CHAPTER 4 MANAGEMENT, OPERATION AND MAINTENANCE

4.1 Water Supply System to be Managed, Operated and Maintained

Existing water supply system and proposed water supply system in 2025 are summarized in Table 4.1. In 2025, the water treatment plants will increase to 3 from one existing; and the total capacity will be 237,000 m^3/d from the current 7,000 m^3/d. There will be 5 transmission pumping stations including the ones located in proposed new water treatment plants. Two additional elevated towers will be constructed. Currently there are almost no service reservoirs but 5 new service reservoirs with a total capacity of 77,000 m^3 is proposed to be constructed by 2025. Transmission and distribution lines will be extended enormously and the total length would amount to around 1,200 km. The current household connections are as few as 2,700 but it is expected to increase to 111,000 in 2025.

Table 4.1 Existing and Proposed Water Supply System in 2025

Category	Facility	Existing system	Proposed system
Production	Water treatment plant	1) Existing: 7,000 m^3/d	1)Existing and expansion WTP: 14,000 m^3/d 2)West WTP: 189,000 m^3/d 3)East WTP: 34,000 m^3/d
	Total capacity	7,000 m^3/d	237,000 m^3/d
Transmission and Distribution	Transmission pumping station (PS)	1) PS in existing WTP 2) Kator PS	1)PS in existing WTP 2)West WTP PS 3)East WTP PS 4)West North PS: Q=48,000 m^3/d, H=45 m 5)West South PS: Q=48,000 m^3/d, H=40 m
	Elevated tank (ET)	1) Elevated tank in parliament 2) Elevated tank in Kator 3) Elevated tank in Hospital	1), 2), 3) Same as existing 4) ET in Gumbo 5) ET in West South High ET
	Service Reservoir (SR)	None	1)West North Low: 24,000 m^3 2)West North High: 16,000 m^3 3)West South Low: 10,000 m^3 4)West South High: 16,000 m^3 5)East Zone (Gumbo): 11,000 m^3
	Total capacity	0 m^3/d	77,000 m^3/d
	Transmission line	About 5 km	About 30 km
	Distribution network	About 60 km	About 1,200 km
Service	House connection	About 2,500 No meter	117,700 With customer meter

To manage, operate and maintain expanded huge water supply system and a relatively large number of customers and to manage UWC staff itself, UWC is required to strengthen its capacity to perform efficiently. This section depicts developments needed in future UWC.

4.2 Management Policy and Concept

(1) Self-Sustaining Organization with Autonomy

Southern Sudan Urban Water Cooperation (SSUWC) was established by a presidential degree in 2007 and became a public entity under the Ministry of Water and Irrigation (MWRI) of Government of Southern Sudan (GOSS), depending on government subsidies as the substantial part of their budget. In the Master Plan prepared in this study, the expansion of the water supply system is planned to meet rapidly and significantly increasing water demand. Accordingly, the required budget scale of UWC of Juba will increase significantly. On the other hand, the financial situation of GOSS seems to be unstable in the long term perspective as the budget of GOSS depends largely on revenue from production of oil, market price of which fluctuates significantly. Given these circumstances, UWC cannot expect large subsidies for management of future large water supply system. Instead, UWC should move to a self-sustaining entity with adequate cash flow and autonomy as a target after 2016, when the 2nd phase of construction of water supply facilities will be completed. In transition period between 2010 and 2015, UWC would be semi-financial autonomous entity, reducing GOSS subsidies. A concept of management status of SSUWC from the present to future is outlined in Figure 4.1.

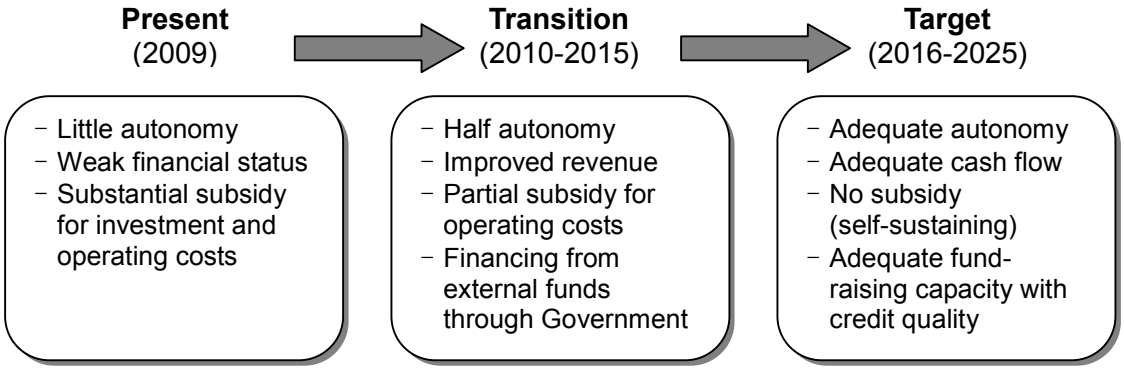


Figure 4.1 Management Status of SSUWC

(2) Concentrated and Unified Decision Making System

Currently, several government agencies are involved in decision making of operation of UWC(CES)-Juba, such as MWRI/GOSS, MOH/GOSS, MOPI/CES, in addition to SSUWC (HQ)/GOSS. As seen in other countries, involvement of many agencies often results in sluggish decision-making of management, lagging improvements in managerial efficiency, and delay in reduction of supply costs. As future management system, it is proposed that adequate steps for concentration of and to bring uniformity in governmental administrative agencies be taken, as is the case of the water sector reform in Kenya by Water Act 2002.

