region are filed with the detail information by the result of the existing water supply scheme inventory survey.	Shape as point
3	Distribution of Water Quality (deep_well) (shallow_well) (surface)	It is prepared 797 location points from the results of the existing water supply schemes inventory survey, 90 samples by the water quality analyses results in the laboratory, 231 water quality data from the existing reports and ten (10) obtained samples from the result of drilling wells by each water source.	Shape as point

(3) Analysis Data

From the results of satellite image analysis by the members of Hydrogeologist two (2) in the study team, lineament and dykes data were digitized as a polyline file. In addition, 40 sheets of the 1:100,000 scales Magnetic Interpretation map, accomplished by the Geosurvey International Gesellschaft mit beschränkter Haftung (former West Germany) under the project of the Ministry of Minerals (MoM) in the United Republic of Tanzania, was digitized and edited as a polyline file by the study team so as to analyze the potential location of groundwater as one bit of additional information.

As the other data by the analysis, basin boundaries, river systems, waterbodies and lithological maps in the Tabora Region were digitized and assembled as polygon and polyline file types. From the data of yield potential, static water level and well depth with coordination data of collected existing reports and the data sheet; it was compiled briefly and exported to the point data. Detailed information of name, description and format of each analysis data and maps are listed in Table 13.3.3.

Table 13.3.3 List of Data for Analyses

Name of Data		Description	Data Type
1	Lineament and dyke (lineament_dyke_tabora)	Certain lineament, inferred lineament and dyke by the satellite image analysis are filed.	Shape as polyline
2	Main lineament (lineament_main)	Main lineament in Tabora Region by the satellite image analysis is filed.	Shape as polyline
3	Interpreted fault (interpreted_fault)	Faults, being based on the 1:100,000 scales magnetic interpretation map, are filed.	Shape as polyline
4	Interpreted dyke (interpreted_dyke)	Dykes, being based on the 1:100,000 scales magnetic interpretation map, are filed.	Shape as polyline
5	Drainage system in Tabora Region (basin)	It is extracted drainage shape in the Tabora Region from the result of the satellite image analysis.	Shape as polygon
6	Drainage boundaries (drainage_boundary)	It is digitized from the drainage system data.	Shape as polyline
7	Waterbody in Tabora Region (waterbody2)	It is extracted and digitized from the result of the satellite image analysis.	Shape as polygon
8	River system in Tabora Region (river_satellite_image)	It is extracted river system in the Tabora Region from the result of the satellite image analysis.	Shape as polyline
9	Lithology in Tabora Region (lithology)	It is the result of the satellite image analysis and 1:1,500,000 scales geologic map in "Tanzania Tabora Rural Integrated Development Project Land Use Component Land Unit Atlas".	Shape as polygon
10	Well Data (yield) (water_level) (well_depth)	It is data compiled and exported based on the collected existing reports, data sheets, the results of drilling wells by the Study Team and the resultant data of yield, water level and well depth by the existing water supply schemes inventory survey.	Shape as point and polyline
11	Hydrogeology (result_hydrogeo)	It is analyzed and created data by the person in charge of the Groundwater Development Planner.	Shape as polygon

13.4 RECOMMENDATIONS

The database system is created as the results of the analysis and of the field investigations performed by the Study Team. In order to facilitate continued effective utilization of the database, the following items are absolutely recommended.

13.4.1 IMPROVEMENT OF THE ACCURACY OF LOCALITY INFORMATION

For the effective application of the database, the locality information is the fundamental matter, especially for the analysis by the GIS. Therefore, it is strongly recommended to determine the coordinate by the GPS when any new data is added to the database. Besides, it is desirable to determine the coordinates even for the existing data.

13.4.2 PERIODICAL UPDATE OF THE DATABASE AND FORMULATION OF THE UPDATING SYSTEM IN TABORA REGION

From reflecting the latest conditions to the database, it is possible to grasp water supply condition in the whole area of Tabora Region more than now. The Study Team proposes as the one of examples that after database in each district is updated by person in charge of the updating data, the Regional Water Advisor in Tabora Region gathers the updated data from each district, integrates the gathered data and manages for database.

From above of the proposal, the Study Team recommends to build the periodical update of database and to formulate the updating system in Tabora Region in order to use as one of tools for designing the water supply plan in the future.

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CHAPTER 14 URBAN WATER SUPPLY PLAN

14.1 GENERAL

14.1.1 SCOPE OF THE URBAN WATER SUPPLY PLAN

In the centre of each district in the Tabora Region, small scale urban water supply facilities are established but they have become decrepit. Therefore, the Study Team shall conduct a survey on the condition of those urban water supply facilities and the situation of operation and maintenance. Based on the baseline survey, the Study Team shall provide recommendations and advice for the Tanzanian side on reform measures for the existing water supply facilities. The Study Team shall also design a conceptual plan of the facilities which are needed to be improved as a result of the recommendations, and provide draft project budget for realisation of improvement of the facilities.

14.1.2 STUDY AREA

The target organisation of the survey is the TUWASA, which covers the Tabora Municipality, the regional capital of the Tabora Region, and other Urban Water Supply and Sewerage Authorities which manage the water supply for the Municipalities of each District. However, the Study Team will not conduct a detailed survey on the Tabora Rural District as it has just been established and not equipped with a water supply facility.

Table 14.1.1 Study Area

District/Municipality	Abbreviation of Urban Water Supply and Sewerage Authority
Igunga District	IGUWASA
Nzega District	NZUWASA
Sikonge District	SUWASA
Tabora Rural District	N/A
Tabora Municipality	TUWASA
Urambo	UUWASA

14.2 SUPERIOR PLAN

14.2.1 WSDP

The general objective of the Water Sector Development Programme (WSDP) with regard to urban water supply and sanitation is improved and sustained quality and quantity of drinking water and sewerage service for urban Tanzanians managed by improved, financially autonomous and commercially viable Urban Water Supply and Sewerage Authority / Water Supply and Sanitation Authority (UWSAs/WSSAs) providing efficient and cost-effective services.

The specific targets of the Urban Water Supply and Sewerage Programme (UWSSP) include raising water supply service coverage from 74% (2005) to 90% in 2010 and 95% by 2015 to meet the MDGs and 100% for Vision 2025. The target for sewerage coverage is to increase from 17% (2003) to 30% by 2010.

The strategy for achieving these goals in the urban sector is to develop the existing UWSAs into bodies that are financially autonomous and commercially viable. In essence, the focus of the

strategy is the commercialisation of the urban water authorities so that they are capable of efficient and cost-effective provision of services. Commercialisation is seen as the next step forward in preparing the UWSA/WSSAs into future corporate to gain public company status. Incentives for continued reforms will be designed towards adoption of more commercial approaches in managing the UWSAs/WSSAs.

The broad objectives of Urban Water Supply and Sewerage (UWSS) are to:

- provide a water service connection to any person or organisation that requests one;
- provide continuous potable water quality 24 hours a day to at least 95% of customers;
- have UWSA/WSSAs be responsible for operating and maintaining their works including replacement of worn out equipment, using revenues from the sale of water and sewerage services;
- have UWSA/WSSAs finance a significant part of their new investments in water supply systems from loans; and
- have sewerage systems as part of an overall sanitation strategy for each town.

Specific objectives include:

- setting appropriate tariffs;
- effectively managing consumer demand;
- establishing good customer relations;
- controlling unaccounted-for-water (UfW);
- operating and maintaining the systems efficiently while minimising operating costs;
- making provision for poor consumers, establishing standards for industrial wastewater discharges to sewers;
- where a sewerage system is provided, wastewater collected should be treated and disposed of in accordance with Tanzanian standards;
- institute ideal billing systems in 10 UWSAs;
- ensure the active and effective participation of both women and men in UWSS; and
- promote prevention and mitigation of HIV/AIDS.

14.3 Existing Conditions of the Urban Water Supply and Sewerage Authorities

14.3.1 General of UWSAs

The table below shows the summary of each UWSA. And the following is the categorisation of each UWSA defined by the government of Tanzania. In the Tabora Region, only TUWASA falls into the Category A and other UWSAs are into the Category C.

- Category A: Authorities cover all the O&M costs of water supply and sewerage, including staff wages, cost of power and some contributions to investment.
- Category B: Authorities meet their O&M costs, including cost sharing of power (as per MoW with each authority) and full salaries for the permanent employees.
- Category C: Authorities meet their O&M costs but require Government support in paying for power supply and the salaries of the permanent employees.

Table 14.3.1 Outline of UWSAs

Service Item	IGUWASA	NZUWASA	SUWASA	TUWASA	UUWASA
Population of town	18,000	32,075	11,411	175,557	30,104
Served population	6,900	18,000	3,800	151,000	4,800
Ratio of served population	38%	56%	33%	86%	16%
Category of UWSAs	C	C	C	A	C
Daily water consumption (m^3/day)	310	789	110	11,283	48
Type of water source and number	Dam (1)	Dam (2)	Dam (1)	Dam (2) Shallow Well (1)	Deep well (3)
Beginning year of water supply	1960's	1955	1974	1950's	1976
Water supply hours per day (hour)	13	18	1	12-18	8
Leakage ratio	40%	34-36%	27%	29%	30-40%
Per capita daily water supply	45	44	29	75	10
Minimum metered tariff (Tsh/litre)	0.6	0.75	0.8	0.54	0.7
Minimum flat rate (Tsh/month)	6,000	-	5,500	12,000	5,000
Number of permanent staff	5	5	5	72	3
Revenue (Tsh/year)	33 million (2007/2008)	137 million (2007/2008)	10 million (2007)	1,460 million (2007/2008)	8 million (2008/2009)
Number of connections	658	1,097	123	9,711	128
Ratio of metering	9%	100%	41%	80%	83%
Revenue collection efficiency	75%	94%	80%	68%	80%

The table above shows the distinct aspects as follows.

- Urambo Urban Water Supply Authority (UUWASA) suffers from the lowest ratio of served population. The reason is that it is not able to expand the coverage area of water supply because it uses deep wells solely as the source of water and the capacity is insufficient.
- Igunga Urban Water Supply Authority (IGUWASA), Nzega Urban Water Supply Authority (NZUWASA) and TUWASA started their water supply services between the 1950's and 1960's, and it was earlier than the other two (2) UWSAs. As IGUWASA and NZUWASA are located along the main road between Dar es Salaam and Mwanza and TUWASA lies in the regional capital of Tabora Region, it is considered that they began their service at an earlier stage.
- Sikonge Urban Water Supply Authority (SUWASA) supplies water one (1) hour per day and it is extremely shorter than the other UWSAs.
- The following table shows the standard per capita daily water supply stipulated in the Design Manual for Water Supply and Waste Water Disposal, 2009. TUWASA is considered to be categorised as an urban water supply and its consumers are nearly the category of Medium income households of M-PBT.

Table 14.3.2 Water Requirements

Consumer Category	Urban Area (litre/capita/day)			Remarks
	FR	M-UT	M-PBT	
Low income using kiosks or public taps	25	25	25	Most squatter area, to be taken as the minimum
Low income multiple household with yard tap	50	45	40	Low income group housing No inside installation and pit latrine
Low income, single household with yard tap	70	60	50	Low income group housing No inside installation and pit latrine
Medium income household	130	110	90	Medium income group housing, with sewer or septic tank
High income household	250	200	150	High income group housing, with sewer or septic tank
FR = flat rate; M-UT = metered with uniform tariff; M-PBT = metered with progressive block tariff				

Source: MoWI, 2009

- As per the minimum water tariff with a meter, TUWASA provides the lowest price. The reason is because it covers a large population and has good investment efficiency and large amount of income from the consumers. IGUWASA also presents a lower rate of minimum water tariff as the operating cost for water supply is lower than the other UWSAs because it requires no water treatment. On the other hand, TUWASA has established a minimum flat rate about twice of the other UWSAs'. The reason is that it aims to prevent excessive use of water through the higher price.
- As for revenue collection efficiency, NZUWASA is comparatively better than the other UWSAs. The reason is they use private companies for their service including maintenance of water source and water treatment plant and collection of water tariff so that both NZUWASA and the company can share the profit and loss as a result of their work. That's why the incentives for collection are generated and its efficiency is more improved than the other UWSAs.

14.3.2 IGUWASA

(1) Outline of IGUWASA

IGUWASA withdraws water from the Bulenya Dam, which is located 10km west of the town, and draws water by gravity without treatment, from the Dam to the Pump House at 1.5km west of the town. From the Pump House, the water is drawn by the pump which is installed on the ground, to the two (2) reservoirs within the town. From the reservoir, the water is distributed to the town by gravity. The water supply service was started in 1960's and IGUWASA was established in 1999.

- Population of town: 18,000 (2009)
- Served population: 6,900
- Ratio of served population: 38%
- Daily water production: 710 m^3/day
- Daily water consumption: 310 m^3/day (Including for livestock)

(2) Situation of Assistance

IGUWASA has two (2) projects for WSDP at present. One of them is a rehabilitation project of the water supply facility which covers Igunga Town and three (3) surrounding villages (Mbutu, Ibutamisuzi and Hindishi). It aims to establish a total pipe extension of about 70km and is at the construction stage. Another project aims to install a new water treatment plant (slow filter) whose

source is the Bulenya Dam. It conducted a tender for construction on June 2009.

(3) Existing Conditions of the Authority

The following is a description of the present water supply condition of IGUWASA.

1) Service Area

The service area of IGUWASA is shown in Table 14.3.3. The present service area is only Igunga Town. Although IGUWASA does not cover all the areas of Igunga Town, and plans to expand its service to the entire area of the town. The three (3) surrounding villages (Mbutu, Ibutamisuzi and Hindishi), where WSDP plans to establish water supply service, are originally out of the jurisdiction of IGUWASA as they are located in rural areas. However, as both the town and the villages use the same water treatment plant, it is under consideration that either DWE or IGUWASA shall manage the water supply scheme.

Table 14.3.3 Service Area (IGUWASA)

Area	Administrative Unit	
	Ward	Village
Current Service Area	Igunga	Igunga Town
Future Service Area	Igunga	Igunga Town
	Mbutu	Ibutamisuzi
		Mbutu
	Isakamaliwa	Hindishi

2) Location of Water Supply Facilities and Water Supply Flowchart

The location of water supply facilities and water supply flowchart are shown in Figure 14.3.1 and Figure 14.3.2. The pump house near Bulenya Dam pumps up to four (4) villages (Nanga, Igogo, Bulyangombe and Migongwa). The management of these four (4) villages is under the DWE.

FIGURE 14.3.1 LOCATION OF WATER SUPPLY FACILITIES OF IGUWASA

THE STUDY ON RURAL WATER SUPPLY IN TABORA REGION	JICA

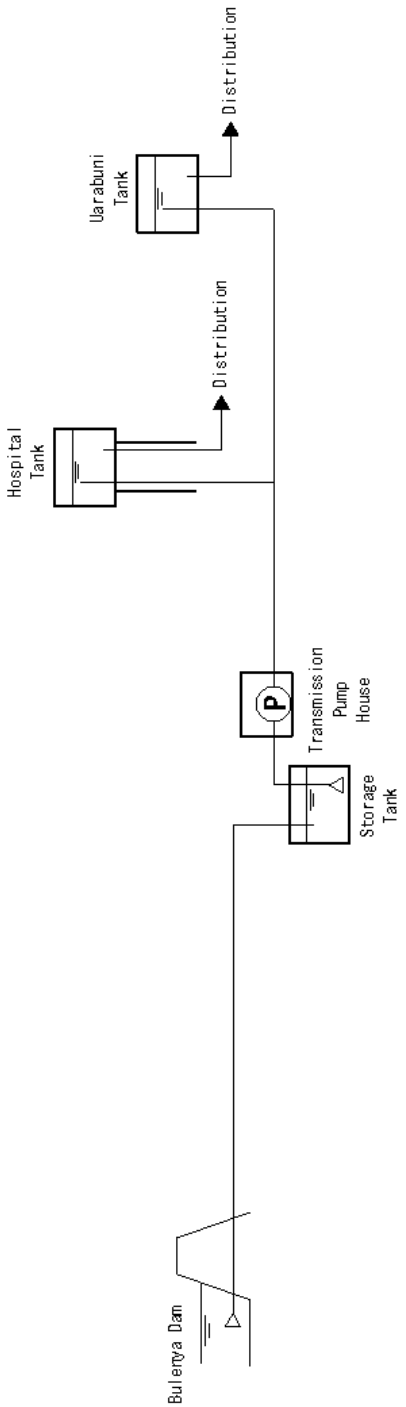

FIGURE 14.3.2 WATER SUPPLY FLOWCHART OF IGUWASA

THE STUDY ON RURAL WATER SUPPLY IN TABORA REGION	JICA

3) Water Quantity

The table below shows the average water quantity of IGUWASA in 2007/2008.

Table 14.3.4 Water Quantity (m^3/day) (IGUWASA)

Water demand		Water consumption	Billable water	Actual water billed	Water loss
Human	Livestock				
1,100	400	710	426	310	284

Source: IGUWASA, 2008

- It does not measure the amount of intake from the Dam as it does not have a water metre
- A water metre is not installed for the reservoirs, either.
- It has installed a water metre only for the Pump House but the metre is not always operating because of clogging from non-purified water.

4) Water Quality

IGUWASA doesn't have a water quality test. But water quality is expected to be poor because there is no treatment plant.

5) Leakage

The ratio of unaccounted for water is 40%. Pipe bursts per year were 3.8 place/km (2007/2008).

6) Average Service Hours

The average service hours are 13 hours. 50% of the area of Igunga town is served by water for 24 hours, 25% is served by water for two (2) hours per day due to several problems, and the remaining area is not getting water since it has no distribution network.

(4) Operation and Maintenance

1) Organisation Chart and Staff

The organisational chart of IGUWASA is shown in Figure 14.3.3. The present composition of the staff is as follows. And there are some vacant positions.

- Permanent Staff: five (5) (Managing Director, Business Manager, Technical Manager, Revenue Collector & Supplies and Pump Operator)
- Part-Time Staff: six (6) (Pump Attendant, Rationing, Attendant, Meter Reader, Revenue Collector, Office attendant and Watch Man)

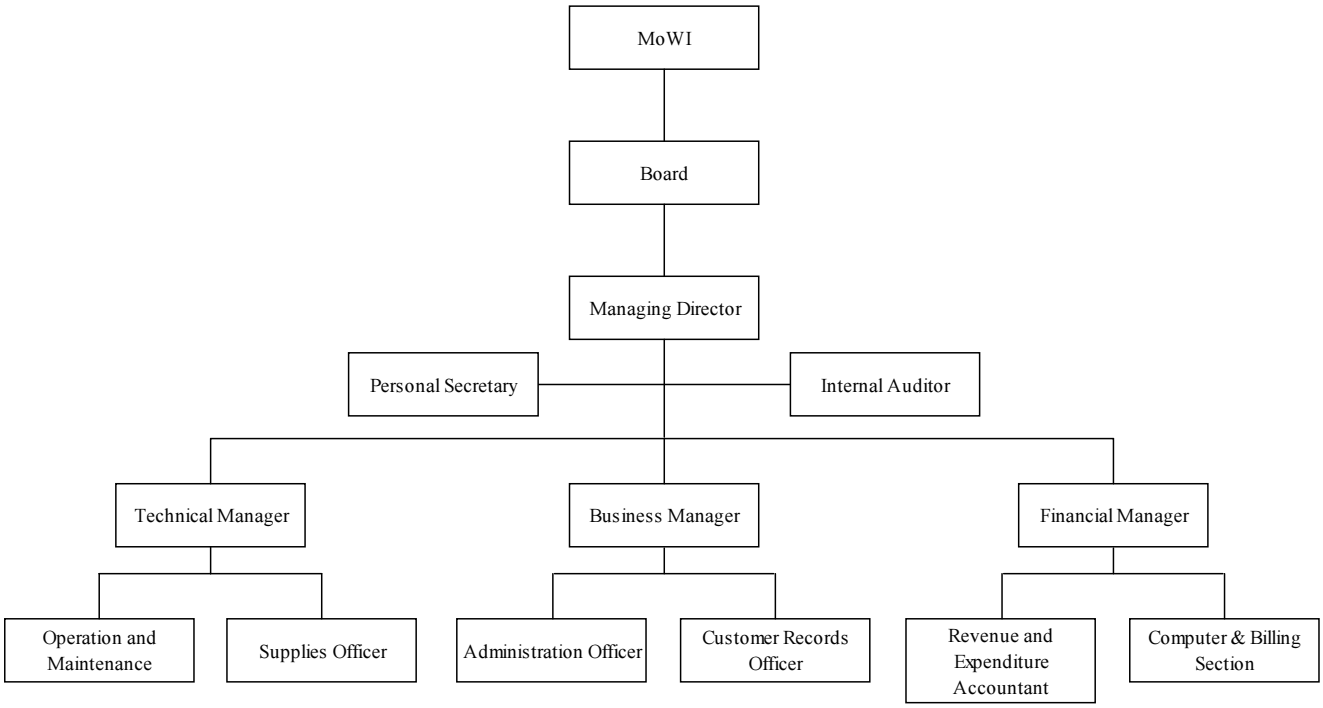

Figure 14.3.3 Organisational Chart of IGUWASA

2) Finance

The table below shows the revenue and expenditure of IGUWASA in FY 2007/2008. The District Council provided a subsidy for electricity costs. IGUWASA spent 18.4 million Tsh for personnel costs, which accounts for a large fraction of 56% of the total expenditure. This is because of the high security costs for vandalism of the pipeline (640,000 Tsh/month). On the other hand, as IGUWASA is defined as a Category C, it received a subsidy from the government for electricity costs and the salary of Permanent Staff.