As stated above, it is also important to take steps towards adequate autonomy of UWC in future. It seems more recommendable to grant autonomy to UWC, especially at the state level, such as UWC (CES) Juba level, and even department level of UWC, with regard to procurement of equipment and materials, personnel affairs, etc. In exchange for the empowerment, the organization should bear accountability for performance and results.

(3) Improvement of Work Efficiency

To provide good service to the customers in the long term, UWC must continuously improve business efficiency, which is expressed as input-output ratio. It does not simply mean profit increase through cost reduction, but maximizing the value of product per input (productivity). In this sense, for instances, use of computer and information technology (IT) can contribute to improving efficiency in data processing of manual ledger keeping and billing work, and use of adequate number of vehicles and machinery can reduce working hours of field work such as pipe repair and leakage control. The investment for improving working environment shall prove to be effective to improve productivity or business efficiency of UWC.

In addition, management should be more conscious of quality of staff, as human resources are interpreted as assets which can bring more returns than financial investment. In this sense, strategic human resource development program should be planned and implemented. In this study, a capacity development plan is prepared in the later section, which includes human resources development plan.

To improve performance of a waterworks, it is proposed that UWC should manage their service using performance indicators (PIs) as defined in ISO/WD24512, “Service activities relating to drinking water supply and sewerage guidelines for the management and assessment of a drinking water supply service,” whose purpose is to quantify the performance of a waterworks. By adopting PIs as a management tool, water supply service can be quantitatively assessed from various points of views.

(4) Enhancement of Fund-raising Capacity

Fund-raising is composed of internal and external funds. In terms of internal funds, UWC should work on improving revenue collection and tariff reforming based on metering system and saving a part of the increased water revenue on self-sustaining basis.

As estimated in this study, huge investment is required for construction of water supply system until the year 2025. Therefore, external fund-raising are essential for investment. As practically no funding source seems to be available in domestic sector; either through government or private funds, it is prerequisite to introduce foreign fund, either official or private. Probably foreign official fund will be

dominant but private financing scheme such as build-operate-transfer (BOT) can be one option in future, in which investment cost will be borne by private fund in return for receiving concessions in business. However, in the current immature investment climate, it seems difficult to attract both private and government investors from overseas.

To attract investment of foreign funds in this sector, it is vital that UWC be in sound financial status by establishing stable balance sheet and sufficient cash flows from water revenue. In addition, UWC needs to prepare appropriate financial statement to be presented to lenders such as foreign financial institutions, when requested. Financial statements must be prepared in accordance with the international accounting standards and audited annually by independent auditors.

Furthermore, debt management should be reinforced, as a significant amount of arrears (SDG 7,838,738 equivalent to USD 3,546,940 in the fiscal year 2008) has accumulated, a major part of which is considered as bad debts. On the other hand, prospective water revenue in the fiscal year 2008 is SDG 661,866 (USD 299,486) only. Also, day's receivable (= [account receivable] / [net sales] x 365) is calculated as 4322 days. If enterprise accounting is applied, this extremely long day's receivable indicates bankruptcy of the enterprise. It is, therefore, proposed that the bad debts be cleared. For this purpose, two options may be considered. The bad debts should be sold to the third party or the government or bad debt collectors should be employed from the third party. As most of the debtors are government entities, the second option may not be successful considering their nature of nonpayment of water charge and therefore, the first option is recommended for clearing the debts quickly.

4.3 Management Targets

(1) General

As discussed in the previous section, UWC should move towards becoming a self-sustaining entity with adequate cash flow and financial autonomy. At the same time, UWC must seek for efficient work performance to provide quality services. Financial soundness is also important to ensure sustainability of water supply service. Given these conditions, the management targets of UWC are established by management category including short term and long term targets as shown in Table 4.2.

Table 4.2 Management Targets in Short and Long Terms

Category	Short Term Target	Long Term Target

Autonomy of UWC	− Officially granted for
	  − Personnel affairs
	  − Budget planning
	  − Bad debt collection and disconnection.
		− Additionally granted
		  − Proposal of tariff revision
		  − Salary system
		  − Sub-contracting
		− Empowerment to staff level

Organization	− Roles and responsibility is defined in written format
	  − Clear job description
	  − O&M manuals
	  − Staff ethical code
	− Private sectors are regulated and involved in water supply system
	− Introducing performance indicators
		− Restructuring and redefinition of organization to perform effectively and efficiently
		− Business manner is shifted to customer-oriented mode
		− IT section is formed