Table 14.3.5 Revenue and Expenditure (IGUWASA)

Item	Amount (Tsh)
REVENUE	
Water Sales for Domestic	12,793,050
Water Sales for Institutional	9,313,621
Water Sales for Commercial	3,756,900
Other	7,372,634
Total	33,236,205
EXPENDITURE	
Electricity	1,867,223
Personnel	22,495,665
Other Operation & Maintenance Costs	10,531,500
Total including Electricity	34,894,388
Total excluding Electricity	33,027,165
BALANCE including Electricity	-1,658183
BALANCE excluding Electricity	209,040

Source: IGUWASA, 2008

3) Connection

IGUWASA has 658 connections. The table below shows the detailed types of connections. 61 water metres are installed among them.

Table 14.3.6 Number of Connections (IGUWASA)

Domestic	Institution	Commercial	Others	Total
617	16	25	-	658

Source: IGUWASA, 2008

4) Water Tariff

The water tariff is charged by with or without a water metre and method of use of water. The present tariff was approved by the EWURA on September 2007. As there are less than 10% of connections which have installed water metres, almost all the customers are charged using a flat rate. The details of the water tariff are as follows:

Table 14.3.7 Water Tariff (IGUWASA)

Custormer Category	Metered	Unmetered
	Tsh/m^3	Tsh/month
Domestic	600	6,000
Institution	800	48,500
Commercial	900	36,000
Domestic Venders	900	63,000
Industrial	1,000	210,000
Cattle Trough	600	-
Kiosk	600	42,000

Source: EWURA, 2007

5) Revenue Collection

The revenue collection efficiency is 75%. The government facilities owe over half of uncollected tariffs.

(5) Existing Conditions of Water Supply Facilities

1) Water Source

The Bulenya Dam is the sole water source of IGUWASA, which locates 10km west of the town.

Table 14.3.8 Water Source (IGUWASA)

Item	Specifications
Type and name of water source	Bulenya Dam
Year of completion	1961
Storage volume	1.62 million m^3 (design)
Intake type	Direct
Pump capacity	No pump

- IGUWASA withdraws water directly from the Dam without treatment process.
- It does not figure out the amount of intake as a water metre is not equipped.

2) Conveyance

The pipelines stretch from the Bulenya Dam to the Pump House at the 1.5km west of the town. They have two (2) systems and the table below shows the detail of each system.

Table 14.3.9 Conveyance Main-1 (IGUWASA)

Item	Specifications
Diameter	150mm
Material	Asbestos cement
Length	11.9km
Year of completion	1961

- It was designed to carry 432 m^3/day, its capacity has dropped to 290 m^3/day due to aging, leaks and corrosive effect of water particularly with respect to the asbestos pipes used.

Table 14.3.10 Conveyance Main-2 (IGUWASA)

Item	Specifications
Diameter	150-300 mm
Material	PVC and Ductile Iron (DI)
Total length	12.88 km
Type of pipes material, size and length	2.16 km (300 mm PVC) 0.81 km (300 mm DI) 1.44 km (250 mm DI) 0.63 km (250 mm PVC) 2.14 km (230 mm PVC) 1.5 km (200 mm PVC) 0.2 km (200 mm DI) 4.0 km (150 mm PVC)
Year of completion	1998

- It was designed to carry 950 m^3/day, its capacity has dropped to 420 m^3/day due to leaks, lack of air valves and washout valves, and some part of the pipeline are clogged with mud.

3) Transmission Facilities

Transmission facility includes the one from the Pump House to the reservoirs in the town.

Table 14.3.11 Transmission Pump-1 (IGUWASA)

Item	Specifications
Pump Capacity	30 m^3/hour
Power	Diesel Engine 25HP (1994)
Year of installation	1994

Table 14.3.12 Transmission Pump-2 (IGUWASA)

Item	Specifications
Pump Capacity	30 m^3/hour
Power	Electric Motor with 25HP (1994)
Year of installation	1999

Table 14.3.13 Storage Tank (IGUWASA)

Item	Specifications
Structure	Circular reinforced concrete ground tank
Year of completion	1964
Effective capacity	105 m^3

4) Distribution Reservoir

IGUWASA distributes water from two (2) reservoirs at present. One of them is an elevated tank.

- Total effective capacity: 195 m^3
- Total hour-amount: 6.6 hours (Actual)

Table 14.3.14 Hospital Tank (IGUWASA)

Item	Specifications
Structure	Elevated panel tank
Year of completion	1988
Effective capacity	90 m^3

- The new elevated tank is under construction next to the existing tank.

Table 14.3.15 Uarabuni Tank (IGUWASA)

Item	Specifications
Structure	Circular reinforced concrete ground tank
Year of completion	1961
Effective capacity	105 m^3

- As this tank is on the ground and provides low water pressure, a new elevated tank (135m^3) is under construction next to the existing tank.

5) Distribution Network

The table below shows the composition of distribution network.

Table 14.3.16 Distribution Network (IGUWASA)

Item	Specifications
Total length	Approx. 12km
Type of pipes material, size and length	2.70 km (150 mm PVC) 0.7 km (150 mm DI) 1.5 km (126 mm PVC) 4.47 km (100 mm PVC) 1.81 km (75 mm PVC) 0.6 km (50 mm PE) 0.3 km (30 mm PE) 0.1 km (30 mm Galvazied Steel Pipe (GSP))

14.3.3 NZUWASA

(1) Outline of NZUWASA

NZUWASA withdraws water from the Uchama and the Kilimi Dam which are located about 2km north and 14 km north of the town, respectively. The Uchama Dam is equipped with the water treatment plant and the water withdrawn from those dams is treated and delivered into the four (4) reservoirs in the town. After the reservoirs, it is distributed by gravity. The water supply service was started in 1955 and NZUWASA was established in 1999. NZUWASA commissions a private company as a package of management activities of water supply service which includes maintenance of the water source and the treatment plant and collection of the water tariff.

- Population of town: 32,075 (2009)
- Served population: 18,000
- Ratio of served population: 56%
- Daily water production: 1,195 m^3/day (July on 2009)
- Daily water consumption: 789 m^3/day (July on 2009)

(2) Situation of Assistance

NZUWASA received an assistance of 62 million Tsh from WSDP for the update of the intake pump and the distribution pump in 2008. Also, they received 6 million Tsh for expansion of the water supply facility.

(3) Existing Conditions of the Authority

The following is a description of the present water supply conditions of NZUWASA.

1) Service Area

The service area of NZUWASA is shown in Table 14.3.17. The present service area is Nzega Town only. Although NZUWASA does not cover all the areas of Nzega Town, it plans to expand its service to the entire area of the town.

Table 14.3.17 Service Area (NZUWASA)

Area	Administrative Unit	
	Ward	Village
Current service area	Nzega	Nzega Mjini
Future Service Area	Nzega	Nzega Mjini

2) Location of Water Supply Facilities and Water Supply Flowchart

The location of water supply facilities and water supply flowchart are shown in Figure 14.3.4 and Figure 14.3.5.

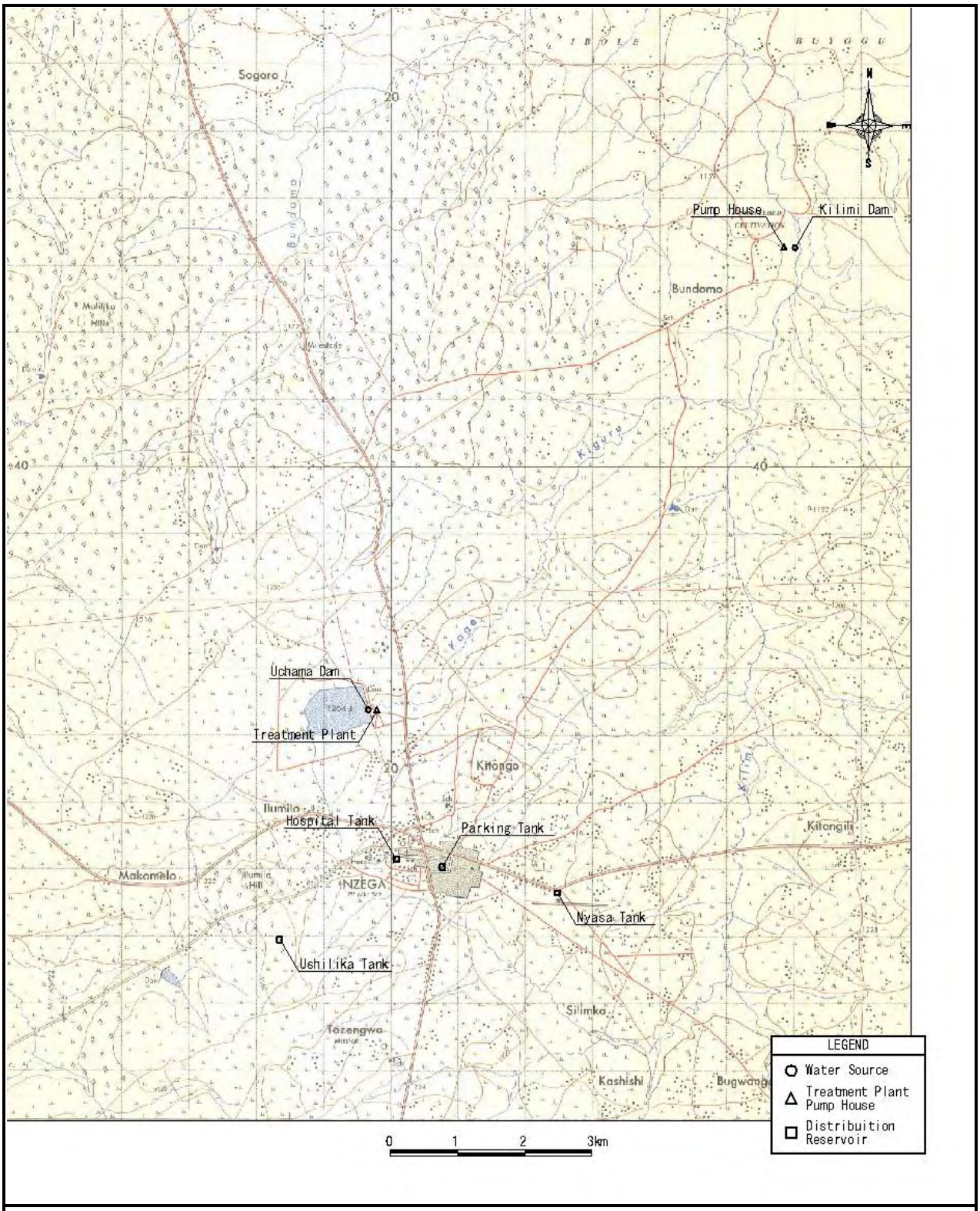

FIGURE 14.3.4 LOCATION OF WATER SUPPLY FACILITIES OF NZUWASA

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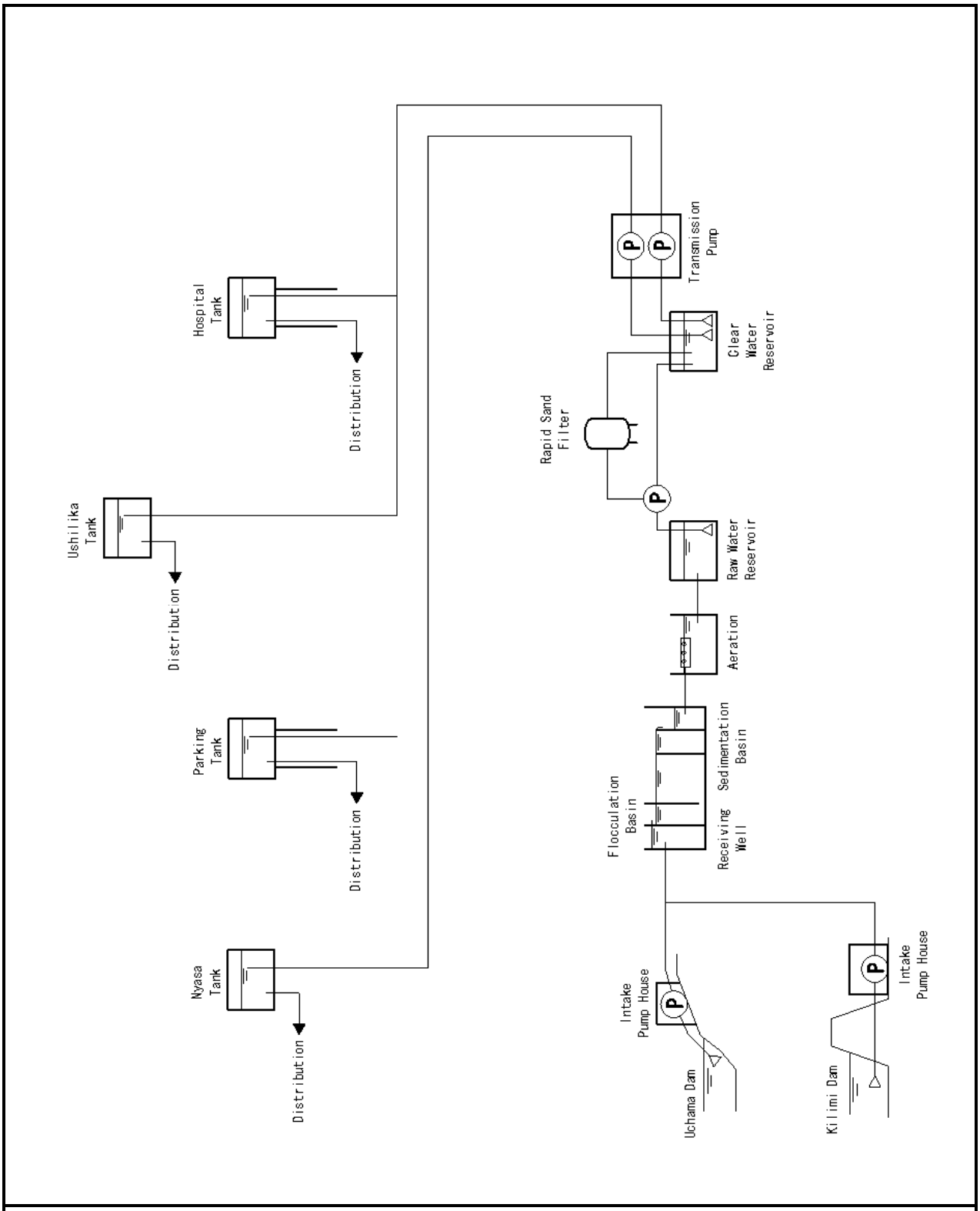

FIGURE 14.3.5 WATER SUPPLY FLOWCHART OF NZUWASA

3) Water Quantity

The table below shows the average water quantity of NZUWASA in 2007/2008.

Table 14.3.18 Water Quantity (m^3/day) (NZUWASA)

Water production	Actual water billed	Water loss
642	530	112

Source: NZUWASA, 2008

- The average water quantity from May to July 2009 was increased as follows: 777 m^3/day (May), 1,016 m^3/day (June) and 1,195 m^3/day (July). This is because of the update of the intake pump of the Uchama Dam.
- All the four (4) reservoirs are equipped with water metres and all the customers are also charged by water metres.
- The ratio of unaccounted water in 2008 was about 17%, and it increased to 34% - 36% in 2009.

4) Water Quality

Shinyanga Zonal Water Quality Laboratory does water analysis on a monthly basis. Bacteriological analysis was done for raw water of Uchama and Kilimi dams, as well as for treated water at treatment plant and some selected public water kiosks. The result was within the Tanzania Temporal Standards (T.T.S) acceptable standards and recommended for human consumption. A bacteriological test was conducted on 1st July 2009 and the results are indicated on following.

Table 14.3.19 Water Quality (NZUWASA)

Sampling point	Turbidity (NTU)	E.coli (0/100mL)	pH	TDS (mg/L)	E.C (mS/m)	F^- (mg/L)	Cl^- (mg/L)	Fe^{3+} (mg/L)	R.Cl (mg/L)
NZUWASA	1.0	0	7.3	160	320	0.75	26.5	0	0.2-0.5
T.T.S	25mg/L	0	6.5-13.2	-	-	4.0	800	1.0	-
WHO	5	0	6.5-9.5	-	-	1.5	-	-	-

Source: NZUWASA, August 2009

5) Leakage

The ratio of unaccounted water in 2008 was about 17%, and it in 2009 was 34 - 36%. During 2007/2008, 123 leakages were registered and repaired.

6) Average Water Supplied Time

Basically the distribution pump operates 24 hours/day. The service hour is 18 hours/day in the dry season and 15 hours/day in the rainy season. The reason why the service hour in the rainy season is shorter is that the customers use rain water.

(4) Operation and Maintenance

1) Organisation Chart and Staff

The organisation chart of NZUWASA is shown in Figure 14.3.6. The present composition of the staff is as follows:

- Permanent Staff: five (5) (Managing Director, Technical Manager, Pump Mechanician, Watchman and Electric Technician).

And WEDECO Ltd., the private company for operation and maintenance, conducts almost all the operation and maintenance activities which include operation of the facility of water source and collection of the water tariff. The organisational chart is shown in Figure 14.3.7. The composition of WEDECO staff is as follows;

- Permanent Staff: 11 (Project Manager, Accountant, Personnel Secretary, four (4) Plumbers and four (4) Pump Operators)
- Part-Time Staff: 31 (25 Water Selling Agent and six (6) Security Guards)

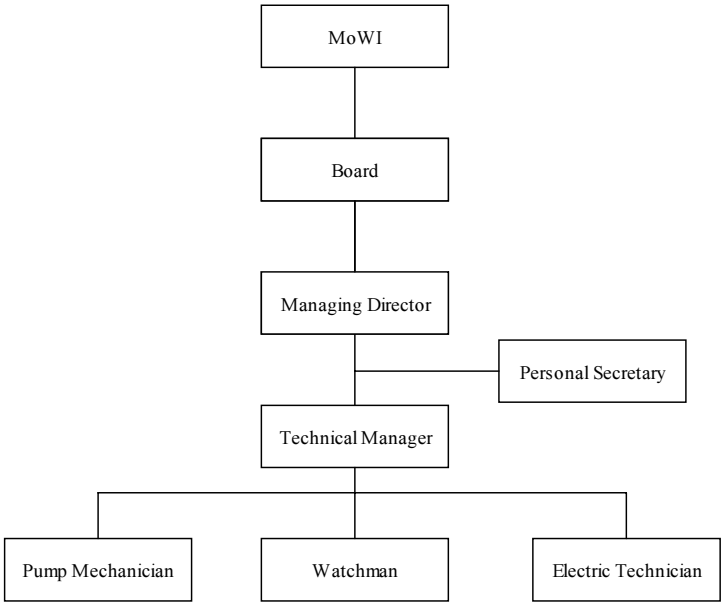

Figure 14.3.6 Organisational Chart of NZUWASA

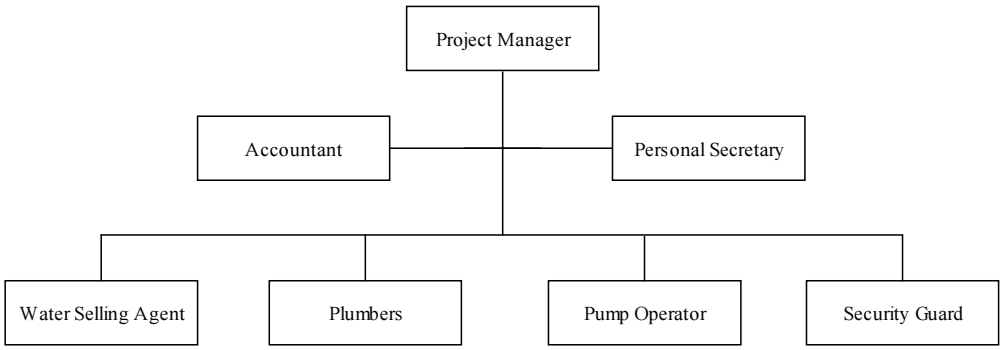

Figure 14.3.7 Organisational Chart of WEDECO

The main contents of WEDECO's service are shown below.