O&M work	− Done according to O&M manual − Work record (daily log, weekly/ monthly report) is managed − O&M budget allocated	− Done in proactive and efficient manner − Work record is integrated into quality assurance system − Supply chain management (SCM) (procurement and stock of material) is controlled by SCM section
Financial status	− O&M cost recovered without the government subsidy − Bad debt management is launched − Billing and revenue collection system is upgraded	− Earn profit after depreciation − Financial statements are prepared according to International Accounting Standards (IAS) − External audit is done
Human resources development (HRD)	− Staff training by using external resources − Budget is allocated	− HRD program is prepared and implemented by UWC − In-house training − Performance evaluation of staff is introduced
Public relations	− Public awareness campaign − Radio announcement − Group tour for WTP	− Newsletter/ magazine is published periodically

(2) Autonomy of UWC

It is proposed that authority should be granted to UWC at state level to improve management efficiency. In return, UWC should bear responsibility for performance quality and result, which should be committed with the upper authority of UWC headquarter (HQ) and board of directors.

Under this condition, UWC shall be able to concentrate on its business and seek profit through efficient work performance as intervention from the upper authorities will be less. Also, the headquarter shall only monitor the performance of UWC by reviewing monthly and annual reports prepared by UWC and concentrate on business planning and decision making as their core function.

Table 4.3 Recommended UWC's Autonomy for Future

Authorization to be granted	Responsibility to be borne
− Personnel affairs under authority − Budget planning and allocation − Bad debt collection and disconnection of non-payment customers − Proposal of tariff revision − Salary system independent from public servant − Import of goods and materials (chemical, pipes, etc.) − Sub-contracting work of contract amount under e.g. USD100,000.- − Lending a loan from financial institution	− Accountability to any business transaction − To provide quality of services (safe and sufficient water) − Earning certain profit committed with upper authority

(3) Organization

Drastic change in organizational structure is not prospected in the short term. Considering the short term implementation and effectiveness, it is recommended to prepare clear job description, O&M manual and staff ethical code. At the same time, it is proposed to introduce performance indicators (PIs) in each section to monitor the work performance of section. By applying appropriate targets of PIs, each section should turn to make efforts to improve the performance by means of effective and efficient work. In this case, incentive system would be effective on condition that the incentive system reasonably reflects the performance and the efforts are fairly evaluated and rewarded. The commonly used PIs are shown in Table 4.4. Issues on organizational restructuring and involvement of the private sectors are discussed in the section 4.4 .

Table 4.4 Examples of Performance Indicators

Indicator	Definition
Indicator	[Water distribution quantity per population served (L/person/d)]
Definition	= [Average daily distribution volume (m^3/d)] / [Population served (persons)]
Indicator	[Rate of population served by water supply (%)]
Definition	= [Population served (persons)] / [population in service area (persons)] x 100
Indicator	[Revenue Water Ratio (%)]
Definition	= [Revenue water volume (m^3)] / [Total distribution volume (m^3)] x 100
Indicator	[Leakage Ratio (%)]
Definition	= [Annual leakage volume (m^3/year)] / [Annual distribution volume (m^3/year)] x 100
Indicator	[Staff number per 1000 connection (staff per 1000)]
Definition	= [Total staff number] / [Total number of connections] x 1000
Indicator	[Operating expenses to sales ratio (%)]
Definition	= [Operating expenses] / [Operating income] x 100
Indicator	[Training time per staff (hours/year)]
Definition	= [Training hours (hours x attendees)] / [Total staff number]

(Reference) "Guidelines for the management and assessment of a drinking water supply service (JWWA Q100)" Japan Water Works Association

(4) O&M Work

Quality service is provided through appropriate operation and maintenance (O&M) which should be performed by qualified staff with adequate supply of necessary materials and goods. The current staff has had no opportunity for proper training that results in poor knowledge on O&M of water supply systems. Therefore, staff training for O&M skills is the first priority in the short term. Simultaneously, work record keeping system should be developed based on O&M manual prepared. This system enables to identify potential problems in the work place and to prepare adequate work plan effectively.

In the long term, it is proposed that work record is developed based on quality assurance system which guarantees service quality in accordance with ISO9001: Quality Management System. Also it is recommended to establish a section for supply chain management, which will control procurement and stock of materials systematically and in economical way.

(5) Financial Management

As a management policy, self-sustaining status without government subsidy is indispensable in management planning. However, a series of up-front disbursement is projected in the Master Plan which has negative impact on the net present values of cash flow and it is difficult to achieve full-cost recovery by water revenue in the short term. Therefore, it is recommended to reduce government subsidy gradually toward zero in the short term. However, in the long term, UWC should ensure financial independence from subsidy.

As discussed later in financial analysis, operating expenses and a part of depreciation would be covered in the short term and full cost is recovered by water revenue in the long term. To be specific, the ratio of operating expenses to sales up to 2025 is projected as shown in Table 4.5. This indicator is one of the indices showing the profitability of water supply business. It indicates the extent to which the income covers the expenses. The lower the ratio, the higher the profit.