- Water source protection
- Daily monitoring of powerhouse, storage tank, rising and distribution mains
- Making repair and maintenance of the scheme promptly
- Treating water continuously
- Water connection to new customers
- Water meter services, attending customer problems related to water connection
- Monthly reading of water meters, billing, bill distribution, revenue collection and monthly report production

2) Finance

The table below shows the revenue and expenditure of NZUWASA in the FY 2007/2008. WEDECO has the right to acquire 30% of the profit while NZUWASA is 70%. This ratio shall also be applied in the case of a deficit

Table 14.3.20 Revenue and Expenditure (NZUWASA)

Item	Amount (Tsh)
REVENUE	
Water Sales for Domestic	90,011,971
Water Sales for Institutional	12,508,320
Water Sales for Commercial	5,675,140
Water Sales for Industrial	951,600
Water Sales for Kiosk	27,522,595
Total	136,669,626
EXPENDITURE	
Total	120,953,780
BALANCE	15,715,846

Source: NZUWASA, 2008

3) Connection

NZUWASA has 1,097 connections as of 2008. The table below shows the detailed types of connections. Although all the customers are equipped with water metres, 7% - 8% of the water metres are not operational.

Table 14.3.21 Number of Connections (NZUWASA)

Domestic	Institutions	Commercial	Industrial	Kiosk	Total
1,023	19	35	2	18	1,097

Source: NZUWASA, 2008

4) Water Tariff

The water tariff is charged by use of water. As all the customers are equipped with the water metres, they are charged only by water metre readings

Table 14.3.22 Water Tariff (NZUWASA)

Custormer Category	Metered Tsh/m^3
Domestic	750
Institution	850
Commercial	900
Kiosk	1000 (20Tsh/20liter)

Source: NZUWASA, 2008

5) Revenue Collection

The revenue collection efficiency is 94%. The reason why the efficiency is higher than the other UWSAs is that the tariff is collected by a private company and it has strong incentives for collection as the profit from the activity are shared by them (NZUMASA: 70%, WEDECO: 30%).

(5) Existing Conditions of Water Supply Facilities

1) Water Source

NZUWASA has two (2) water sources, one of them is the Uchama Dam, which is located two (2) km north of the town and another the Kilimi Dam 14km north of the town.

Table 14.3.23 Water Source-1 (NZUWASA)

Item	Specifications
Type and name of water source	Uchama Dam
Year of completion	1955
Storage volume	1.33 million m^3 (design), 1.0 million m^3 (present)
Intake type	Crib (By Suction Pipe)
Pump capacity	35 m^3/hour x 30 mH x 4.09 kW x 2 units
Installation year of pump	2009
Operation hour of pump	Average 6 hours/day

- In the case of the low water level of the Dam, NZUWASA withdraws the water directly without using a Crib.
- Dense waterweeds in the Dam affect the water intake.
- The suction pipe is not firmly installed.
- It withdraws water by the suction method, but sometimes it needs to use water from the Tee (pipe) as the water in the suction pipe drops. And the former pump has many holes because of cavitations erosion generated by intake of the pocket.

Table 14.3.24 Water Source-2 (NZUWASA)

Item	Specifications
Type and name of water source	Kilimi Dam
Year of completion	1999
Storage volume	3.5 million m^3 (design)
Intake type	Crib (by pushed-in)
Pump capacity	162 m^3/hour x 95 mH x 44 kW x 2 units
Installation year of pump	2004
Operation hour of pump	average 12 hours/day

- Originally the both pumps operate in turn, but now only one (1) pump is operating as the coupling of another pump has been broken since two (2) – three (3) months ago. IGUWASA will procure the new coupling in the near future.

2) Conveyance

The pipeline stretches from the Pump House of the Kilimi Dam to the water treatment plant of the Uchama Dam. Its total length is about 15km.

Table 14.3.25 Conveyance Main (NZUWASA)

Item	Specifications
Diameter	8”
Material	PVC
Length	15 km
Year of completion	2004

- The diameter of the pipeline is not large enough, compared with the distribution capacity of the pump (162 m^3/hour). It makes water flow at high speed of 1.4 m/sec and the designed amount of water is not distributed properly.

3) Water Treatment Plant

The capacity of water treatment is 100 m^3/hour. However, it does not operate the filtering process as the valve of rapid filter is broken.

- Design capacity: 2,000 m^3/day

Table 14.3.26 Receiving Well (NZUWASA)

Item	Specifications
Structure	Reinforced concrete
Year of completion	1960's (Rehabilitation 2004 ; hight increasing)
Effective dimension	D2.1-2.3 m x W2.7 m x L1.9 m
Effective capacity	Approx. 11 m^3
Detention time	7.9 min (design)

- As the measuring facility is not equipped, IGUWASA is not able to manage the appropriate amount of coagulant.

Table 14.3.27 Coagulant (NZUWASA)

Item	Specifications
Name of coagulant	Aluminium Sulfate
Type	Solid 17%
Dosing point	Receiving Well
Dosing type	Gravity
Feed Rate	Max 10 litre/kg, Ave 12 litre/kg, Min 15 litre/kg

- The way of injection is as follows. The chlorine and coagulant are blended in a bucket and it is placed on the ceiling of the receiving well and they fall in drops from the bucket into the well.
- As there is no mixing tank and the point of dosing is not appropriate, coagulant and raw water are not blended properly and flock is not appropriately formed.

Table 14.3.28 Chlorination (NZUWASA)

Item	Specifications
Name of chlorination	Calcium Hypochlorite
Type	Powder or Granular
Dosing point	Receiving Well
Dosing type	Gravity

- The way of injection is the same as that of the coagulant.
- As there is no mixing tank and the drop point is not appropriate, the chlorine and raw water are not blended properly.
- The process of chlorination applies only before the sedimentation process, but it is estimated that the chlorine is overly consumed as the raw water and chlorine react with each other. It is expected to be able to manage the appropriate amount of injection.

Table 14.3.29 Flocculation Basin (NZUWASA)

Item	Specifications
Structure	Reinforced concrete
Year of completion	1960's (rehabilitation 2004: hight increasing)
Effective dimension	D2.4m x W4.3 m x L1.9 m x 2 units
Effective capacity	Approx. 39 m^3
Detention time	28 min (design)

- There is no problem with the detention time, while the agitation mechanism is not equipped.
- The serial treatment process of mixing, flocculation and sedimentation is not applied. Firstly the plant needs to blend and agitate the coagulant and raw water, and secondly it is

necessary to install a baffle plate for flocculation.

Table 14.3.30 Sedimentation Basin (NZUWASA)

Item	Specifications
Structure	Reinforced concrete
Year of completion	1960's (rehabilitation 2004: hight increasing)
Effective dimension	D2.3 m (2.55-2.65 m) x W4.3 m x L6.2 m x 2 units
Effective capacity	Approx. 123 m^3
Detention time	1.5 hours (design)
Inlet type	Inlet from lower part of inlet wall
Outlet type	Weir type
Weir load	233 m^3/day/m (design)
Sludge removal	Using submersible pump
Frequency of sludge removal	Once/month
Effective surface area	26.7 m^2/unit
Surface loading	26 mm/min (design)
Ratio of length to width	1.44
Average flow speed	70 mm/min (design)

- Normally it is necessary for three (3) to five (5) hours as a detention time in the sedimentation basin, however actually it is only 1.5 hours in the plant.
- As this basin has no baffle plate and the inlet is set at the bottom, the flow of water goes up the flock. This leads low efficiency of sedimentation.
- There is a baffle plate at the point of outlet, but the water flows out at the weir. The weir load itself is 233 m^3/day/m, which is less than 500 m^3/day/m, but the floating flocks are carried over to the next basin as they are.
- The ratio of length to the width is 1.44, but the desirable ratio is about three (3) to eight (8).
- The desirable surface loading of the sedimentation basing is normally from 15 to 30 mm/min and this plant falls within the appropriate range.
- As the length width ratio is small, the average flow speed is less than 400 mm/min.
- The accumulation of sludge was not found in the sedimentation basin as it is cleaned once in a month.

Table 14.3.31 Aeration (NZUWASA)

Item	Specifications
Structure	Reinforced concrete
Year of completion	1960's
Effective dimension	D4.5 m x W4.0 m x L4.0 m
Effective capacity	72 m^3

- The plant is equipped with an aeration facility after the sedimentation basin. However, the aeration process is not necessary, considering the quality of raw water. It seems very possible that the plant can use the former treatment facility as it is.

Table 14.3.32 Raw Water Reservoir (NZUWASA)

Item	Specifications
Structure	Circular reinforced concrete
Year of completion	1960's
Effective dimension	D1.65 m x φ7.2 m
Effective capacity	Approx. 67 m^3
Detention time	0.8 hour (design)

- As now the plant does not use a rapid filter, the water is pumped up from the raw water reservoir into the receiving well. As their water level is similar, it is better to install a bypass pipe, and lead water directly into the receiving well so that it might not waste energy.

Table 14.3.33 Filtration Basin (NZUWASA)

Item	Specifications
Type	Rapid filtration
Structure	Steel φ1.2 m x H1.5 m
Number of vessel	8 units
Year of completion	1st 2 units 2001, 2nd 6 units 2004
Design flow rate	100 m^3/hour (12.5 m^3/hour per filter)
Filtration flow rate	11.1 m/hour
Control method	Automatic operation, PLC monitoring
Process pump	100 m^3/hour x 35 mH x 50HP
Back wash pump	40 m^3/hour x 25 mH x 12.5HP
Blower	75 m^3/hour x 5 mH x 7 kW
Support layer	Basalt approx. 100 mm depth
Main bed	Quartz approx. 550 mm depth
Top layer	Anthracite approx. 350 mm depth

- As there is a problem with the pneumatic power for operation of the valve, it has not been used for two (2) years ago since 2007.
- The pump which was designed for filtering is now used for distribution of water into the receiving well and has becomes overworked.
- The rapid filter is made in Israel so that the spare parts such as valve and etc. are not easily available.

Table 14.3.34 Clear Water Reservoir (NZUWASA)

Item	Specifications
Structure	Circular reinforced concrete tank
Year of completion	2001
Effective dimension	D2.3 m x φ8.2 m
Effective capacity	Approx. 121 m^3
Hour-amount	1.5 hours (design)

4) Transmission Facilities

Table 14.3.35 Transmission Pump (NZUWASA)

Item	Specifications
Pump capacity	35 m^3/hour x 195 mH x 28.18 kW x 2 units
Year of installation	2009

- Those pumps are used for distribution of water to four (4) reservoirs in the town. However, although there is a difference of elevation among them, the specification of the pumps is the same.

Table 14.3.36 Transmission Main (NZUWASA)

Item	Specifications
Diameter	110 mm, 160 mm
Material	PVC and Cast Iron (CI)
Type of pipes material, size and length	2.2 km (6" CI) 3.0 km (160 mm PVC) 3.9 km (110 mm PVC)

5) Distribution Reservoir

There are four (4) reservoirs at present. The two (2) reservoirs among them are an elevated tank.

- Total effective capacity: 525 m^3
- Total hour-amount: 10.5 hours (Actual)

Table 14.3.37 Hospital Tank (NZUWASA)

Item	Specifications
Structure	Elevated panel tank
Year of completion	N/A
Effective capacity	Approx. 180 m^3

Table 14.3.38 Ushilika Tank (NZUWASA)

Item	Specifications
Structure	Stone masonry ground tank
Year of completion	N/A
Effective capacity	Approx. 135 m^3

- As this is a stone masonry tank, the water will leak if the water level rises. Therefore, the tank is operated at a low water level.

Table 14.3.39 Parking Tank (NZUWASA)

Item	Specifications
Structure	Elevated panel tank
Year of completion	2001
Effective capacity	Approx. 75 m^3

Table 14.3.40 Nyasa Tank (NZUWASA)

Item	Specifications
Structure	Reinforced concrete ground tank
Year of completion	2001
Effective capacity	Approx. 135 m^3

- The tank is distributing water for the surrounding areas, but as it is on the ground, the pressure will be not enough when the water level of the tank becomes less than half.

6) Distribution Network

The table below shows the composition of the distribution network.

Table 14.3.41 Distribution Network (NZUWASA)

Item	Specifications
Total length	Approx. 31 km
Type of pipes material, size and length	0.9 km (6" DIP) 6.6 km (4" PVC) 2.4 km (4" GSP) 5.869 km (3" PVC) 0.65 km (3" GSP) 4.8 km (3" CI) 0.95 km (2-1/2" PVC) 7.2 km (2" PE) 1.1 km (2" GSP) 0.9 km (1" Polyethylene Pipe (PE))

14.3.4 SUWASA

(1) Outline of SUWASA

SUWASA withdraws water from the Utyatya Dam, which is located about 15 km east of the town, and purifies the water at the treatment plant which sits next to the Dam. After the treatment, the water is delivered into the reservoir in the town and distributed by gravity. The water supply service was started in 1974 and SUWASA was established in 2005.

- Population of town: 11,411 (2009)
- Served population: 3,800
- Ratio of served population: 33%
- Daily water production: 150 m^3/day
- Daily water consumption: 110 m^3/day

(2) Situation of Assistance

Currently SUWASA have ongoing project including TUWASA and UUWASA. The purpose of this assignment is to improve the water supply and sanitation services in Tabora Municipality, Sikonge and Urambo townships.

(3) Existing Conditions of the Authority

The following is a description of the present water supply conditions of SUWASA.

1) Service Area

The service area of SUWASA is shown in Table 14.3.42.

Table 14.3.42 Service Area (SUWASA)

Area	Administrative unit	
	Ward	Village
Current Service Area	Sikonge	Sikonge
		Mwamayunga
Future Service Area	Chabutowa	Chabutowa
	Igigwa	Lufisi
		Tumbili
	Sikonge	Igalula
		Kisanga
		Mkolye
		Mlogolo
		Mwamayunga
	Tutuo	Tutuo

2) Location of Water Supply Facilities and Water Supply Flowchart

The location of water supply facilities and water supply flowchart are shown in Figure 14.3.8 and Figure 14.3.9.

FIGURE 14.3.8 LOCATION OF WATER SUPPLY FACILITIES OF SUWASA

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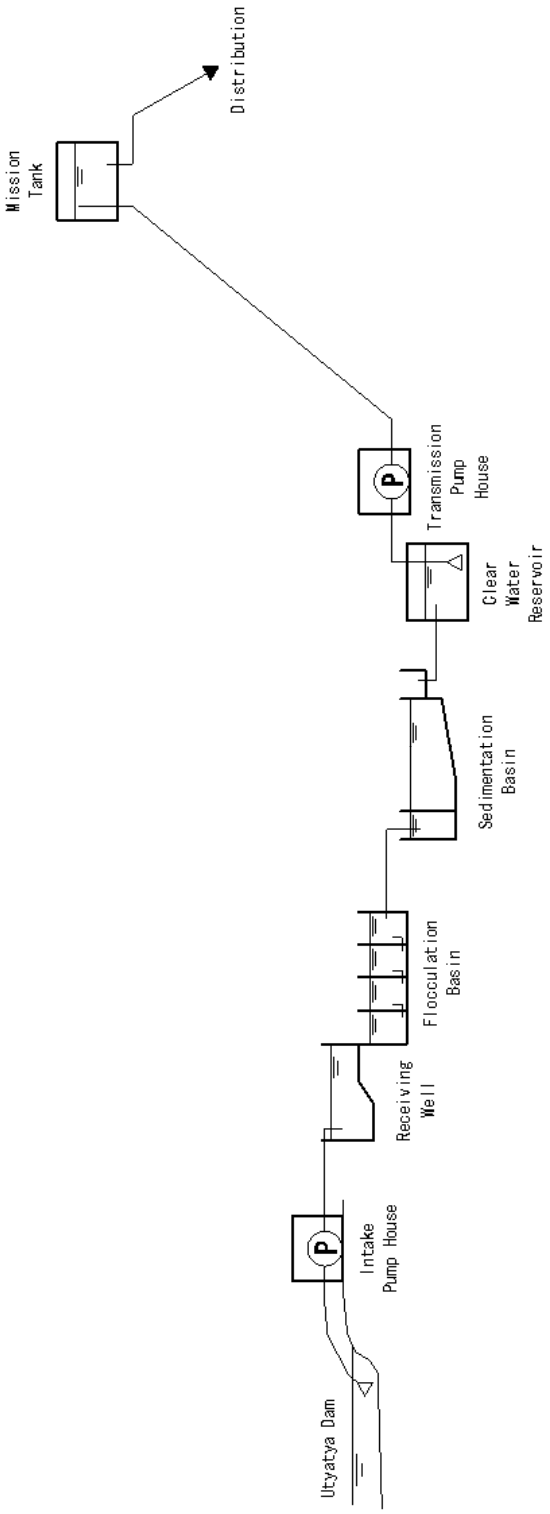

FIGURE 14.3.9 WATER SUPPLY FLOWCHART OF SUWASA

3) Water Quantity

The table below shows the average water quantity of SUWASA.

Table 14.3.43 Water Quantity (m^3/day) (SUWASA)

Water production	Actual water billed	Water loss
150	110	40

4) Water Quality

As SUWASA does not conduct a water analysis, there is no data on water quality.

5) Leakage

The ratio of unaccounted water is estimated about 27%. The composition of the unaccounted water is divided into leakage from pipes (11%) and commercial loses (16%).

6) Average Service Hours

The service hour is one (1) hour/day in the dry season and two (2) hours/day in the rainy season. SUWASA divided the areas and distributes water for each area once in three (3) days. As it takes about three (3) hours for the tank to become empty, this means that each area will have the service one (1) hour/day on average.

(4) Operation and Maintenance

1) Organisation Chart and Staff

The organisation chart of SUWASA is shown in Figure 14.3.10. The present composition of the staff is as follows;

- Permanent Staff: five (5)
- Part-Time Staff: 10

However, SUWASA needs to employ 29 staffs in total as shown in the chart in order to operate their activities effectively.

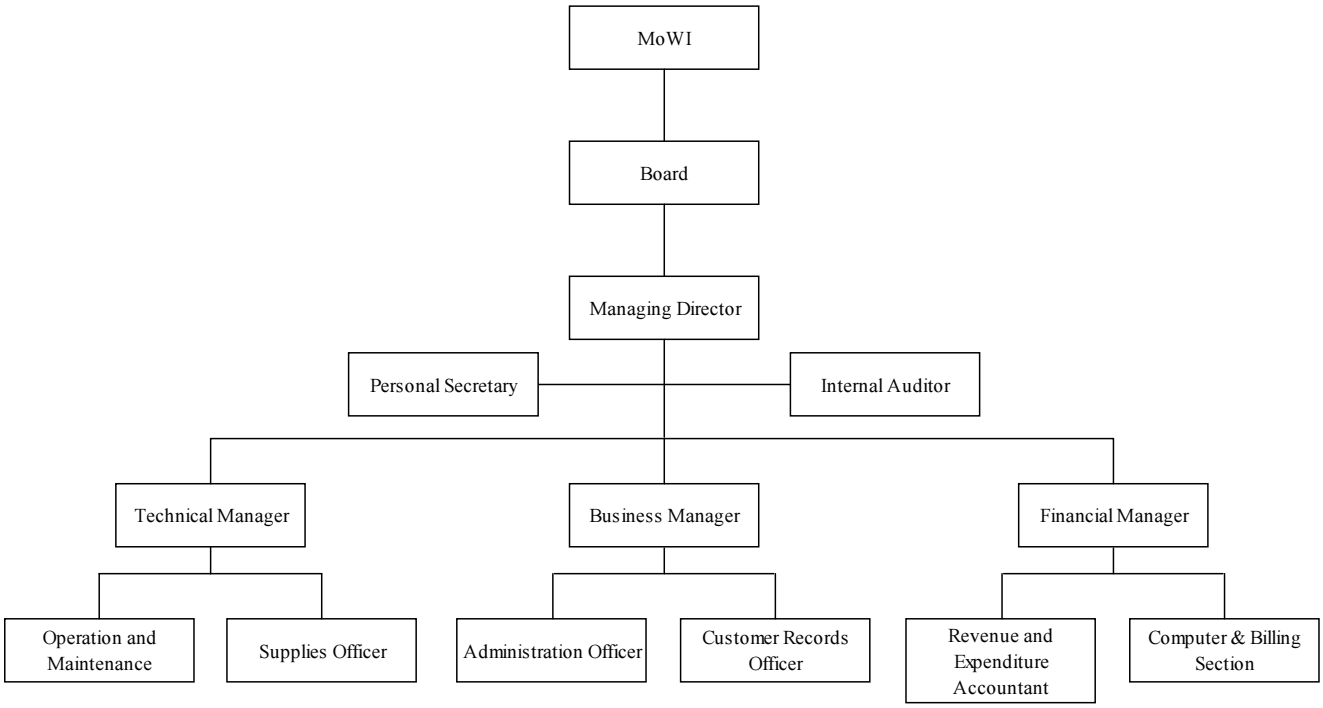

Figure 14.3.10 Organisation Chart of SUWASA

2) Finance

The table below shows the revenue and expenditure of SUWASA in FY 2005/2006. As SUWASA had started its operation in 2005, it is difficult to say that the authority was stable in the year 2005/2006. The Study Team could not obtain the statement of account of the year 2008/2009 and figure out its details, but the revenue stated in the Business Plan of 2007 was 10.4 million Tsh in 2007.

Table 14.3.44 Revenue and Expenditure (SUWASA)

Item	Amount (Tsh)
REVENUE	
Water Sales for Domestic	2,205,200
Water Sales for Institutional	2,041,475
Water Sales for Commercial	103,700
Other	197,13.15
Total	4,548,290
EXPENDITURE	
Diesel and lubricants	9,506,950
Chemicals	1,666,800
Personnel	10,534,800
Other Operation & Maintenance Costs	1,478,000
Total	23,186,550
BALANCE	-18,638,260

Source: SUWASA, 2006

3) Connection

SUWASA had 123 connections on December 2006. The table below shows the detailed types of connections. 50 water metres are installed among them.

Table 14.3.45 Number of Connections (SUWASA)

Domestic	Institution	Commercial	Others	Total
98	17	8	N/A	123

Source: SUWASA, 2006

4) Water Tariff

The water tariff is charged by with or without having a water metre and way of use of water. Details of the Water tariff are in the chart below.

Table 14.3.46 Water Tariff (SUWASA)

Custormer Category	Metered	Unmetered
	Tsh/m^3	Tsh/month
Domestic	800	5,500
Institution	900	9,500
		25,000*
Kiosk	1,000	N/A

*The member of institution is over 300.

5) Revenue Collection

The revenue collection efficiency is about 80%. The government facilities owe almost all the uncollected tariffs. They shall certainly pay but not on a monthly basis.

(5) Existing Conditions of Water Supply Facilities

1) Water Source

SUWASA use two (2) types of water source (Dam and six (6) shallow wells. However, almost all the amounts of water are withdrawn from the Utyatya Dam.

Table 14.3.47 Water Source (SUWASA)

Item	Specifications
Type and name of water source	Utyatya Dam
Year of completion	1959
Storage volume	690,000 m^3 (design), 290,000 m^3 (present)
Intake type	Direct (by suction pipe)
Pump capacity	15 m^3/hour x 80 mH x 5.64 kW
Installation year of pump	2009
Operation hour of pump	average 9 hours/day
Suction pipe	GSP φ80 L = approx. 57 m

- It is troublesome to extend or remove the suction pipe in accordance with the changes of the water level during the dry and rainy season.
- The pump installed for the Dam is capable to deliver the water directly into the reservoir if the water quality is good. Therefore, if the pump delivers the water into the treatment plant next to the Dam, its capacity is too large.
- Photovoltaic panels are installed for the dam. However, as they are not enough for the pump capacity, they are used only for the lights in the room.
- A water metre is not equipped and the pressure gauge is broken.
- As a Crib is not equipped and it withdraws the water directly, water with sand and turbidity is delivered.
- The Pump House was built in 1974.

2) Conveyance

Table 14.3.48 Conveyance Main (SUWASA)

Item	Specifications
Diameter	φ100
Material	PVC, GSP
Length	Approx. 93 m
Year of completion	1974

- Considering the design amount of water, it shall be 0.5 m/sec and the strength of pipe does not matter.

3) Water Treatment Plant

The water treatment plant was built in 2004 through assistance of the Tanzania-Japan Counter Fund. The table below shows the details of each facility.

- Design Capacity: 340 m^3/day

Table 14.3.49 Receiving Well (SUWASA)

Item	Specifications
Structure	Reinforced concrete tank
Year of completion	2004
Effective dimension	D1.0-0.6 m x W2.2-0.85 m x L3.0 m
Effective capacity	Approx. 5 m^3
Detention time	21 min (design)

Table 14.3.50 Coagulant (SUWASA)

Item	Specifications
Name of coagulant	Aluminium sulfate
Type	Solid
Dosing point	Receiving well
Dosing type	Direct
Feed Rate	Max 45 kg, Ave 30 kg, Min 25 kg (volume/10 hours)

- The solid coagulant is injected directly into the receiving well without dissolution. Therefore, the concentration of the coagulant is not stable. As a result of a simple test of pH at the receiving well, it was found that the pH of raw water (9.3) is rapidly decreasing into 6.2 in the receiving well. If a coagulant is installed at the entrance of flume, the concentration may not occur as such because of the water flow.
- The ratio of coagulant injection was at first decided by a jar test conducted by a technician, and now also the same ratio has been used. Originally, the ratio should be decided appropriately in accordance with the change of water quality.

Table 14.3.51 Rapid Mix Chamber (SUWASA)

Item	Specifications
Structure	Reinforced concrete
Type	Hydraulic (flume)
Year of completion	2004
Effective dimension	D0.62 m x W0.85-0.30 m x L1.3 m
Effective capacity	Approx. 0.5 m^3
Detention time	2.1 min (design)

- As the present water production is less than 50% of the design, the speed of water flow is

slow. This makes the mixing process ineffective.

- The rear of the rapid mix chamber expands suddenly and the speed of water flow is decreasing at this point. A short cutting flow is also generated and the flocks are floating on both sides.

Table 14.3.52 Flocculation Basin (SUWASA)

Item	Specifications
Structure	Reinforced concrete
Year of completion	2004
Effective dimension	D1.1 m x W1.2 m x L1.45 m x 5 units
Effective capacity	Approx. 9.6 m^3
Detention time	40 min (design)
Average flow speed	23 cm/sec (design)

- There is no problem with the detention time.
- The system applies Alabama-type flocculator, which leads water from the bottom up to the surface and after that the water sinks down and flows into the next chamber. This system requires 2.5 m water depth at least, but this plant has only 1.1 m so that it is estimated that the generation of flocks is not appropriate.

Table 14.3.53 Sedimentation Basin (SUWASA)

Item	Specifications
Structure	Rectangular reinforced concrete
Year of completion	2004
Effective dimension	D2.55 m (2.8-2.3 m) x W4.0 m x L10 m x 2 units
Effective capacity	Approx. 204 m^3
Detention time	14 hours
Inlet type	Baffle wall (open ratio is unknown)
Outlet type	φ150 hole in 2 place each
Weir load	567 m^3/day/m
Sludge removal	Using submersible pump
Frequency of sludge removal	Three times / year
Effective surface area	40 m^2/unit
Surface loading	3 mm/min
Ratio of length to width	2.5
Average flow speed	12 mm/min

- Normally it is necessary three (3) to five (5) hours as a detention time in the sedimentation basin, and the plant spares long enough (14 hours) for the detention time.
- The baffle plate for inlet is equipped but the ratio of the hole is unknown.
- The baffle plate for the outlet is not equipped and the water outflows from the hole (φ150) on the wall. The weir load is over 500 m^3/day/m. As sludge is accumulated up to the surface of the water, the flocks are carried over into the next chamber.
- The ratio of length to the width is 2.5, but the desirable ratio is about three (3) to eight (8).
- The desirable surface loading of the sedimentation basing is normally from 15 to 30 mm/min and that of this plant is three (3) mm/min, which is far less than the normal surface loading.
- The average flow speed is far less than 400 mm/min.

- The sludge of the sedimentation basin is cleaned three (3) times per year. This cleaning activity requires about 24 hours and the water supply stops during the cleaning. A submersible pump is used for draining sludge but it is not easy to evacuate the sludge from the basin by mixing it as the accumulated sludge becomes hard. If the cleaning activity is conducted regularly, it may be easier.
- As the sludge is not cleaned from the sedimentation basin, most parts of the basin are dominated by the sludge.
- The pipeline leads water from the flocculation basin into the sedimentation basin. However, as there is a difference of altitude between the two (2) basins, it is possible that growing flocks are broken inside the pipeline.
- Normally the filtering basin is necessary after the sedimentation basin, but the plant is not equipped with one Therefore, the flocks are carried over and delivered directly into the reservoir or the distribution pipe as they are.

Table 14.3.54 Chlorination (SUWASA)

Item	Specifications
Name of chlorination	Calcium hypochlorite
Type	Powder
Dosing point	End of sedimentation basin
Dosing type	Gravity

- The chlorination is mixed every morning.
- The ratio of injection was decided by a former technician and has been used as it was.

Table 14.3.55 Clear Water Reservoir (SUWASA)

Item	Specifications
Structure	Circular reinforced concrete tank
Year of completion	2004
Effective dimension	D1.5 m x φ5.0 m
Effective capacity	Approx. 29 m^3
Hour-amount	2 hours

4) Transmission Facilities

Table 14.3.56 Transmission Pump (SUWASA)

Item	Specifications
Pump capacity	15 m^3/hour x 80 mH x 5.64 kw
Year of installation	2009

Table 14.3.57 Transmission Main (SUWASA)

Item	Specifications
Diameter	100 mm
Material	PVC
Length	12 km
Year of completion	1974

5) Distribution Reservoir

There are three (3) reservoirs but only the Mission Tank is operating at present.

- Total Effective capacity: 145 m^3 (Current)
- Total hour-amount: 10 hours (Current)

Table 14.3.58 Mission Tank (SUWASA)

Item	Specifications
Structure	Circular reinforced concrete ground tank
Year of completion	1970
Effective capacity	Approx. 145 m^3
Hour-amount	10 hours

Table 14.3.59 Madukani Tank (SUWASA)

Item	Specifications
Structure	Rectangular stone masonry ground tank
Year of completion	1966
Effective capacity	Approx. 25 m^3

- This tank is not used at present.

Table 14.3.60 Isugilunde Tank (SUWASA)

Item	Specifications
Structure	Circular stone masonry ground tank
Year of completion	1974
Effective capacity	Approx. 35 m^3

- This tank is not used at present.

6) Distribution Network

The table below shows the composition of distribution network.

Table 14.3.61 Distribution Network (SUWASA)

Item	Specifications
Total length	Approx. 11 km
Type of pipes material, size and length	1.86 km (6" PVC) 1.176 km (4" PVC) 0.2 km (3" PVC) 1.65 km (3" PE) 4.4 km (2" PE) 1.5 km (1-1/2" PE)

14.3.5 TUWASA

(1) Outline of TUWASA

TUWASA withdraws water from the Igombe and the Kazima Dam which are located about 20km north and 10km east of the Municipality. Those Dams are equipped with a water treatment plant and the water withdrawn from those dams is purified at the plants and delivered into the Kazeh Hill reservoir in the Municipality. From the reservoir, it is distributed by gravity. The water supply service was started in 1950's and TUWASA was established in 1998.

- Population of town: 175,557 (2009)-14 ward
- Served population: 151,000
- Ratio of served population: 86%
- Daily water production: 15,858 m^3/day
- Daily water consumption: 11,283 m^3/day

(2) Situation of Assistance

TUWASA plans to receive assistance from Swiss State Secretariat for Economic Affairs (SECO)

from 2006 on improvements of the water treatment plant. It also accepts the project by WSDP from 2008.

(3) Existing Conditions of the Authority

The following is a description of the present water supply condition of TUWASA.

1) Service Area

The service area of TUWASA is shown in Table 14.3.62. TUWASA takes the role of water supplier for all the Tabora Municipality areas. However, households are scattered except for the 14 centre wards, so that it is difficult to install a profitable distribution network for the entire Municipality. The table below shows the current service areas and the future service areas.

Table 14.3.62 Service Area (TUWASA)

Area	Administrative Unit	
	Ward	Village
Current Service Area	Chemchem	
	Cheyo	
	Gongoni	
	Ipuli	
	Isevya	
	Kanyenye	
	Kiloleni	
	Kitete	
	Mbugani	
	Tambukareli	
	Ng'ambo	
	Misha	Igambilo
		Itaga
		Misha
Future Service Area	Malolo	
	Mtendeni	
	Itetemia	Itetemia
	Uyui	Uyui

2) Location of Water Supply Facilities and Water Supply Flowchart

The location of water supply facilities and water supply flowchart are shown in Figure 14.3.11 and Figure 14.3.12.

FIGURE 14.3.11 LOCATION OF WATER SUPPLY FACILITIES OF TUWASA

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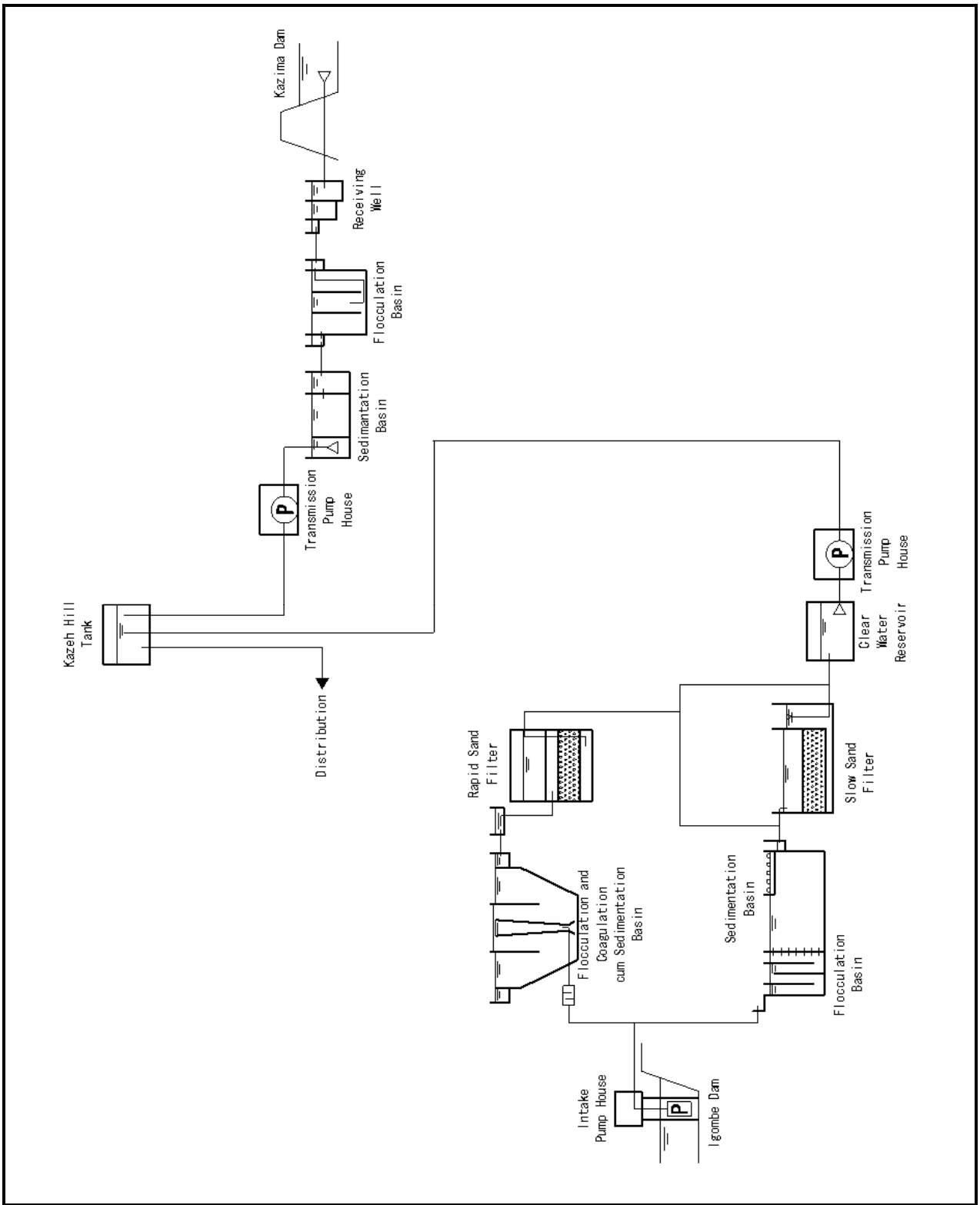

FIGURE 14.3.12 WATER SUPPLY FLOWCHART OF TUWASA

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3) Water Quantity

The table below shows the average water quantity of TUWASA in 2007/2008.

Table 14.3.63 Water Quantity (m^3/day) (TUWASA)

Water production capacity	Actual water produced	Billable water	Actual water billed	Water loss
17,450	15,858	15,541	11,283	4,575

Source: TUWASA, 2008

- The ratio of water production of each water source is as follows; the Igombe Dam: 86.1%, the Kazima Dam: 13.8% and Shallow Wells: 0.1%.

4) Water Quality

The table below shows the results of the water analysis, which was conducted on September 19th, 2009. All the parameters satisfied the Tanzania Temporary Standards (T.T.S) and WHO Standards about the treated water, although Turbidity is same as T.T.S.

Table 14.3.64 Water Quality (TUWASA)

Sampling point	Turbidity (NTU)	E.coli (0/100mL)	pH	TDS (mg/L)	E.C (mS/m)	F^- (mg/L)	Cl^- (mg/L)	Fe^{3+} (mg/L)	R.Cl (mg/L)
Igombe raw	88	210	6.96	25	50	0.4	10.3	0.09	N/A
Kazima raw	75	120	6.7	30	60	0.6	8.3	0.1	N/A
Igombe treat	5	0	7.2	40	80	0.25	12.6	0	0.5
Kazehill tank	5	0	7.3	30	60	0.2	8.1	0	0.3
T.T.S	25mg/L	0	6.5-13.2	N/A	N/A	4.0	800	1.0	N/A
WHO	5	0	6.5-9.5	N/A	N/A	1.5	-	-	N/A

Source: Daily Water Sampling, Date16/03/2009

5) Leakage

There is no water metre at the outlet of the reservoir so that an accurate amount of water outflow cannot be detected, but it is estimated that the ratio of unaccounted water is approximately 29%. 20% of the unaccounted water is a result of physical leakage and the remaining is of commercial loss. The main cause of leakage is the aging degradation of the cast-iron pipe which was installed in the 1960's.

6) Average Service Hours

The service hours are normally 12 to 18 hours/day. At present, it is 8 to 12 hours as the water treatment plant of the Kazima Dam is not operating because of the decreasing level of water in the Dam.

(4) Operation and Maintenance

1) Organisation Chart and Staff

The organisation chart of TUWASA is shown in Figure 14.3.13. The present composition of the staff is as follows. The total number of staff is 85.