Table 4.5 Projection for Operating Expenses to Sales Ratio

	2007	2015	2020	2025
	SDG	(1000 USD)		
Operating Expenses*	350,505	8,134	20,317	33,059
- O&M	(350,505)	(6,730)	(15,114)	(21,691)
- Depreciation**	(N/A)	(1,404)	(5,203)	(11,368)
Operating Income (1000 USD)	381,873	8,763	24,310	51,688
Operating Ratio	92 %***	93 %	84 %	64 %

(Note)

* Operating expenses: Costs necessary to the main service activities in a year. They include labor, repair, power, chemical and depreciation costs, but interest cost is not included.

** Depreciation is assumed by straight-line method with lifetime 25 years for all construction cost for calculation purpose. But it doesn't include depreciation for the existing facility, on account that reliable financial data is not available and the asset value is assumed to be very small compared to the facilities planned in the Study.

[Depreciation (MDTF)] = [Construction cost for WTP of 7000m^3/d (est.)] / 25 years
= USD 5,538,000 / 25 years = USD 221,520 p.a. (2010-2035)
[Depreciation (Phase-1)] = [Construction cost (Ph-1)] / 25 years
= USD 29,550,000 / 25 years = USD 1,182,000 p.a. (2013-2037)
[Depreciation (Phase-2)] = [Construction cost (ph-2)] / 25 years
= USD 94,983,000 / 25 years = USD 3,799,320 p.a. (2016-2040)
[Depreciation (Phase-3)] = [Construction cost (ph-3)] / 25 years
= USD 103,614,000 / 25 years = USD 4,144,560 p.a. (2021-20345)
[Depreciation (Phase-4)] = [Construction cost (ph-4)] / 25 years
= USD 50,511,000 / 25 years = USD 2,020,440 p.a. (2023-2047)

*** Operating ratio for 2007 is calculated with reference to "Revenue & Expenditure Statement for Fiscal Year 2007". In the statement, subsidy from government and depreciation is not included.

(6) Human Resources Development

The performance of business corporation largely depends on human resources being engaged in the business. Therefore, the top management of UWC should recognize the significance of human resources development, as a number of new employments would be required in coming future with the rapid expansion of water supply system. Therefore, human resources development plan should be strategically prepared and implemented as an essential part of waterworks management.

In the short term, training needs should be met by external resources as almost no training resource is available in domestic and in the long term, training program should be made and trainers should be fostered within the organization. It is also recommended in future to introduce performance evaluation system, in which work performance of staff is evaluated and reflected in promotion and salary.

(7) Public Relations

Public relations activities should be planned and implemented as UWC should work closer to the customers for whom UWC have to provide quality service and to make the customers understand about water supply business and pay water charges according to their uses. To promote public awareness related to water supply services and its importance and significance, UWC should make efforts to inform and educate people through several public awareness campaigns such as announcement through mass media, group tour to water supply system, distribution of awareness goods, and publishing newsletters.

4.4 Organization Plan

(1) Outlook for Workforce

In the study, future workforce of UWC has been estimated by using staff efficiency per connection as shown in Table 4.6. In the estimation, the composition by staff level is projected assuming annual growth.

Table 4.6 Outlook for Future Workforce

Item	Unit	2009	2015	2020	2025
[1] Water production capacity	m^3/d	7,000	77,000	174,000	237,000
[2] No. of connection	nos	2,467	25,197	71,379	117,716
[3] Staff efficiency	The number of staff per 1000 connections	68	15	10	7
[4] Staff Number	nos	167	378	714	824

[1] As planned in M/P
[2] Actual record (2009)
Estimated by [population served] / [average family size] (2015-2025)
[average family size]: assumed to be 7.8 persons (2015), 7.0 persons (2025)
[3] Calculated by [4] / [2] x 1000 (2009)
Assumed to be 15 (2015), 10 (2020) and 7 (2025)
[4] Actual number (2009)
Calculated by [2] x [3] / 1000 (2015-2025)

The key assumption in the projection is that the staff efficiency will increase to 7 staff per 1000 connections in 2025, which is at the same level of performance as in case of National Water and Sewerage Corporation (NWSC) of Uganda in fiscal year 2008. To attain high staff efficiency, productivity of staff should be improved by recruiting competitive staff and training existing and prospective staff continuously. It also requires that the staff should be treated by motivation including good salary in adequate working environment.

(2) Organizational Structure

As discussed above, the number of UWC staff will increase to 824 in 2025 and UWC will be granted adequate autonomy under self-sustaining status. As the responsibility and business scale of UWC expands rapidly, UWC is envisaged to have several working places, such as a head office, customer service offices, stock yards and workshops. Accordingly, UWC will need to reform organizational structure to suit the future business practices and organizational needs.

In reforming the organization, improvement of entire business performance of UWC should be primarily considered. Given this, both consolidating function into a single unit and decentralizing into several independent units should be well examined. The best balance would be different in various cases depending on management policy, capacity of organization, etc. For referential purpose, prospective section and roles for future are presented in Table 4.7.