- Technical Department: 41
- Commercial Department: 29
- Financial and Administration Department: 15

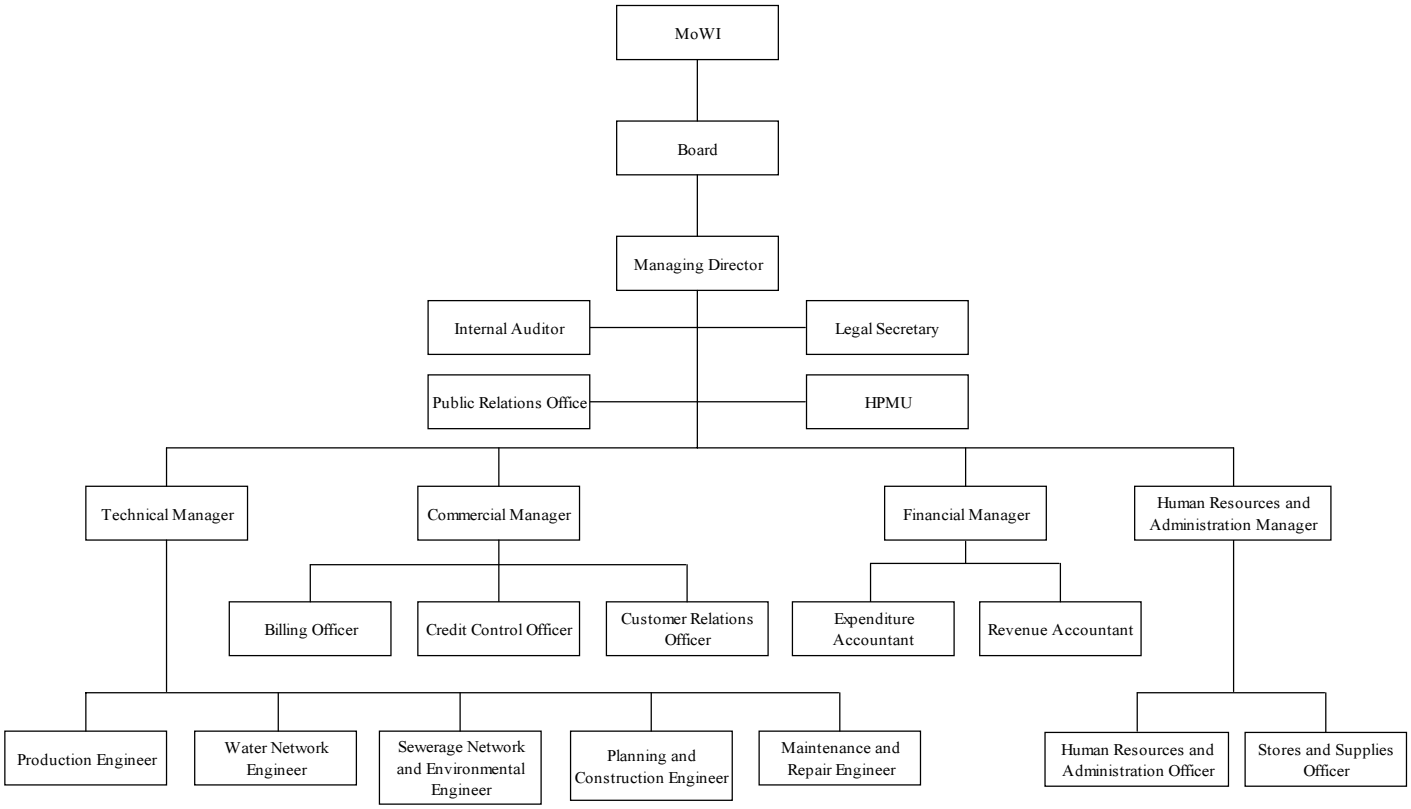

Figure 14.3.13 Organisation Chart of TUWASA

2) Finance

The table below shows the revenue and expenditure of TUWASA in the fiscal year 2007/2008. As TUWASA is in the Category A, it has to manage all the costs for operation and maintenance such as staff salary and electricity costs by themselves as well as a part of cost for construction of the facility. It achieves a budget surplus in 2007/2008.

Table 14.3.65 Revenue and Expenditure (TUWASA)

Item	Amount (Tsh)
REVENUE	
Water sales	1,426,379,357
Sewerage	20,610,150
Other	13,006,450
Total	1,459,995,957
EXPENDITURE	
Water production expenses	342,029,873
Distribution expenses	464,337
Sewerage disposal and sanitation	3,328,655
Maintenance and repair expenses	39,575,407
Personnel expenses	310,405,370
Administration expenses	252,653,716
Business promotion expenses	13,944,960
Events and donations	12,648,000
Total O&M expenses	975,050,318
Other expenses	1,842,371
Provision for depreciation	97,626,106
Development expenditure	101,130,869
Total	1,175,649,664
BALANCE	284,346,293

Source: TUWASA, 2008

3) Connection

TUWASA has 9,711 connections. The table below shows the detail types of connections. 7,756 water metres are installed among them.

Table 14.3.66 Number of Connections (TUWASA)

Domestic	Institution	Commercial	Others	Total
13.172	213.1	198	50	9,711

Source: TUWASA, 2008

4) Water Tariff

The water tariff is charged by with or without a water metre and method of water use. And it applies a step-up tariff system in order to prevent wasteful use of water. The present water tariff was approved by EWURA on June 2009. The detail of the water tariff is as follows:

Table 14.3.67 Water Tariff (TUWASA)

Custormer Category	Metered		Unmetered
	Range (m^3)	Tsh/m^3	Tsh/month
Domestic	1-10	540	12,000
	10-15	630	
	Above 15	720	
Institutions	1-15	630	25,000
	Above 15	670	
Commercial	1-15	900	25,000
	Above 15	1,170	
Industrial	1-20	1,170	30,000
	Above 20	1,260	
Kiosks		600	N/A

Source: EWURA, 2009

5) Revenue Collection

The revenue collection efficiency is 68%. Late payment of current bills is by Government institutions. The settling of current bills for large government institutions was late for some months resulting in a burden in executing Authority's works programme.

(5) Existing Conditions of Water Supply Facilities

1) Water Source

TUWASA has two (2) main water sources, the Igombe Dam and the Kazima Dam, which are located 20km north and two (2) km east of the Municipality. In addition, it has the shallow wells in the Municipality but the ratio for the water production is only about 0.1%.

Table 14.3.68 Water Source-1 (TUWASA)

Item	Specifications
Type and name of water source	Igombe Dam
Year of completion	1958
Storage volume	41 million m^3
Intake type	Tower
Pump capacity	480 m^3/hour x 24 mH x 45 kW x 2 submergible pumps, 342 m^3/hour x 1 floating pump
Installation year of pump	2004 (submergible), 1913.2 (floating)
Operation hour of pump	24 hours/day

- It smells in the dry season as the algae are growing.

Table 14.3.69 Water Source-2 (TUWASA)

Item	Specifications
Type and name of water source	Kazima Dam
Year of completion	1952
Storage volume	1.2 million m^3
Intake type	Crib (by gravity)
Operation hour	Normally 18 hours/day

- The drought of 1999 to 2000 made the water level decrease so that TUWASA could not operate the water treatment plant at that time. This year the decreasing water level makes it unable to treat water.

2) Igombe Water Treatment Plant

The capacity of the Igombe Water Treatment Plant is 15,000 m^3/day. The plant applies a system composed of the suspended solid contact unit (the flocculation basin and suspended solid contact clarifier), the rapid filter basin with siphon method and the slow filter basin (this is used if the turbidity is high).

- Design Capacity: 15,000 m^3/day

Table 14.3.70 Mixing Chamber (TUWASA)

Item	Specifications
Structure	Steel
Year of completion	1913.1
Effective dimension	φ700 mm x L1.0 m

Table 14.3.71 Coagulant (TUWASA)

Item	Specifications
Name of coagulant	Aluminium Sulfate
Type	Solid
Dosing point	Before mixing chamber
Dosing type	Pump
Feed Rate	1,150 liter/hour
Concentration	40-80 mg/l
Installation year of pump	1913.2

- The Injection House was built in 1970's.
- The ratio of injection is decided by jar test.
- Agitator has not been functioning since two (2) months ago because of failure in the switch.

Table 14.3.72 Flocculation and coagulation with Sedimentation Basin (TUWASA)

Item	Specifications
Structure	Reinforced concrete
Year of completion	1913.1
Effective dimension	Lower φ13m x upper side φ20.5 m x H8.4 m
Effective capacity	Approx. 2,000m^3
Detention time	3.2 hours
Outlet type	Weir type
Weir load	Actual: 454 m^3/day/m , Design: 227 m^3/day/m
Sludge Removal	Flush out with valve operation
Frequency of Sludge Removal	6 times/day (every 4 hours)
Effective surface area	330 m^2
Surface Loading	32 mm/min

- The suspended solid contact unit normally needs 1.5 to 2 hours for detention time, and this plant secures 3.2 hours.
- The surface loading is slightly over the 15 to 30 mm/min, which is the design value for the sedimentation basin.
- The outlet is an overflow weir type. Half of the weir is unable to be used because of degradation of the weir. The weir loading is 454 m^3/day/m, if the calculation is based on the operating weir length. It is in fact less than 500 m^3/day/m, but it is twice of the

design value so that the stable treatment might be difficult.

Table 14.3.73 Filtration Basin – Rapid Sand Filter (TUWASA)

Item	Specifications
Type	Rapid filtration
Structure	Reinforced concrete φ5.6 m
Number of unit	4 units
Year of completion	1913.1
Filter are	23.767 m^2/unit
Filter media	Only sand
Thickness of filter media	450 mm (φ0.5 mm), 150 mm (φ0.7-1.2 mm)
Filtration flow rate	158 m/day
Control method	Automation (by siphon)
Frequency of back wash	Normally 2 times/day/unit

- Normal filtering system applies only in the rapid filtering process after suspended solid contact process.
- As the plant employs the rapid filtering system with a siphon method, it operates automatically without any manual handling.
- The chlorine gas pipe for sterilising algae is not functioning at present.
- The filtering sands are cleaned once a year.

Table 14.3.74 Filtration Basin – Slow Sand Filter (TUWASA)

Item	Specifications
Type	Slow filtration
Structure	Reinforced concrete
Number of unit	5 units
Year of completion	1978
Effective dimension/unit	W20m x L30 m/unit
Filter area	600 m^2/unit
Sand cleaning frequency	2 times/month

- If the turbidity of the water after the treatment of the suspended solid and rapid filtering processes is higher than the standard, the slow sand filter basin is utilised. The slow sand filter basin is operating especially in the dry season as the rapid filtering basin cannot treat the water with high turbidity affected by the algae.
- If all the processes of water treatment including the slow sand filter basin are utilised, the treatment speed becomes 5 m/day, which is the normal speed of the slow filter process.

Table 14.3.75 Chlorination (TUWASA)

Item	Specifications
Name of chlorination	Calcium hypochlorite
Type	Powder
Dosing point	Before clear water reservoir
Dosing type	Gravity
Feed rate	25 liter/hour
Residual concentration	2 - 4 mg/l

- Previously the chlorine was injected by pump, but at present it is injected from the tank by gravity.

Table 14.3.76 Clear Water Reservoir (TUWASA)

Item	Specifications
Structure	Reinforced concrete semi-underground tank
Year of completion	1974
Effective dimension	D2.5 m x W14 m x L14 m
Effective capacity	Approx. 490 m^3
Hour-amount	0.8 hour

3) Kazima Water Treatment Plant

The capacity of the Kazima Water Treatment Plant is 2,400 m^3/day. The plant applies the system of treatment by gravity utilising the water level of the Dam. However, it becomes unable to treat water when the water level of the Dam gets lower. The Study Team found that the plant was not functioning because of the low level of the water.

- Design Capacity: 2,400 m^3/day

Table 14.3.77 Receiving Well (TUWASA)

Item	Specifications
Structure	Reinforced concrete
Year of completion	N/A
Effective dimension	D1.6 m x W2.2 m x L1.5 m, D1.5 m x W2.2 m x L1.5 m
Effective capacity	Approx. 10.3 m^3
Detention time	6.2 min

- Without a measuring flow facility, TUWASA is not able to manage appropriate injection of coagulant.
- Both chlorine and coagulant are injected into the receiving well by gravity.

Table 14.3.78 Flocculation Basin (TUWASA)

Item	Specifications
Structure	Circular reinforced concrete
Year of completion	N/A
Effective dimension	φ7.0 m x H4.9 m
Effective capacity	Approx. 189 m^3
Detention time	1.9 hours

Table 14.3.79 Sedimentation Basin (TUWASA)

Item	Specifications
Structure	Rectangular reinforced concrete
Year of completion	N/A
Effective dimension	D2.5 m x W3.6 m x L3.0 m
Effective capacity	Approx. 27 m^3
Detention time	0.3 hour
Inlet type	Baffle wall (8 holes x φ150)
Outlet type	Weir type
Weir load	667 m^3/day/m
Effective surface area	10.8 m^2
Surface loading	154 mm/min
Ratio of length to width	0.83
Average Flow Speed	185 mm/min

- Normal sedimentation basin needs 3 to 5 hours for detention time, but the plant spares only 0.3 hour.
- There is a baffle plate at the inlet and a weir at the outlet. The weir loading of the plant becomes over 500 m^3/day/m, which is the normal value.
- The ratio of length to width is 0.83, but the desirable ratio is about three (3) to eight (8).
- The desirable surface loading of the sedimentation basin is normally 15 – 30 mm/min, but the value of the plant was 154 mm/min, which is far beyond the value.
- The ratio of length to width is inversion so that the average flow speed is less than 400 mm/min.
- There is no clear water reservoir and the plant withdraws water directly with the suction pipe, and it delivers the water into the reservoir.

4) Transmission Facilities – From Igombe to Kazeh Hill Tank

The two (2) Transmission Pumps are functioning at present, which are installed for the Igombe Treatment Plant. A water metre is not installed and the amount of transmission is not monitored. At night the water is delivered into the Kazeh Hill Tank, while from the morning until evening it is distributed directly into the pipeline of Municipality without delivered into the tank.

Table 14.3.80 Transmission Pump-1 (TUWASA)

Item	Specifications
Pump capacity	420 m^3/hour x 159 mH x 250kW
Year of installation	1996

Table 14.3.81 Transmission Pump-2 (TUWASA)

Item	Specifications
Pump capacity	460 m^3/hour x 188 mH x 355 kW
Year of installation	2000

Table 14.3.82 Transmission Pump-3 (TUWASA)

Item	Specifications
Pump capacity	460 m^3/hour x 188 mH x 355 kW
Year of installation	2000

- It has not been functioning since November 2008.

Table 14.3.83 Transmission Pump-4 (TUWASA)

Item	Specifications
Pump capacity	380 m^3/hour x 141 mH x 250 kW
Year of installation	1993

- It has not been functioning since November 2008.

Table 14.3.84 Transmission Main (TUWASA)

Item	Specifications
Diameter	φ300-φ600
Material	DI
Type of pipes size, length and installation year	12.23 km (φ600)-2000 3.2 km (φ500)-1978 14.5 km (φ400)-1978 2.9 km (φ300)-1978

5) Transmission Facilities – From Kazima to Kazeh Hill Tank

Table 14.3.85 Transmission Pump (TUWASA)

Item	Specifications
Pump capacity	128 m^3/hour x 110kW
Year of installation	2004

Table 14.3.86 Transmission Main (TUWASA)

Item	Specifications
Diameter	φ300
Material	CI

6) Distribution Reservoir

The treated water is distributed by gravity from the Kazeh Hill Tank, the only distribution reservoir. There is no flow metre so that the amount of distributed water is not monitored.

- Total Effective Capacity: 5,865 m^3
- Total hour-amount: 8.9 hours (Actual)

Table 14.3.87 Kazeh Hill Tank (TUWASA)

Item	Specifications
Structure and year of completion	Rectangular: 1,365 m^3-1958 Circle: 2,250 m^3-1983 Circle: 2,250 m^3-2000
Total Effective Capacity	5,865 m^3
Total hour-amount	8.9 hours

7) Distribution Network

The distribution network is made up of pipes of diameters ranging from 75mm to 3000mm. The pipes originate from Kazeh Hill Tanks to various sites of the town. Generally the available distribution network is not extensive, and very old lines are located mostly within the town centre while the new developing areas have few distribution networks. Frequent pipe bursts in town centre are because of ageing of the cast iron pipes laid in 1960's and this contributes to physical high water losses. The total length of the distribution network is 230km.

Table 14.3.88 Distribution Network (TUWASA)

Item	Specifications
Total length	Approx. 230 km
Pipe size	From 75 mm to 3000 mm

14.3.6 UUWASA

(1) Outline of UUWASA

UUWASA withdraws water from the Farm II Corner Well, the Block Q Well and the No. 9 Well, which is located about 7.5km south, 2km south and the centre of the town. It delivers the water to the two (2) reservoirs in the town and distributes it by gravity from there. The water supply service was started in 1976 and UUWASA was established in 2005.

- Population of town: 30,104 (2009)
- Served population: 4,800
- Ratio of served population: 16%
- Daily water production: 74 m^3/day
- Daily water consumption: 48 m^3/day

(2) Situation of Assistance

Currently UUWASA have on-going projects including TUWASA and SUWASA. The purpose of this assignment is to improve the water supply and sanitation services in Sikonge and Urambo townships.

(3) Existing Conditions of the Authority

The following is a description of the present water supply condition of UUWASA

1) Service Area

The service area of UUWASA is shown in Table 14.3.89. The present service area is Urambo Town only. Although UUWASA does not cover all the areas of Urambo Town, it plans to expand its service to whole area of the town.

Table 14.3.89 Service Area (UUWASA)

Area	Administrative Unit	
	Ward	Village
Current Service Area	Urambo	Urambo Kati
		Urambo Kusini
		Urambo Magharibi
		Urambo Mashariki
Future Service Area	Urambo	Urambo Kati
		Urambo Kusini
		Urambo Magharibi
		Urambo Mashariki

2) Location of Water Supply Facilities and Water Supply Flowchart

The location of water supply facilities and water supply flowchart are shown in Figure 14.3.14 and Figure 14.3.15.

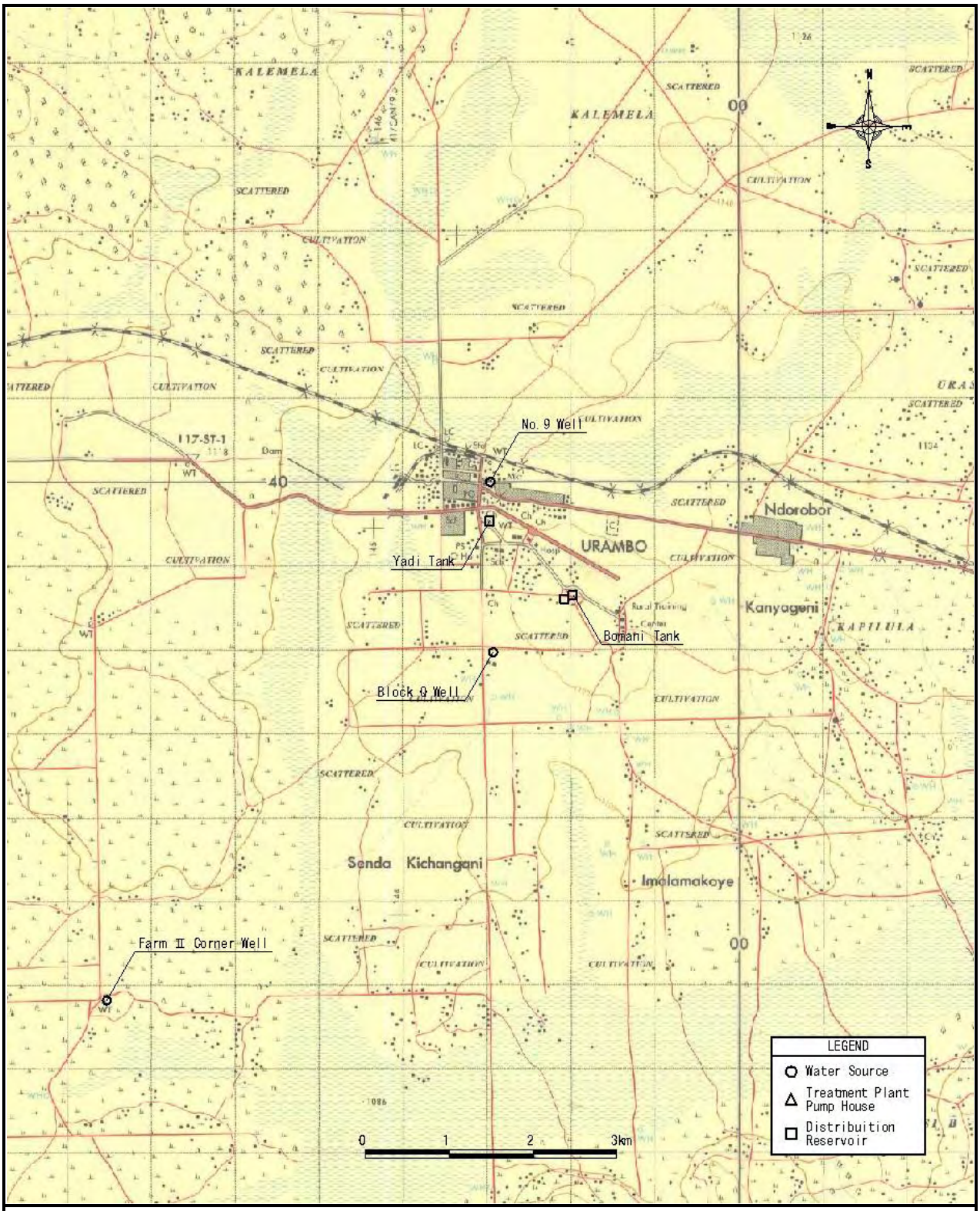

FIGURE 14.3.14 LOCATION OF WATER SUPPLY FACILITIES OF UUWASA

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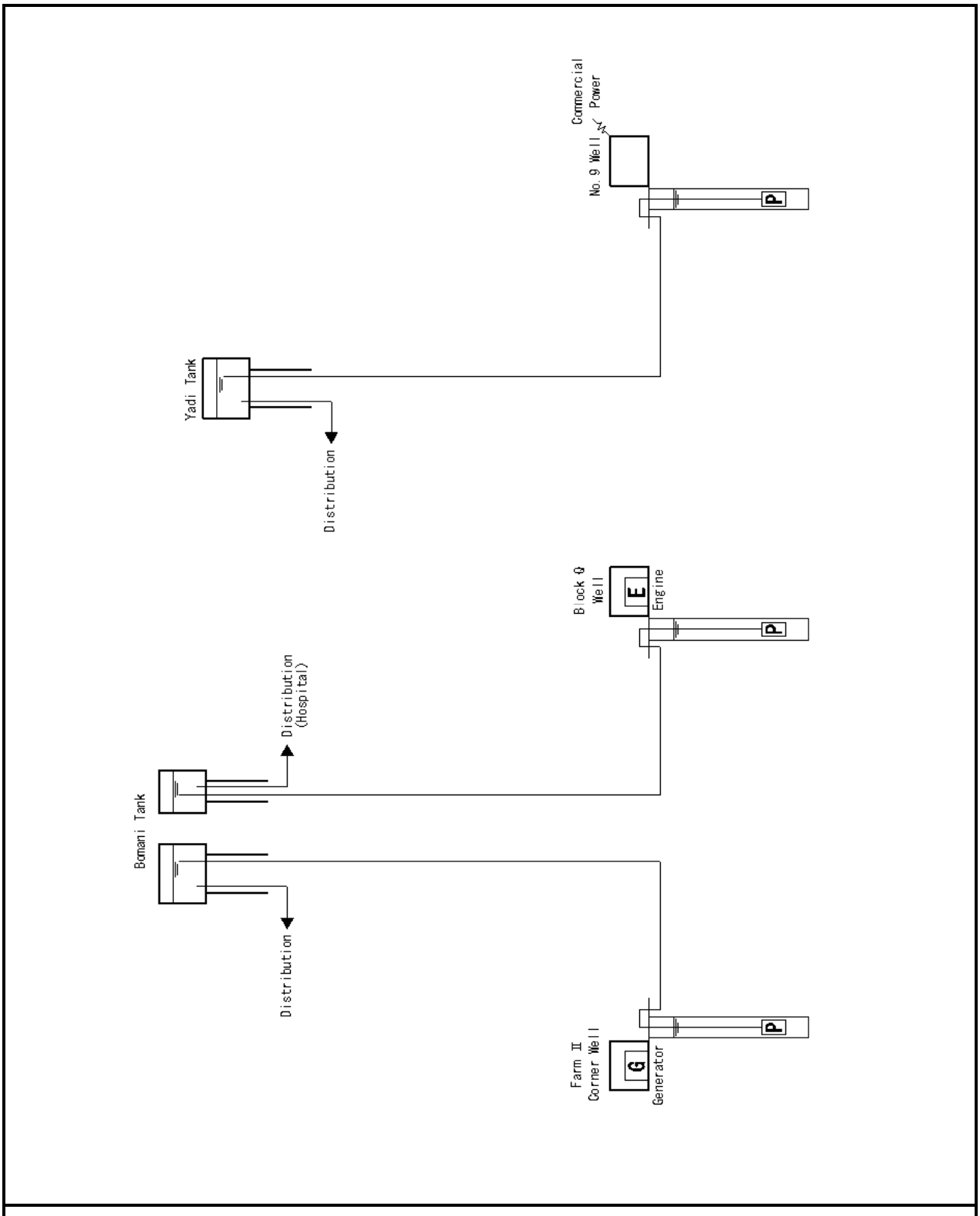

FIGURE 14.3.15 WATER SUPPLY FLOWCHART OF UUWASA

3) Water Quantity

The table below shows the average water quantity of UUWASA in 2007/2008.

Table 14.3.90 Water Quantity (m^3/day) (UUWASA)

Water production	Actual water billed	Water loss
74	48	26

- The total maximum water intake is 74 m^3/day, but sometimes stops withdrawing water because of electricity failure. Therefore, the total average water production throughout the year becomes 32 m^3/day.

4) Water Quality

All the water sources of UUWASA are deep wells and the water analysis is not conducted as the water quality is comparatively good. However, it is said that the water from the Block Q Well and the No. 9 Well is saline though its concentration is not so high.

5) Leakage

The ratio of leakage is not accurately monitored. It is said that it is 40% in the urban area, where the water supply service was started in the earlier stages and about 30% in the other areas.

6) Average Service Hours

The pump operating hours are 8 hours/day in the dry season and 6 hours/day in the rainy season. The reason why the service hours in the rainy season are shorter is that the customers use also rain water.

(4) Operation and Maintenance

1) Organisation Chart and Staff

The organisation chart of UUWASA is shown in Figure 14.3.16. The present composition of the staff is as follows:

- Permanent Staff: three (3) (Acting Managing Director, Acting Business Manager and Acting Technical Manager)
- Part-Time Staff: six (6) (Cashier, Meter Reader and four (4) Watch Men)

There are some vacant positions. In addition, the managing position is covered by the acting staff.

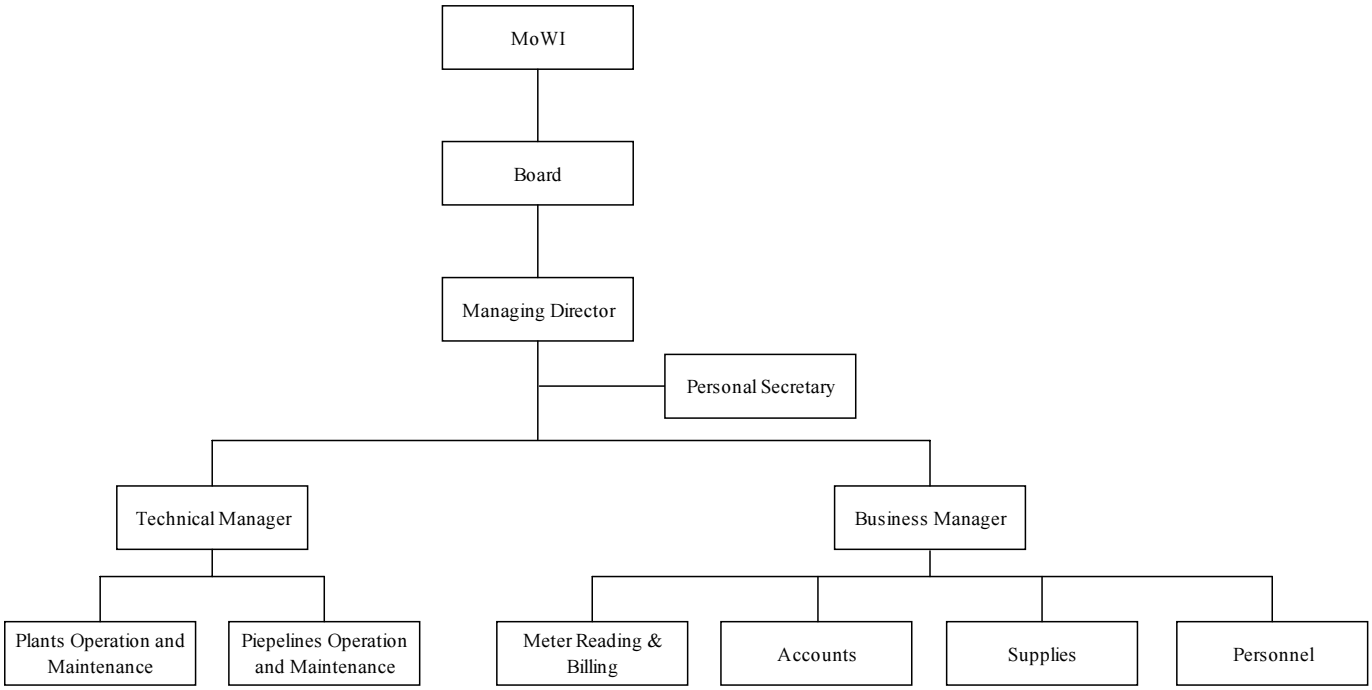

Figure 14.3.16 Organisation Chart of UUWASA

2) Finance

The table below shows the revenue and expenditure of UUWASA in the FY2007/2008. The expenditure is 1.7 times bigger than the revenue and it cannot manage the costs for operation and maintenance by the revenue itself.

Table 14.3.91 Revenue and Expenditure (UUWASA)

Item	Amount (Tsh)
REVENUE	
Total	8,443,227
EXPENDITURE	
Recurrent	14,706,200
Total	14,706,200
BALANCE	-6,262,973

Source: UUWASA, 2009

3) Connection

Currently UUWASA has 128 connections. 106 water metres are installed among them.

4) Water Tariff

The water tariff is charged by with or without a water metre and method of use of water. The present water tariff was established in 2005. The details of the water tariff are as follows:

Table 14.3.92 Water Tariff (UUWASA)

Custormer Category	Metered	Unmetered
	Tsh/m^3	Tsh/month
Domestic	700	5,000
Institution-small	700	10,000
Institution-big	700	20,000
Commercial	700	10,000
Kiosk	700	N/A

Source: Basler & Hofmann, 2009

- The customers who accept the flat rate (unmetered) should pay the tariff to with or without the water supply service though the service stops in case of am electricity failure, which makes the customers dissatisfied with the flat rate payment.

5) Revenue Collection

The revenue collection efficiency is 80%.

(5) Existing Conditions of Water Supply Facilities

1) Water Source

UUWASA withdraws water from three (3) water sources. One of them is the Farm II Corner Well at 10km south of the town, the second is the No. 9 Well at the centre of the town and another is the Block Q Well at 2km south of the town.

Table 14.3.93 Water Source-1 (UUWASA)

Item	Specifications
Type and name of water source	Farm II Corner Well
Well type	Deep well
Year of completion	1978 (new borehole was constructed in 2002 within the field)
Maximum well yield	5.9 m^3/hour
Well yield	4.8 m^3/hour
Depth	40 m
Diameter	6”
Material	Casing: PVC, Screen: PVC
Pump type	Submersible pump
Pump capacity	4.8 m^3/hour
Power	Diesel engine generator (2007)
Installation year of pump	2007
Operation hour of pump	8 hours/day

- The photovoltaic panels had been used until 2006 since they were installed in 2002. Actually they had not been used as the panels do not meet the pump capacity.
- A submersible pump was installed with the UUWASA funds while the MoW replaced the engine.

Table 14.3.94 Water Source-2 (UUWASA)

Item	Specifications
Type and name of water source	No.9 Well (Majengo well)
Well type	Deep well
Year of completion	1976
Maximum well yield	N/A
Well yield	3.8 m^3/hour
Depth	63 m
Diameter	6”
Material	Casing: PVC, Screen: PVC
Pump type	Submersible pump
Pump capacity	3.8 m^3/hour
Power	Commercial power
Installation year of pump	2008
Operation hour of pump	8 hours/day

- The diesel engine was replaced by commercial power in 2008 in order to decrease the energy costs.
- The facility itself suffers from heavy aging degradation.
- Some amount of saline is found in the water.

Table 14.3.95 Water Source-3 (UUWASA)

Item	Specifications
Type and name of water source	Block Q Well
Well type	Deep well
Year of completion	1979
Maximum well yield	2.0 m^3/hour
Well yield	1.5 m^3/hour
Depth	64 m
Diameter	6”
Material	Casing: SP and PVC, Screen: PVC
Pump type	Vertical shaft pump with engine
Pump capacity	1.5 m^3/hour
Power	Diesel Engine (2006)
Installation year of pump	1999
Operation hour of pump	4 hours/day

- The water supply facility is used exclusively for the hospital.
- The facility itself suffers from heavy aging degradation.
- Some amount of saline is found in the water.

2) Transmission Facilities

There are three rising mains, from the three boreholes. The mains can be briefly described as follows:

Table 14.3.96 Transmission Main-1 (UUWASA)

Item	Specifications
Section	Farm II corner well to Bomani Tank
Diameter	100 mm, 90 mm
Material	mainly PVC
Length	7.4 km

Table 14.3.97 Transmission Main-2 (UUWASA)

Item	Specifications
Section	Block Q well to Bomani Tank
Diameter	80 mm
Material	HDPE
Length	0.5 km

Table 14.3.98 Transmission Main-3 (UUWASA)

Item	Specifications
Section	No.9 well to Yadi Tank
Diameter	100 mm, 80 mm, 3”
Material	PVC (100 mm, 80 mm), GSP (3”)
Length	1.2 km

3) Distribution Reservoir

There are two reinforced concrete block-work tanks and one steel tank on five (5) m raisers.

- Total Effective capacity: 97.5 m^3
- Total hour-amount: 32 hours (Actual)

Table 14.3.99 Bomani Tank (UUWASA)

Item	Specifications
Structure	Reinforced concrete block-work tank
Year of completion	1970’s
Effective capacity	Approx. 45 m^3

- As the tank size is φ5 m x 5 mH, it can contain about 90 m^3. However, as the tank is too old to hold full amount of water and leaking, it operates with about half the amount of water.

Table 14.3.100 Bomani (Hospital) Tank (UUWASA)

Item	Specifications
Structure	Steel tank
Year of completion	1970’s
Effective capacity	7.5 m^3

- The tank is one of the four (4) steel tanks. The other three (3) tanks have corrosion holes and cannot be used.

Table 14.3.101 Yadi Tank (UUWASA)

Item	Specifications
Structure	Reinforced concrete block tank
Year of completion	1970's
Effective capacity	Approx. 45 m^3

- As the tank size is φ5 m x 5 mH, it can contain about 90 m^3. However, as the tank is too old to hold full amount of water and leaking, it operates with about half the amount of water.

4) Distribution Network

The total length of the existing distribution system is about 15 km, most of which was laid before the 1970's. The DI pipes DN100 were reported to have been constructed in the 1950's and are completely blocked due to encrustation and have been abandoned.

Table 14.3.102 Distribution Network (UUWASA)

Item	Specifications
Type of pipes	DI, GS, PVC and HDPE
Pipe size	From 20 mm to 100 mm
Total length	Approx. 20 km

14.4 WATER SUPPLY IMPROVEMENT PLAN

14.4.1 GENERAL

The study found that the UWASAs have received assistance from such donors as WSDP Each UWASA except for NZUWASA has been disbursed supporting funds for drastic improvement or expansion of its water supply facilities, which is shown in the following sections.

The study aims to recommend and advise an improvement plan of the existing water supply facilities based on the results of the baseline survey. All the UWASAs except for NZUWASA have already been surveyed for the present conditions and implementing the projects for improvement of their facilities. Therefore, to establish an improvement plan for the water supply facilities of those UWASAs except for NZUWASA shall be duplication with the object of this study. Accordingly, in this section, the Study Team recommends the improvement plan for NZUWASA, which has not established an improvement plan for its facility until now.

(1) SECO Project: TUWASA

The SECO Project is a tripartite programme between the Swiss Government through State Secretariat for Economic Affairs (SECO) and the Tanzania Government and the respective UWSAs of Dodoma and Tabora aims at improving water supply and sanitation in these towns.

The SECO Project was implemented during the year 2006 and the agreement between the Swiss Government and Tanzanian Government was signed on 7th August, 2006. Thereafter the contract between the Swiss Government and Consultant firm of Switzerland was signed in Switzerland on 15th June, 2007.

Initially the aim was to rehabilitate the water supply infrastructures and a private operator was intended to deal with water production where TUWASA was supposed to sell the water received from the private operator and pay back the money to the operator to cover the O&M expenses known as Public Private Partnerships (PPP). This option was not directly agreed by the TUWASA Board of Directors even after having a study tour. The resolution for discontinuation of the PPP

option was reached by the TUWASA Board of Directors in November, 2008.

SECO was supposed to disburse USD 5.2 Million towards the project but due to the failure of the PPP option the negotiations are still under way on how to utilize the amount. During the joint meeting between SECO, TUWASA and MoW held in December, 2008. SECO was willing to disburse this amount to TUWASA instead of transferring it to the WSDP basket fund. TUWASA in collaboration with the Consultant have already prepared and sent to SECO the proposals for utilization of this money for approval. The proposed activities to be done at Igombe water works are as follows;

- Rehabilitation of existing treatment plant
- Construction of new treatment plant similar to the existing ones
- Construction of reservoir tank
- Supply and installation of pump sets
- Rehabilitation of two (2) existing transformers
- Supply and installation of stand-by generator

As some of these proposed activities were also planned to be implemented under WSDP and under the supervision of the same Consultant, it was agreed that the Consultants have to complete the design work under WSDP and after procurement of the Contractor, the activities that will be done at Igombe plant will be financed under SECO.

Other activities to be implemented under SECO Project are as follows:

- Rehabilitation of water supply system in some area of Tabora Municipality
- Supply and installation of bulk water supply meters at the intakes and in several zones
- Capacity building (including lab equipments, computers, water testing in various laboratories within and outside the country)

(2) WSDP Project: TUWASA, SUWASA and UUWASA

The programme is financed by the Tanzanian Central Government through the MoW. In the Tabora Region, originally it was intended to improve the water supply system in Tabora Municipality but later the towns of Urambo and Sikonge were included under the supervision of the Managing Director for TUWASA. The activities are sub-divided into two phases whereby Phase I is for design of works and Phase II is the construction of works.

1) Phase I

The Contract for Phase I between TUWASA and the Consultant firm of Switzerland was signed on 30 October, 2008 for a contract value of USD 463,600; the effective date of the contract is 30 November, 2008 and the contract duration is nine (9) months and the contract for Phase II will be signed depending on the successful completion of Phase I.

In this phase, the Consultant will perform the following activities:

- Water demand for the project area up to year 2025
- Sewage discharge for the project area up to year 2025
- Detailed design report and tender documents.
- Required capital investment for the rehabilitation, improvement and extension of the existing infrastructure.
- Tariff analysis, affordability, willingness to connect and willingness to pay.
- Detailed operation and maintenance plans developed showing resource requirement,

financing plans and required appropriate skills.

- Training and capacity building plan / requirements.
- EIA results report and the mitigation measures.
- Required capital investment for the operation and maintenance of the infrastructures.
- Social, economic and financial impact of the projects.
- Preparation of tender documents and award of contract.

2) Phase II

After the completion of Phase I, the Consultant will also supervise the construction of the proposed water supply and sewerage works that include the following activities:

- Design and supervise the construction for the improvement of existing treatment plant at Kazima dam to accommodate 6,000 m^3/day against the existing plant capacity of 2,400 m^3/day.
- To design and supervise the construction of the distribution network to the un-served and new developed areas for Ipuli, 4.8km long, Cheyo 1.4km long, Kariakoo 1.4km long, Kipalapara 3km long and Mtendeni – Uyui JWTZ camp 3.6km long.
- Supervise the construction of new rising main from Tabotex with 600mm DI pipes, 5km long. This has to replace the existing old steel pipes of diameter 300mm. This section is very old as it was laid in the 1950's, dilapidated and leaking severely and also under-capacity due to increase in demand.
- Procure and install new additional pumping set of discharge capacity 250 m^3/hour and 160 m pumping head. This is to increase water production from the current 2,400 m^3/day to 6,000 m^3/day.
- Additional rising main of length 3.2km with DI pipes of 400mm.
- Design and supervise the construction of new rising main from Kazima Dam 300mm DI pipes, 12km long. This has to replace the existing old cast iron pipes of 300mm to accommodate expected 6,000 m^3/day.
- Review / update the detailed design and tender document for invitation of tenders to contractors for implementation of the immediate work.
- Increasing water production of the treatment plant from current 17,400 m^3/day to 35,000 m^3/day to meet the demand levels of year 2025.
- Perform ground water quantity to serve proposed areas of Inara, Kazima and Lwanzari.
- Increasing storage capacitates from existing 5,865 m^3 to 13,365 m^3 by constructing new storage tank of capacity 5,000 m^3 at Kazehill and 2,500 m^3 at Uyui JWTZ camp.
- Expansion of the distribution system and tertiary network to un-served and new developing areas.
- Rehabilitation of the distribution system in central areas.
- Ground water verification and exploratory drilling
- Design and supervise the construction of new rising main 300mm DI pipes, 9km from Tabotex to Uyui IWTZ camp via Mirambo Barracks / Kiloleni to feed expected 2,500 m^3 reservoir tank.
- Upgrading the water treatment works at Kazima dam

3) Objectives and Scope of the Project for Sikonge and Urambo

The purpose of the assignment is to improve water supply and sanitation services in the Sikonge and Urambo townships. The consultant should draw up the investments required for the entire

work and supervise the contractors during the construction works. The task includes the following:

- Identify bottlenecks in the existing system.
- Suggest measures needed to improve water supply and sanitation services in each town in the short term. The tasks will include rectifying bottlenecks in existing water sources, malfunctioning existing scheme and in uncompleted projects.
- Draw up the investments required for the entire work in phases, and provide detailed design and tender documents for the short term.
- Carry out detailed studies to improve water and sanitation situation in the three towns up to the year 2025 and make them sustainable and commercially viable.
- Identify the required improvements (technical, institutional, commercial and management in each town)
- Supervise of the works in each town
- Conducting feasibility studies
- Carrying out detailed design
- Prepare tender documents
- Procurement of the contractor

(3) WSDP Project: IGUWASA

The programme uses funds by WSDP for the programme activity. This programme is a rehabilitation project of the water supply system and civil works for Igunga town including three villages of Mbutu, Ibutamisuzi and Hindishi. The contract for the construction of three (3) lots was concluded in July 2008 as well as the one for supervision of the construction and the design of the water treatment plant. In addition, the tender for construction of the water treatment plant, which was established in June 2009, has already been conducted. The following sections show the detail of each lot.