(3) Redefinition of Business Unit with Profit Responsibility

To date, UWC of Juba is regarded as a single business unit, in which all tasks are performed as their job as a whole and water revenue and expenditure is managed by single account of UWC. As the organization will grow in future, it is recommended to redefine suitable business units which have internally independent account. Each business unit shall be granted with discretion as well as profit responsibility and be linked to each other by internal profit relationship. The concept of redefinition of organization by profit unit is illustrated in Figure 4.2.

In this definition, each unit will be given with profit responsibility which leads to raise motivation of staff to reduce cost and maximize internal profit through improving their performance. The management monitors the performance of individual unit, gives direction to each unit and supports to improve the performance of waterworks as a whole. It should be understood that the terminology of “internal profit” is used for descriptive purpose, to visualize the performance of different business activities by using single criteria of profit. Therefore, “internal profit” does not mean any business unit earns “real profit” from the others.

The definition of business unit should be carefully considered. If a unit is defined by too small group, total business performance of the entire organization often results in poor performance due to lack of cooperation between small units by sectionalism. In this regard, the management body of UWC shall define the appropriate business unit, from viewpoint of the customer-oriented service.

Table 4.7 Required Section and Function of Future Organization

Section	Main Function
Area Manager (Head office)	− To be responsible and control overall business activity of UWC − To monitor the performance of each section and prepare report to SSUWC HQ − To direct and coordinate between sections
Financial Section (Head office)	− To manage entire financial activity of UWC − To prepare budget planning and financial statements − To prepare water tariff revision proposal
Human Resources Section (Head office)	− To prepare job description − To recruit and dismiss staff − To evaluate personnel performance − To implement carrier development plan
Administration & General Affairs Section (Head office)	− To improve work environment − To take care general affairs
Supply Chain Management Section (Head office)	− To procure consumables, spare parts, etc. − To choose contractor for construction work
Asset Management Section (Head office)	− To maintain facility drawings and maintenance record − To prepare repair and replacement plan
IT section (Head office)	− To support management information and facility information
Water Treatment Plant (Production department)	− To operate and maintain the plant, pump station, and generator
Water Quality Control Section (Production department)	− To control water quality in treatment process and treated water − To instruct chemical dosing rate according to water quality monitoring
Mechanical service section (Production department)	− To maintain mechanical equipment
Electrical service section (Production department)	− To maintain electrical equipment
Meter reading section (Customer service department)	− To read water meter and report to ledger keeper − To distribute water bill to customers
Ledger keeping section (Customer service department)	− To issue bill − To keep water ledgers − To take care of debt management
Customer care section (Customer service department)	− To collect water charge − To manage contract with customers − To promote public relationship
Plumbing section (Customer service department)	− To install service connection and water meter − To repair leaking and damaged pipe and report to asset management section − To repair/ replace water meter
Leakage control section (Customer service department)	− To detect leakage (physical loss) and report to asset management section
Planning & project section (UWC Headquarter)	− To prepare business plan, facility improvement plan, etc. − To manage construction project
Legal affair section (UWC Headquarter)	− To prepare code of water supply service − To prepare corporate ethical codes − To deal with court cases
Audit section (UWC Headquarter)	− To perform internal audit of financial and quality control − To prevent corruption among staff

(Note) Name of section and its group to which it belongs is provisionally prepared by the Study Team as example. They should be modified and adjusted according to actual organization plan.

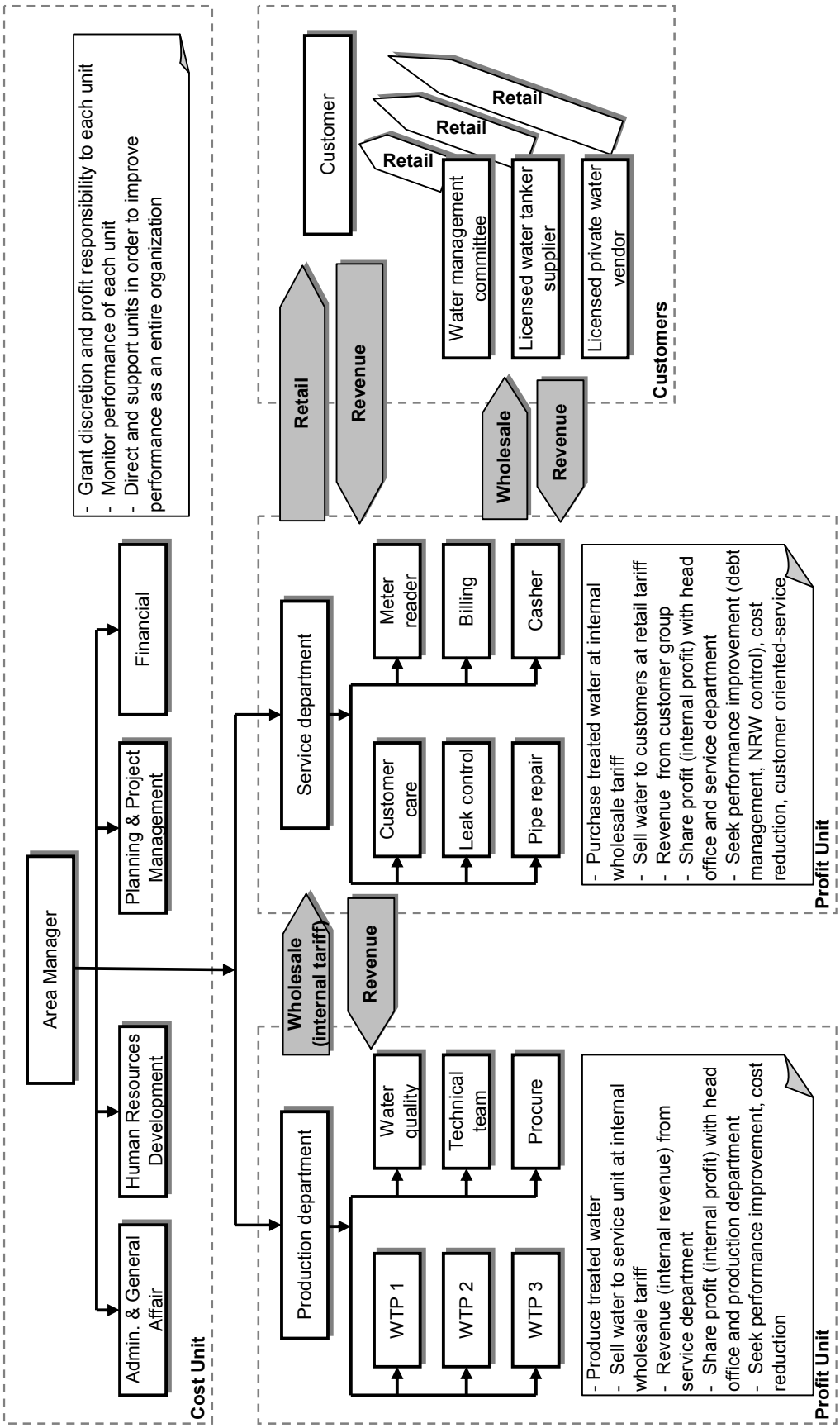


Figure 4.2 Concept of Redefinition of Organization by Internal Profit Unit

(4) Customer Service Offices

As the number of customers is expected to increase significantly, the function of customer services should be reinforced accordingly. It is proposed to establish customer service offices in future at least one office in each administrative area of Juba, Kator, Munuki, Rejaf and Gudele.

The function of customer service office includes customer care, billing and revenue collection, which means that customer information is basically managed at the service office level. And optionally plumbing section would be attached to the office in order to take care of installing new service connections, and leakage control at the service office level. The concept of customer service office is illustrated in Figure 4.3.

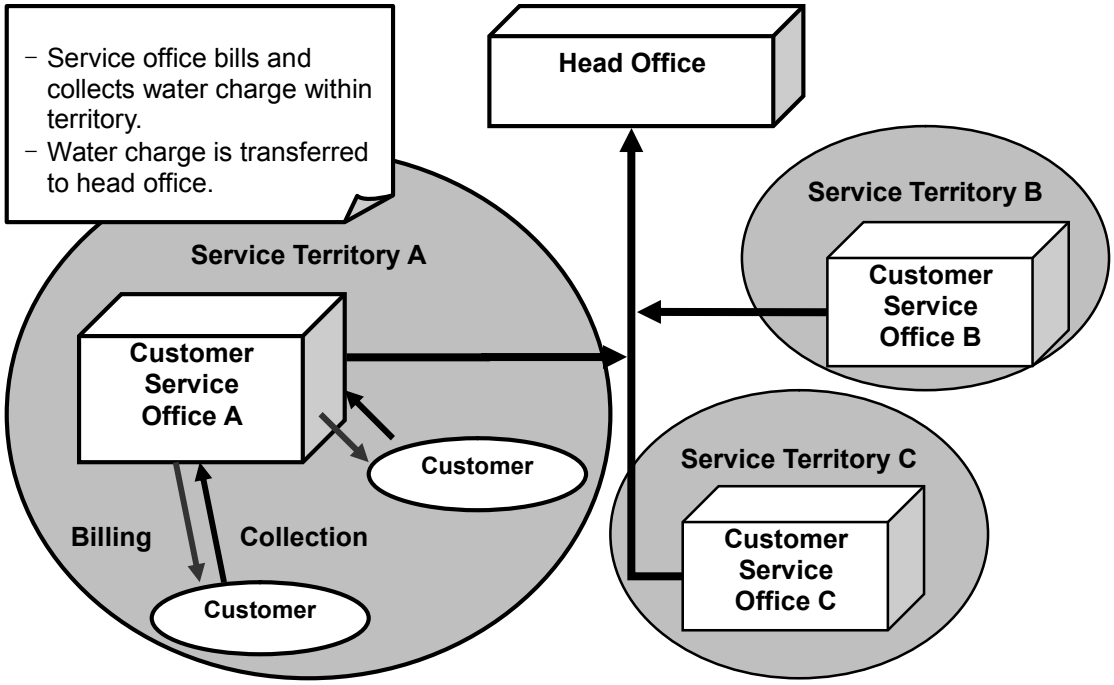


Figure 4.3 Concept of Customer Service Office

(5) Involvement of Private Sectors

In the Master Plan, it is proposed to provide safe and clean treated water through house connection, public tap and private venders including water tankers. In case of house connection, the consumers are contracted directly with UWC. It is proposed for future, the private sectors be involved to manage public taps and water tanker supply under appropriate regulation. However, in this context, it does not imply private finance for investment.