1) Rehabilitation of Gravity Mains and Civil works from Bulenya Dam to Igunta Town

The contract amount of this lot is 1.57 billion Tsh. The contents of the Works are the following:

- Construction of pipelines 315 - 40mm, total length 11.826km
- Construct one (1) tank volume 135 m^3 on 6m raiser
- Rehabilitate two (2) tank volume 105 m^3 on ground
- Rehabilitate two (2) cattle troughs and construct two (2) new tanks
- Install six (6) air valves and six (6) water meters and washouts

2) Rehabilitation of Water Distribution System and Civil Works in Igunga Town

The contract amount of this lot is 954 million Tsh. The contents of the Works are the following:

- Construction of pipelines 160 - 40mm, total length 19.79km
- Construct one (1) tank volume 135 m^3 on 6m raiser
- Rehabilitate two (2) tank, one (1) tank volume 105 m^3 on ground and one (1) tank volume 90 m^3 on 6 m raiser
- Construct one (1) new pump house
- Supply and install two (2) centrifugal electrical pumps
- Supply and Install 15 water meters and 12 washouts

3) Rehabilitation of Water Distribution System and Civil Works for villages of Mbutu, Ibutamisuzi and Hindishi

The contract amount of this lot is 1.16 billion Tsh. The contents of the Works are the following:

- Construction of pipelines 200-40mm, total length 36.421km
- Construct one (1) tank volume 45 m^3 on ground
- Rehabilitate three (3) tank volume 105 m^3 on ground
- Rehabilitate four (4) cattle troughs and construct three (3) new troughs
- Installation eight (8) air valves and 15 water meters and washouts
- Construct new two (2) taps water domestic points 10 nos.
- Construct new four (4) taps water domestic points 2 nos.

4) Consultancy Services for Above Works

The contract amount of this lot is 74 million Tsh. The contents of the Works are the following:

- Consultancy services in carrying out design, drawing, and preparation of engineer's estimates, and propose optimal packages for contracting the works and prepare tender documents for the implementation of the treatment plant to serve Igunga town, Mbutu, Ibutamisuzi and Hinish villages in Igunga district.
- Construction supervision for the treatment plant to serve Igunga town, Mbutu, Ibutamisuzi and Hindish villages and piped system and civil works for above construction works in Igunga district.

14.4.2 IMPROVEMENT PLAN OF NZUWASA

(1) Basic Policy

As mentioned in the section above, the Study Team proposes the improvement plan only for NZUWASA, and the basic policy of the plan is shown as follows:

- Design amount of water production of the treatment plant shall be the same as of the design capacity of the existing facility.
- It is supposed to rehabilitate the facility in order to improve the quality of treated water and to be operated appropriately.
- The plan is supposed to utilise the existing facility and basically not to construct a new facility.

(2) Design Policy

1) Selection of Expected Facilities to be Improved

Based on the result of the baseline survey, the Study Team will identify the main problems of each facility and propose an improvement plan to deal with the issues. In addition, based on the results, the Study Team will establish the priority standard in the aspects of imperiousness and easiness and select the facilities to be improved.

Table 14.4.1 Issues and Improvement Plan

Facility	Main Issue	Improvement Plan
Uchama Dam Intake Pump	The water is withdrawn from the Dam by suction method, but it generates cabitation to the pump and damages it.	・The pump shall be replaced by a vaccum pump ・Installation of self suction tank
Receiving Well/ Injection Facility	It is difficult to manage appropriate injection of coagulant.	・Installation of water metre for raw water flow ・Measurement of water flow of each pump in operation
	Coagulant and disinfectant are not mixed fully with raw water.	・Changes in the injection point
Flocculation Basin	As the flocks are not mixed, they cannot grow bigger.	・Installation of flock mixing device
Sedimentaiton Basin	As flocks are withdrawn from the bottom of intake wall, they roll up in the basin.	・Improvement of point of intake
	Flocks are carried over into next basin.	・Improvement in efficiency of sedimentation
Rapid Filtration	It is not fuctioning because of failure of valve	・Supply of new valve and replace of the malfunctioning one
Raw Water Basin	It wastes costs of electricity when the water in the raw water basin is pumped up into treatment basin.	・Installation of connecting pipe
Reservoir	As high water level of the Ushilika Tank makes it leaking from the bottom, it should be operated with low water level.	・Internal water proofing
	The water pressure becomes insufficient when the water level of Nyasa Tank is low.	・Installation of elevated tank ・Construction of small scale elevated tank and distribution pipes.

In accordance with the issues and improvement plan, the Study Team will select the priority facility as a proposed improvement plan of the study, from the aspect of urgency and easiness (planning and implementation).

Urgency

- High : Need to be addressed urgently
- Middle : Desirable to be addressed at an early stage
- Low : Negligible at present

Easiness

- High : Able to propose as a result of the present survey
- Middle : Need further investigation
- Low : Difficult to formulate and implement a plan, need a thorough survey and analysis

Table 14.4.2 Selection of the Facility to be Improved

Facility	Urgency	Easiness	Plan	Remark
Uchama Dam Intake Pump	Low	Low	No	The pump has just been replaced in 2009 and operates without any problems. It is necessary to conduct detail survey and verification for establishment of improvement plan, the plan is not easy to be made.
Receiving Well/ Injection Facility	Middle	High	Yes	This facility is not so urgent to be rehabilitated as the treated water quality satisfy the standard at present. It is necessary to verify the place to install the water metre, it is easy to monitor the flow of water from each pump in operation. In addition, it is also easy to change the point of injection of coagulant.
Flocculation Basin	Middle	Low	Yes	This facility is not so urgent to be rehabilitated as the treated water quality satisfy the standard at present. There is a constrain as it is a condition to use the existing facility.
Sedimentation Basin	Middle	Low	Yes	This facility is not so urgent to be rehabilitated as the treated water quality satisfy the standard at present. As it is necessary to conduct some measures in order to increase efficiency in sedimentation, this plan is not easy to implment.
Rapid Filtration	Low	Low	No	This facility is not so urgent to be rehabilitated as the treated water quality satisfy the standard at present. NZUWASA is planning to procure the new valve in order to replace the malfunctioning one.
Raw Water Basin	Low	Middle	No	It does not have any problems in operation. It is necessary to conduct a detail survey on relation of water level between the basins and the place of the existing pipes for verification of the connecting pipe.
Ushilika Tank	Low	Middle	No	This facility is not so urgent to be rehabilitated as it is operated with low water level. As for the internal water proofing, it is necessary to verify inside the tank and selection of waterproof agents before conducting the water proofing.
Nyasa Tank	High	Low	Yes	This facility is urgent to be rehabilitated as it has been complained of low water pureassure. The amount of water consumption in the target area is not identified at present, which is necessary for decision of capacity of expected elevated tank. Detail design of the connecting pipe cannot be completed as there is no drawing of distribution pipes.

Based on the discussion above, the Study Team proposes the following facility to be improved.

- Receiving well, injection facility
- Installation of baffle plates in flocculation basin
- Improvement of the sedimentation basin
- Improvement of water pressure of the Nyasa tank distribution

2) Design Standard

The improvement plan shall be compliant with the design standard of Japan Water Works Association (JWWA) for a design standard for rehabilitation of water treatment plant.

(3) Facility Plan

1) Receiving Well / Injection Facility

It is necessary to spread the coagulant into the raw water rapidly and equally to realise an effective flocculation. Therefore, it is necessary to mix them in several seconds.

The present method of coagulant injection is to drop it in front of the receiving well by gravity. As the water flow of the injection point is stable, the mixing of coagulant with the raw water is

insufficient.

The Study Team establishes a simple improvement plan as follows; to change the injection point of the coagulant from the receiving well to the upper outlet point of the flocculation basin, and to drop the coagulant from above, utilising the turbulence flow of the outlet of the receiving well for mixing the raw water and coagulant. As there are two (2) outlets, the Study Team proposes that another tank of coagulant should be added to the existing one.

The present point of injection of coagulant

The proposed points of injection

The flow of intake is not monitored at present. It is desirable to install a water metre and manage the amount of coagulant injection in accordance with the amount of water flow. However, the entire amount of water intake is generated by pumping, so it is possible to identify the draft amount of water flow by monitoring each amount of water intake generated by each pump (estimated by the capacity of the receiving well) and cranking in those values. It is possible to decide the amount of coagulant injection in accordance with monitored flow of water, so the water metre for the raw water flow is not expected to be installed.

- The contents of improvement of facility: nothing

2) Installation of Baffle Plates in Flocculation Basin

The flocculation basin is the second step for flocculation, which is for crashing flocks with each other in order to make them bigger, generated by the rapid mixing. Therefore, it is important to mix the flocks step by step so that the mixing can slow down and to crash and increase the flocks in order to accelerate the growth of flocks.

The existing flocculation basin is to be improved as it does not match with the mixing function. The plan applies the water flow method for mixing instead of the machinery flocculation such as using a mixing device which is not employed as it needs to install a new machine and electronic device and to operate and maintain them. The plan adopts using wooden boards which are easy to install as baffle plates dividing the basin. As flocks are withdrawn from the bottom of the intake wall, they roll up in the basin. Therefore, a wall shall be installed in the surrounding intake, which makes roll-up flowing until the middle of the basin. The following figure shows the draft plan of the baffle plate installation.

- Type: horizontal baffle type flocculation basin
- Material of Baffle Wall: wooden plate (water proof)

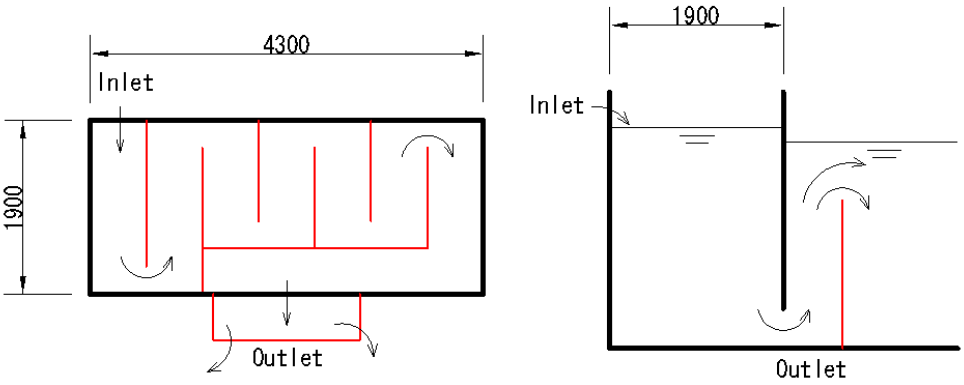

Figure 14.4.1 Installation of Baffle Plates into Flocculation Basin (Plan and Section)

3) Improvement of Sedimentation Basin

In normal rapid filtration, almost all the turbidity matters are removed from the raw water at the sedimentation basin, and thereafter at the process of filtration the small flocks which do not sink in the sedimentation basin are removed. Therefore, it is necessary to increase big and heavy flocks which sink rapidly in the sedimentation basin and are removed easily in the process of flocculation as the former one of sedimentation, which increases the sedimentation efficiency. The following is a measure to improve the sedimentation efficiency:

- To enlarge the proportion of sedimentation basin
- To accelerate the speed of sedimentation of flocks
- To decrease of amount of water flow

As per the acceleration of sedimentation speed of flocks, this measure shall be realised through the installation of baffle plates in the flocculation basin. As per the enlargement of proportion of sedimentation basin shall become true through installation of sedimentation devices such as inclined plates or tubes, as it is desirable to decrease the turbidity in the sedimentation basin because the treatment plant does not use rapid filtration thereafter. The plan applies the inclined plates, which are possible to be installed at comparatively low cost. The following figure shows the example of installation of inclined plates.

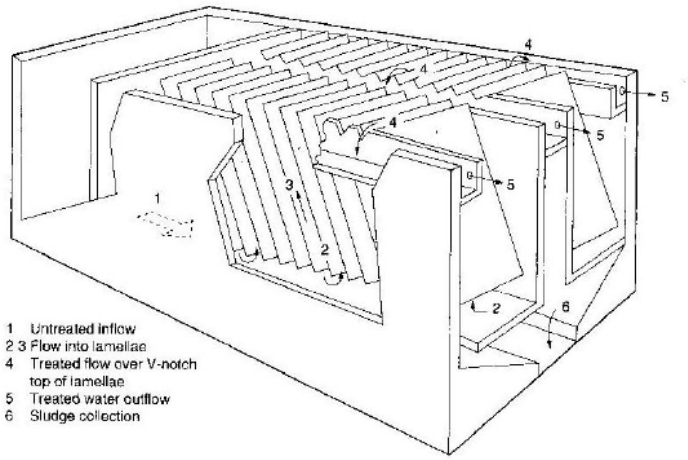

Figure 14.4.2 Installation of Inclined Plates in the Flocculation Basin

Source: MoWI, 2009

- Type: Horizontal-flow Sedimentation Basin with Inclined Plates
- Disposition of Inclined Plates: 10 steps x 10 lines x 4 units x 2 basins

- Size of Inclined Plates: D1.8m x W1.0m x L2.0m x 8 units
- Surface Loading of Inclined Plates: below 10 mm/min

4) Improvement of Water Pressure of the Nyasa Tank Distribution

The present issue on the distribution from the Nyasa Tank is that the surrounding households complain of low water pressure when the water level of the Nyasa Tank becomes low, the problem with low pressure is supposed to be limited to a part of the service area. Therefore, the Study Team estimates that there is no need to construct a new elevated tank which covers all the water of the entire service areas of the present Nyasa Tank, rather, the team proposes that a small scale elevated tank which covers the areas suffering from low pressure. The draft improvement plan is shown in the figure below. The plan aims to divide the service areas into a new elevated tank distribution and the Nyasa Tank distribution, and to install the new connecting pipe for the Nyasa Tank distribution. Basically, though it is necessary to conduct a detailed survey to establish a plan, the plan calculates the draft project budget based on the following assumption.

- Structure of Tank: Elevated Tank with Reinforced Concrete (H=5m)
- Capacity of Tank: 45 m^3 (Necessity is assumed to be about 1/3 of the present capacity)
- Distribution Pipe: it is assumed 4" PVC L = 1,000m

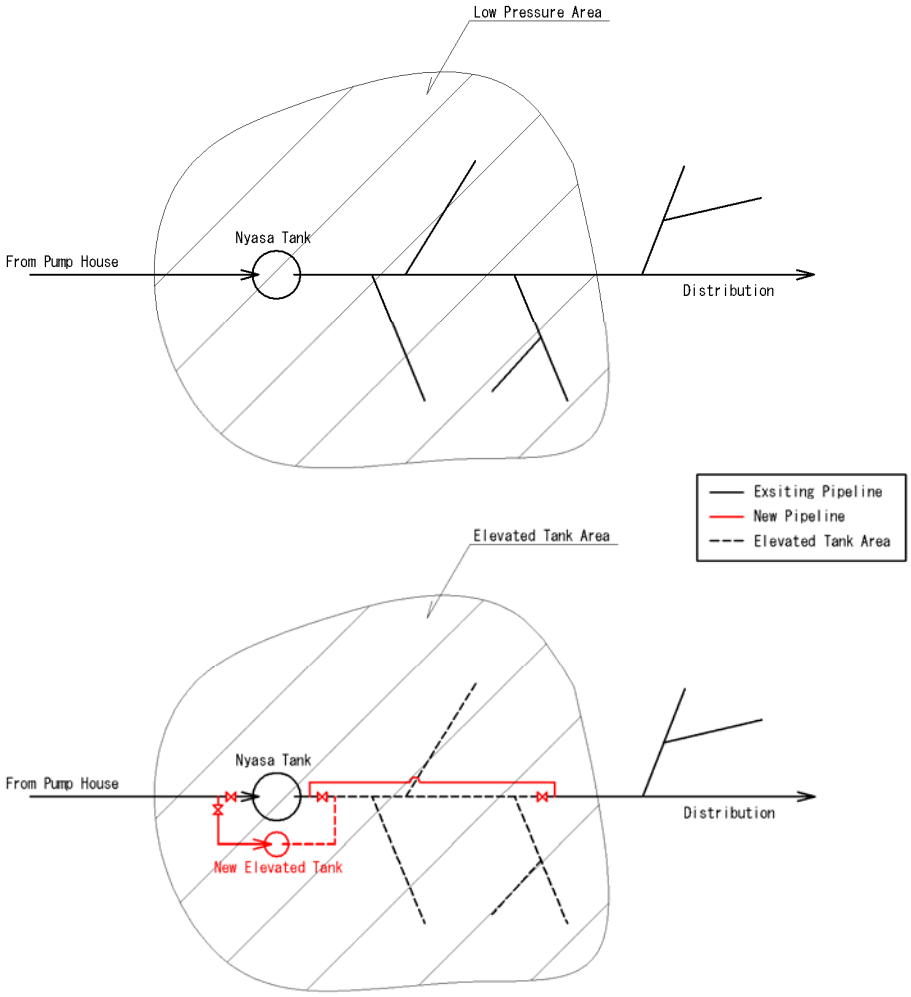

Figure 14.4.3 Nyasa Tank Distribution Area (Above: Present, Below: After Improvement)

(4) Project Budget

The following is the draft project budget, which is calculated from the plan of the facility in the section above.

The following estimation is the local (direct) construction cost by local contractors or suppliers, and does not include consulting fees, contingencies and other costs.

Conditions applied for the cost estimate are as follows:

- Date of Cost Estimation: October, 2009
- Currency Exchange Rate: 1US$ = JPY 89.98, 1Tsh = JPY 0.069

Table 14.4.3 Cost Estimation

Facility	Detail	Number	Cost (US$)	Remark
Receiving Well, Injection Facility	Replacement of the position of Injection Tank	1 unit	N/A	No construction
Improvement of Flocculation Basin	Installation of Baffle Wall	1 unit	6,000	
Improvement of Sedimentation Basin	Installation of Inclined Plates	1 unit	99,000	
Improvement of Nyasa Tank	・45 m^3RC Elevated Tank ・4" PVC L = 1,000 m ・Appurtenant Facility	1 unit	44,000	
Total			149,000	

14.4.3 PROPOSAL FOR IMPROVEMENT OF OPERATION AND MAINTENANCE

The Study Team has not conducted a detailed survey on operation and maintenance of the facility, so the team cannot propose a concrete plan for operation and maintenance. However, the team proposes an improvement plan of each UWASA, based on observed areas of each UWASAs during the survey.

(1) Water Quality Management

1) Raw Water Quality Management

It is necessary to manage raw water quality appropriately through regular water tests, as the management of raw water is an important factor for decision of amount of injection of coagulant and disinfection agents for treatment of water.

2) Treated Water Quality Management

As well as the management of raw water quality, it is necessary to manage the appropriate quality of water during the treatment process. Turbidity and pH are the important factors for deciding the injection ratio of coagulants, so management of treated water quality should be conducted.

3) Served Water Quality Management

It is necessary to conduct daily or regular water quality management at the service points such as the public taps. Especially it is necessary to monitor the residual chlorine concentration ratio to detect the disinfection effect.