In the Study, community based organization is formed in Munuki Payam where public stands were constructed under JICA urgent reconstruction project in 2005 and rehabilitated in 2009. Main roles of the management organization are to maintain the taps in operational condition and collect water charge from residents. In future, another option should be considered such as water Kiosk which is common in Kenya. The water Kiosk is a private business entity which is granted with license to sell water to citizens under contract with waterworks, where management responsibility is clearly stated. Unlike voluntary residential or community group, for example, water Kiosk works by business-oriented mind, where service hours might be extended for convenience of customers.

Water suppliers through water tankers are not currently regulated by laws in Juba, although they play important role of supplying water to citizens in considerably major part of Juba. In the Master Plan, water tankers is planned to distribute treated water from UWC. Water tanker suppliers are envisaged to be the private sectors. In that case, they would be granted with license for selling treated water. As the water tanker suppliers are regarded as a part of urban water supply system, they should be regularly monitored by UWC whether they ensure that water tankers sell water of good quality (without any contamination) and at a regulated price. The concept of private sector involvement is illustrated in Figure 4.4.

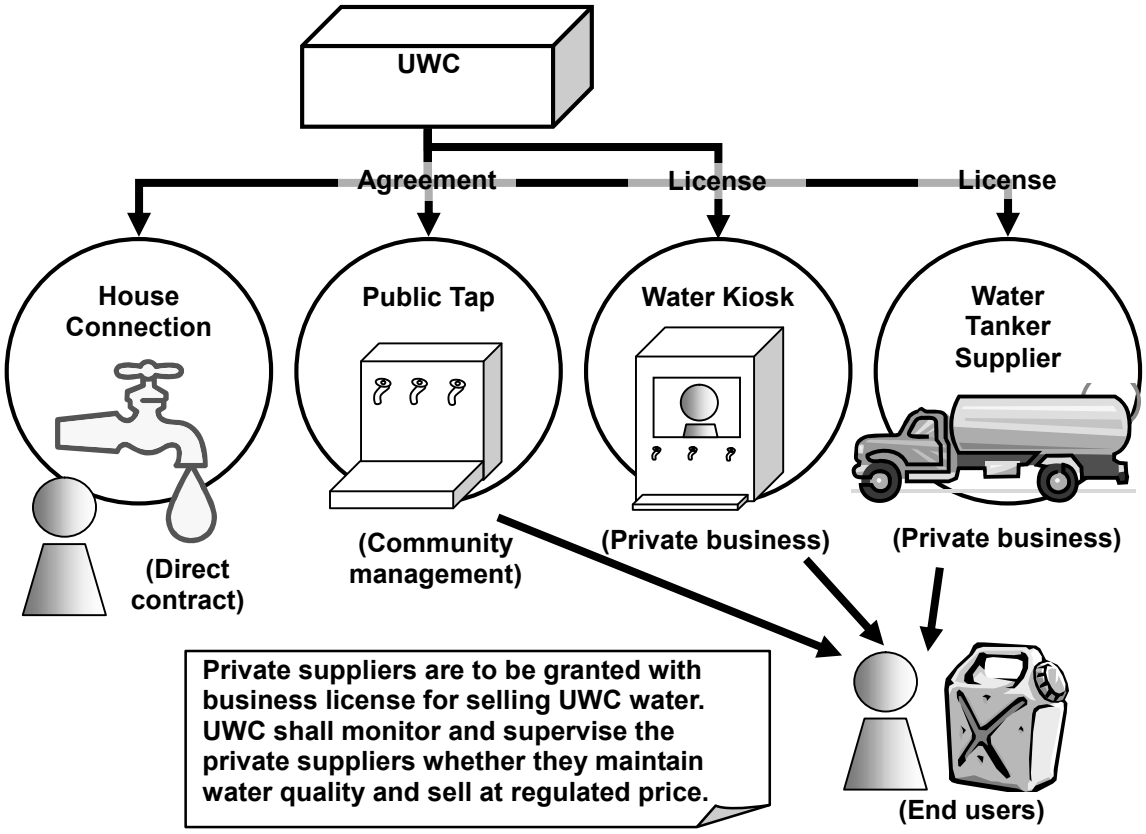


Figure 4.4 Concept of Involvement of Private Supplier

(6) Ownership of Assets

Ownership of assets (facilities, buildings, etc.) is not clearly stated since the balance sheet of UWC is not available so far. However, to seek external fund in future, provision of financial statements including balance sheet in accordance with international accounting standard and external audit is necessary.

In future, two alternatives are assumed for asset owning. The one is that fixed assets are owned by the Government (MWRI/GOSS) and the assets are leased to UWC. In this case, UWC is not required to account the fixed asset into their balance sheet, but have to enter lease payment into their income statement as expense. Under this system, UWC is not responsible for financing of major replacement or new investment and UWC remains dependent on the budget of the Government for replacement.