(2) Water Amount Control

1) Intake Amount Control

It is necessary to monitor the intake amount as it has a close relationship with the amount of injection of coagulant in the treatment process.

2) Deliver and Distribution Amount Control

It is necessary to monitor the amount of leakage from the pipeline which delivers water from the pump to the reservoir and of the delivered water at the outlet of the reservoir. Especially it is desirable to monitor the outlet of the reservoir as it is important to detect the amount of leakage.

3) Leakage Amount Control

It is possible to estimate the leakage from the distribution network by the outlet amount of water at the reservoir and consumed water amount shown in the water metres installed in each household. In addition, it is desirable to consider applying another type of leakage management, which divides the water supply areas and installs water metres for each area.

(3) Facility Management

1) Facility Inventory

It is desirable to establish an inventory which shows the structure, scale, capacity, number, year of the completion and cost of construction of each facility, and to keep records of the condition of operation and maintenance of the facilities.

2) Drawing Inventory

It is desirable to establish a drawing inventory through arrangement of completion drawings of each facility, and to keep updating and recording with revision in every time a facility is newly constructed, expanded, improved, removed,etc..

3) Pipe Inventory

It is desirable to establish a pipe inventory which clarifies the year of installation, type of pipe, diameter, length, and type and place of slice valve, air valve and drain valve, and to keep updating records with revision every time it is malfunctioning, leaking and/or upgraded.

4) Water Supply Inventory

It is desirable to establish and keep an inventory which records the diameter of the pipe and year of installation of the water metre for each customer. According to the Operational Guidelines for the Urban Water Supply and Sewerage Authorities, 2007, established by WSDP, all the customers are supposed to install a water metre before 2010. Installation of a water metre will prevent the customers from excess use of water as a result of flat rate tariff system. It will also meet the complaint of the people who have to pay the same tariff even in a month when water supply is stopped for a long time.

5) Operation Record of Intake and Treatment Plant

It is desirable to establish and manage a format of daily operation record of intake and water treatment plant (quality of raw and treated water, amount of treated water, amount of chemicals used, power consumption and amount and pressure of distribution of water) and checklist for operation and maintenance (inspection of equipment maintenance, part replacement and repair).

6) Regular Drainage of Sludge

It is necessary to remove sludge regularly, which accumulates at the bottom of the sedimentation basin. The neglect of regular removal generates such problems as an unusual smell which is caused by decomposition of organic matter of the anaerobic sludge or difficulty in removal work because of hardened sludge. In addition, a large accumulation of sludge makes the detention time shorter or flocks easy to roll up in the basin, which causes such problem as flocks carrying over regularly.

7) Renovation Plan of Degradated Pipe

Each UWASA suffers from leakage or trouble caused by the degradation of pipes which were installed in the beginning, and requires much effort to deal with the waste of water or troubleshooting. It is desirable to include in the budget a yearly planned replacement of degraded pipes in order to avoid a case-by-case reaction against troubles or leakage.

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CHAPTER 15 REPAIRING OF EXISTING HAND PUMP

15.1 GENERAL

The inventory survey of existing water supply schemes carried out in the Study revealed that there exist 1,420 hand pumps in the rural area of Tabora (Study area) and 760 hand pumps of them were not functioning (November 2009). Then, the survey for repairing of hand pump was carried out to confirm the reason for not working, contents of malfunctioning and repairing cost (March 2010). According to the results of the survey there were some hand pumps which would recover the function by simple repairing.

Such hand pumps were repaired in the Study. In addition, explanation of importance of collecting water tariff and training on the repairing of the hand pump.

15.2 TARGET HAND PUMPS TO BE REPAIRED

The target hand pumps to be repaired were selected based on the result of the repairing survey. The number of hand pump was 27 Afridev pumps and 19 Tanira pumps, totaling 46 pumps. The number of village where the target hand pump exists is 41. Status of existing hand pump and the target hand pumps by District/Municipality are shown in Table 15.2.1.

Table 15.2.1 Status of Existing Hand Pumps and Number of Target Hand Pumps

District /Municipality	Existing Hand PUmp			Target Hand PUmp			Number of Village
	Total	Functioning	Unfunctioning	Afridev	Tanira	Total	
Igunga District	100	21	79	3	1	4	4
Nzega District	521	255	266	12	11	23	19
Sikonge District	127	56	71	0	5	5	5
Tabora Rural District	189	92	97	2	0	2	2
Tabora Municipality	85	56	29	1	0	1	1
Urambo District	398	180	218	9	2	11	10
Total	1,420	660	760	27	19	46	41
(%)	100	46.5	53.5	-			-

The list of target hand pump is shown in Table 15.4.1

15.3 METHOD OF REPAIRING

Community Based Resources Centre (CBRC) was selected by tendering from the consultants and NGOs with experience of repairing of hand pump. Prior to the repairing, CBRC called the community people in the target villages to explain and train on the following issues. After that CBRC repaired the target hand pump. The pamphlets prepared by CBRC for the issues below were distributed to the target villages.

(1) To collect water tariff in order to enable to purchase spare parts in malfunctioning of the hand pump.

(2) Explanation and training on maintenance and repairing of hand pump, showing the structure of hand pump.

15.4 RESULT OF REPAIRING

All the repaired hand pumps were inspected by the member of the Study Team and it was confirmed that all the repaired hand pumps were properly functioning (November, 2010).

Table 15.4.1 List of Hand Pump Repaired

No.	District/Municipality	HP Code	Ward No.	Ward	vs No.	Village/Street	SS No.	Sub-Village/Street	Location	Handpump No. in village	Lon	Lat	Type of Water Source	Type of Handpump	Water level	Well depth	Actual pump parts replaced	Actual concrete repairing
1	Igunga	IgVS-014HP-08	4	Igoweko	14	Uswaya	85	Mwakadele	Kamata	8	4.70404	33.51950	Deep well	Afridev	2	14.7	4 bearing bush,4 Bolt&Nuts, 1 Fulcram pin, 1 cup u seal, 1 o-ring, 2 riser main 3m	Cracked slab repaired
2	Igunga	IgVS-016HP-04	5	Igunga	16	Igunga Small Township	103	Stoo ya Pamba	Market	4	4.27874	33.87538	Deep well	Afridev	6	19	4 bearing bush,4 Bolt&Nuts, 1 Fulcram pin, 1 cup u seal, 1 o-ring, 1 flapper rubber	damaged apron and cracked cover repaired
3	Igunga	IgVs-064HP-01	18	Ndembez	64	Moyofuke	440	Shelui	Mr. Yohadna Mishoro	1	4.33268	33.53714	Deep well	Afridev	3	12	4 bearing bush, 1 Cup u seal, 1 o-ring,1 foot valve receiver,1 fulcrum pin, rope 100m	damaged apron repaired
4	Igunga	IgVS-055HP-03	16	Mwisi	55	Busomeke	378	Kati	Kaluma	3	4.52631	33.46684	Shallow well	TANIRA	1.2	4.2	handle pump 1pc, shock absorber 1pc, riser/rod 1.0m 1pc	well over repaired
5	Nzega	NZVS-006HP-03	3	Igusule	6	Sojo	40	Nseme	NSEME	3	3.93916	32.86778	Deep well	Afridev	6.5	52	Bearing bush 8pc, flapper rubber 1pc,cup u seal 1pc, plunger ring assembly and o-ring 1pc	Nil
6	Nzega	NZVS-006HP-04	3	Igusule	6	Sojo	36	Bombani	BOMBANI	4	3.95529	32.86791	Deep well	Afridev	11	50	Bearing bush 4pc, flapper rubber 1pc,cup u seal 1pc, plunger ring assembly and O-ring 1pc	Nil
7	Nzega	NZVS-006HP-05	3	Igusule	6	Sojo	36	Bombani	BOMBANI	5	3.96676	32.86699	Deep well	Afridev	11	59	Bearing bush 4pc, flapper rubber 1pc, cup u seal 1pc and plunger assembly	Nil
8	Nzega	NZVS-006HP-08	3	Igusule	6	Sojo	39	Ngogoto	NGOGOTO	8	3.98578	32.85896	Deep well	Afridev	48	70	Bearing bush 4pc, cylinder, flapper rubber 1pc, riser main 3m 8pc, rope 100m, o-ring, rod centrollizer 4pc and cup u seal 1pc	damaged apron repaired
9	Nzega	NZVS-014HP-12	5	Ikindwa	14	Kayombo	97	Matale	Matale	12	4.14980	32.89951	Shallow well	Tanira	1.5	3.5	Shock absober 1pc and sleeve bearing 1pc	damaged apron repaired
10	Nzega	NZVS-015HP-03	5	Ikindwa	15	Malolo	107	Malolo	Malolo	3	4.09841	32.86539	Shallow well	Tanira	1.5	3.6	Shock absober 1pc, sleeve bearing 1pc and plunger ring 1pc	damaged apron repaired
11	Nzega	NZVS-015HP-05	5	Ikindwa	15	Malolo	105	Kilyaloha	Kilyalyoma	5	4.08799	32.89006	Shallow well	Tanira	0.75	4.5	Hexagon screws 4pc, nuts 4pc shock absorber 1pc, sleeve bearing 1pv and plunger ring 1pc	Well cover and apron constructed
12	Nzega	NZVS-027HP-03	8	Itobo	27	Itobo	181	Nyasuli	NYASULI	3	4.17673	33.03605	Shallow well	Tanira	4.5	7	Cylinder complete, rods 1m,2m,3m, riser main 1pc, hexagon screws 4pc, nuts 4pc, sleve bearing 1pc and shock absorber 1pc	damaged apron and cover repaired
13	Nzega	NZVS-035HP-05	10	Kahama	35	Nhabala	251	Nhabala	Nhabala	5	4.13915	32.69303	Shallow well	Tanira	3	8.6	Cylinder complete, shock absober 1pc, sleeve bearing 1pc and plunger ring 1pc	damaged apron repaired and inspection cape provided
14	Nzega	NZVS-040HP-10	12	Kasela	40	Kasela	283	Njuka	NJUKA 2	10	4.09170	32.99449	Shallow well	Tanira	1	3.6	Shock absober 1pc, sleeve bearing 1pc and plunger ring 1pc	damaged apron and cover repaired
15	Nzega	NZVS-046HP-	13	Lusu	46	Ifumba	307	Ifumba	KALEMANI	2	3.99056	33.23083	Unknown	Afridev	8.4	58	Bearing bush 8pc, flapper rubber 1pc, o-ring 1pc, riser main 1pc, rod 3m 2pc and cylinder assembly	Nil
16	Nzega	NZVS-047HP-01	13	Lusu	47	Isanga (Kipya)	310	Iponyamadumu	MLIMANI	1	4.05403	33.19281	Shallow well	Afridev	6	58	Bearing bush 8pc, flapper rubber 1pc, riser main 10pc, rod 3m 1pc, o-ring, cylinder complete, nuts 4pc and rope 120m	damaged apron repaired
17	Nzega	NZVS-049HP-	13	Lusu	49	Mwaluzwilo	318	Bujinja	UNKNOWN	3	4.01515	33.20607	Deep well	Afridev	25	53	O-ring 1pc, cup u seal 1pc bearing bush 4pc and flapper rubber 1pc	Nil
18	Nzega	NZVS-054HP-05	14	Magengati	54	Magengati	349	Chang' Ombe	Chang'ombe	5	4.81128	33.05738	Shallow well	Tanira	1.5	3.3	Plunger ring1pc, riser couplne 1pc and hexagon screws 4pc	Nil
19	Nzega	NZVS-064HP-	16	Mbogwe	64	Mbogwe	406	Mwangongo	MWANGONGO	5	4.13956	33.25614	Deep well	Afridev	12	50	Bearing bush 4pc, flapper rubber 1pc, o-ring, cup u seal 1pc and rod centrollizer 7pc	Nil
20	Nzega	NZVS-065HP-	16	Mbogwe	65	Nhobola	411	Misana	MISAdna	2	4.11265	33.28784	Deep well	Afridev	6	34	O-ring 1pc, cup u seal 1pc and bearing bush 8pc	Nil
21	Nzega	NZVS-083HP-01	20	Mogwa	83	Usalala	520	King' Wangoko	KINGWANGOKO	1	4.25669	32.80421	Shallow well	Tanira	2	3.6	pump stand, sleeve bearing shock absorberand hexagon screws 4pc	damaged apron repaired and inspection cape provided
22	Nzega	NZVS-085HP-02	21	Muhugi	85	Ubinga	544	Ubinga	UBINGA	2	4.41341	33.30730	Shallow well	Tanira			Shorck absober1pc Sleeve bearing 1pc Raiser main 1m 1pc	damaged apron repaired
23	Nzega	NZVS-105HP-	25	Nata	105	Kabale	676	Kasela	KASELA	8	4.05619	33.17280	Deep well	Afridev	10	58	Bearing bush 4pc, flapper rubber 1pc, o-ring 1pc, cup u seal 1pc and bolt&nuts 12x30mm	Nil
24	Nzega	NZVS-109HP-01	25	Nata	109	Nata	702	Nyalaja	dnaTA SHULENI	1	4.02965	33.13224	Shallow well	Afridev	22.4	33.8	Bearing bush 4pc, flapper rubber 1pc, o-ring 1pc, U seal 1pc foot valve and fulcrum pin 1pc	damaged apron repaired
25	Nzega	NZVS-147HP-04	36	Utwigu	147	Mwanhala	969	Mwanhala 'B'	UK	4	4.37594	33.14026	Shallow well	Tanira	2	4	Shock absober 1pc, sleeve bearing 1pc, hexagon screws and cylinder complete	damage apron and cover repaired
26	Nzega	NZVS-152HP-01	37	Wela	152	Mwansambo	995	Mwansambo 'A'	MWANSAMBO A	1	4.06328	33.34555	Shallow well	Tanira	2	5	pump handle assembly, cylinder 1.5m and riser/rod 3m 1pc, rod 1.5m 1pc	damage apron and cover repaired
27	Nzega	NZVS-153HP-	37	Wela	153	Wela	1000	Kityelo	KITYELO	3	4.14258	33.29978	Shallow well	Afridev	7.8	62	U sael 1pc, o-ring 1pc, bearing bush 8pc and flapper rubber 1pc	Nil
28	Sikonge	SkVS-002HP-01	1	Chabutwa	2	Kabanga	3	Chang'ombe	Mzumia	1	5.79092	32.79138	Shallow well	Tanira	1.5	4.5	Shock absorber 1pc, sleeve bearing 1pc, plunger ring 1pc, gasket, punger ring 1pc, bottom valve 1pc, bottom valve body and handle nipple	Well cover provided with inspection cape
29	Sikonge	SkVS-004HP-03	1	Chabutwa	4	Kipanga Milimani	10	Kipanga Kati	Barahani	3	5.70512	32.82202	Shallow well	Tanira	2	4.7	Sleeve bearing 1pc, shock absorber 1pc, complete cylinder, Nuts M12 4pc	Well cover and apron repaired
30	Sikonge	SkVS-008HP-01	2	Igigwa	8	Lufwisi	32	Lufwisi	Juma Saidi	1	5.51670	32.80321	Shallow well	Tanira	1.5	4.7	Shock absorber 1pc, sleeve bearing 1pc, cast in pedestal, socket head hex screws 4pc and 1mriser/rod 1pc	Provision of cast in pedstal
31	Sikonge	SkVS-019HP-01	4	Kilolelı	19	Mtakuja	73	Mtakuja	Kwa Abel	1	5.91202	32.92888	Shallow well	Tanira	2	4.7	Shock absorber 1pc, sleeve bearing 1pc, socket head hex screws 4pc and nuts 4pc	Well cover provided with inspection cape
32	Sikonge	SkVS-021HP-01	5	Kilolı	21	Mwitko	79	Mwitko	Kwa Musa	1	6.83329	33.36206	Shallow well	Tanira	1.5	4.5	Sleeve bearing 1pc, shock absorber 1pc, hexagon screws 4pc, pump rod 1pc, cylinder complete	Well cover provided with inspection cape
33	Tabora Rural	TrVS-070HP-03	11	Mabama	70	Maswanya	306	Maswanya Mashariki	Shuleni	3	5.06497	32.49199	Shallow well	Afridev	2	5	Bearing bush 4pc, o-ring 1pc, u seal 1pc, rod centrollizer 3pc, 3mriser main 3pc, foot valve, bolt&nuts 4pc and pump body	damaged apron repaired
34	Tabora Rural	TrVS-103HP-01	16	Upuge	103	Mhogwe	443	Mhogwe B	Michel Paul	1	4.87703	33.04002	Shallow well	Afridev	3	55	Bearing bush 4pc, o-ring 1pc, foot valve assembly, bolt&nuts 4pc plunger ring 1pc and U seal 1pc	damaged apron repaired Tanira repaired
35	Tabora Urban	TuVS-018HP-03	6	Ndevelwa	18	Inala	76	Ibasa	RAMADHAN	3	5.12019	32.95776	Shallow well	Afridev	1.1	4.4	Bearing bush 1pc , flapper rubber 1pc fulcrum pin 1pc, pum rod 1pc, o-ring 1pc, U seal 1pc andfoot valve	damaged apron and cov repaired
36	Urambo	UrVS-020HP-01	5	Kaliua	20	Ilindwanoni	77	Mtapenda	Ally Kayugilo	1	5.04001	31.70268	Deep well	Afridev	8	20	Pump handle , flupper rubber and cup u seal	Nil
37	Urambo	UrVS-029HP-02	7	Kashishi	29	Ilege	111	Shindeni	Juakali Luhaga	2	4.44465	32.28248	Deep well	Afridev	1.5	41	Bearing bush 4pc, riser/rod 4pc, rod centrollizer 3pc and socket joint 1pc	Apron repaired
38	Urambo	UrVS-041HP-01	8	Kazaroho	41	Kazaroho	167	Kazaroho Mashariki	Kasele	1	4.98919	31.85712	Deep well	Afridev	25	65	Bearing bush 4pc, O-ring 1pc, U seal 1pc, flapper rubber 1pc and rod centrolizer 7pc	Nil
39	Urambo	UrVS-050HP-05	10	Muungano	50	Kalemela A	204	Magharibi A	George	5	4.99158	32.04001	Shallow well	Afridev	10	15.3	Bearing bush 4pc, handle pump assembly, pump rod 3m, U seal 1pc and o-ring 1pc	Nil
40	Urambo	UrVS-052HP-05	10	Muungano	52	Muungano	215	Mtukula	Shaaban dnasoro	5	5.01121	32.15076	Deep well	Afridev	3	45	Bearing bush 4pc, O-ring 1pc, U seal 1pc, plunger assembly, Flapper rubber 1pc and bolt& nuts 3pc	Nil
41	Urambo	UrVS-052HP-06	10	Muungano	52	Muungano	214	Mtakuja B	Mtoni Vilali	6	5.02766	32.15095	Deep well	Afridev	12	46	Bearing bush 4pc, O-ring 1pc, U seal 1pc and foot valve 1pc	Nil
42	Urambo	UrVS-063HP-08	12	Songambele	63	Uyogo	268	Uyogo mashariki	Mzee Mbogo	8	4.91114	32.03369	Shallow well	Afridev	5	8.5	Bearing bush 4pc, O-ring 1pc, U seal 1pc, flapper rubber 1pc, handle assembly and rope 20m	Well cover and apron repaired
43	Urambo	UrVS-065HP-02	13	Ugunga	65	Tuombe Mungu	275	Kusini	Shuleni/Mwl Lowe	2	5.09018	31.70813	Deep well	Afridev	9.5	45	Bearing bush 4pc, O-ring 1pc, U seal 1pc, flapper rubber 1pc and rod centrollizer 3pc NOTE:handle pump 1pc was replaced by D/Council	Nil
44	Urambo	UrVS-086HP-02	18	Usinge	86	Kombe	367	Kombe Kaskazini	Wambao	2	5.05880	31.54194	Deep well	Afridev	5	31	Bearing bush 4pcCup u seal 1pc, o-ring 1pc, flapper rubber 1pc and cylinder pipe 1pc	Well cover and apron repaired
45	Urambo	UrVS-090HP-06	18	Usinge	90	Usinge	382	Majengo Tabora	H Mstapha	6	5.09648	31.30966	Shallow well	Tanira	3	7.6	shock absorber 1pc, sleeve bearing 1pc, plunger ring 1pc and cylinder complete	Well cover and apron repaired
46	Urambo	UrVS-090HP-02	18	Usinge	90	Usinge	390	Usinge Mashariki	Shuleni	2	5.09282	31.30641	Shallow well	Tanira	4	7.1	shock absorber 1pc and sleeve bearing 1pc	Well cover and apron repaired