The other alternative is that MWRI/GOSS would transfer assets' ownership to UWC in exchange of holding equity ownership of UWC. MWRI keeps indirect control of UWC through its equity ownership. In this case UWC should pay dividend to MWRI (equity holder) in future.

4.5 Operation and Maintenance of Proposed Facilities

4.5.1 Operation and Maintenance Issues

Under this Study, several water supply facilities have been proposed to be newly constructed. These facilities should be operated and maintained appropriately by experts and skilled workers. To do so, the development of the technical capacities of staff is required and efficient and effective O&M system should be established.

Proper operation and appropriate maintenance of water supply facilities are prerequisite not only to keep the function of the facilities, that is, stable supply of safe and good quality water but also to secure the full span of their useful life.

Existing practices of operation and maintenance of water supply facilities are not appropriate, even for small scale facilities. On the completion of proposed facilities proposed under this Study, the system would be extensive and it is necessary to improve the system of operation and maintenance for the developed facilities.

During the site visits and through series of discussions with the staff-members involved in operation and maintenance, it is observed that existing poor condition of operation and maintenance are directly or indirectly related to the following major issues:

- Lack of skilled and qualified staff-members

- Lack of clear definition of roles and responsibilities of staff-members
- Lack of equipment and spare parts
- Lack of training and training facilities, and capacity development programs
- Lack of guidelines and manuals
- Lack of facilities for database management and keeping operation and maintenance records
- Lack of communication with related organization in the form of reporting
- Lack of customer information involvement in operation and maintenance

These key points need to be addressed for efficient and effective operation and maintenance of water supply facilities.

4.5.2 Main Objectives of Operation and Maintenance

The main function of waterworks is to provide safe and sufficient water to the consumers. This is achieved through the stages of planning, designing, construction, operation and maintenance, etc. The purpose of operation and maintenance is to manage waterworks facilities safely and efficiently in order to supply water of standard quality in adequate quantity and with sufficiently required pressure. The process of water supply includes intake of raw water, conveyance, purification, storage, transmission and distribution of treated water. These processes are influenced by various external factors or conditions such as progress of urbanization and increased population and industrial activities, increase in standards of living, etc. These factors result into increased water demand and thereby necessitate expansion of water supply services. Juba town and its neighboring areas are also experiencing significant increase in water demand due to increased population and accelerated industrial activities. To meet the increasing demands, it is inevitable to manage existing water supply facilities and services properly and plan additional facilities in advance to meet future water requirements.

As also described in the *Water Policy* issued by the Ministry of Water Resources and Irrigation, GOSS in November 2007, sustainable operation and maintenance of urban water supply and sanitation presents a major challenge. The importance of efficient operation of water supply systems and adequate maintenance of assets has been emphasized to meet demands of growing urban population.

Operation refers to the procedures and activities involved in the actual delivery of services, e.g. intake, treatment, pumping, transmission and distribution of drinking-water. Maintenance refers to activities aimed at keeping existing capital assets in serviceable condition, e.g. by repairing water distribution pipes, pumps and public taps.

The main purposes of operation and maintenance of water supply systems is:

- To ensure continued and sufficient water supply at sufficient pressure and of good quality to Consumers
- Cost efficient operation, and
- Increased service life

Broad categories of operation activities include routine jobs, measurement and tests, monitoring and reporting. Maintenance includes activities that could be broadly categorized as preventive maintenance, reactive maintenance, important repairs and overhauling, and stores and purchases. Preventive maintenance, including inspection, cleaning, lubrication, consists of the systematic routine actions needed to keep the utility plant in good condition. It sometimes also includes minor repairs and replacement as dictated by the routine examination. Reactive maintenance normally occurs as a result of reported pipe breaks and the malfunctioning or breakdown of equipment.

In O&M, the role of managers is to provide directions, make decisions, and control. The roles of operators are to maintain quality of output and match rate of working with requirements. Maintenance staff members are responsible for carrying out repair or replacement of worn or defective components to ensure continued satisfactory level of services.

Each water treatment plant, pumping stations and reservoirs should have its own team of O&M staff and they should report to the head office periodically. There should be inspectors for transmission and distribution networks. At each water treatment plant, there should be laboratory to take care of water quality analysis and management. It is suggested to have laboratory assistants and sampler to facilitate the works smoothly. The laboratory should be well equipped to carry out analysis for all the required parameters included in the regulations.

4.5.3 Operation and Maintenance Manuals, Records and Reporting

To operate and maintain the facilities appropriately by experts and skilled workers, the development of the technical capacities of staff is required and efficient and effective O&M system should be established. The capacity development plan is given in Chapter 5. In this section, operation and maintenance manuals, records and reporting that promote efficient and effective operation and maintenance of the facilities are discussed.

(1) Operation and Maintenance Manuals

Close rapport between operators, designers and scientists is of fundamental benefit to all of them. Design improves to facilitate operation; design understanding leads to increased effectiveness of operation; and a cross flow of scientific knowledge and practical experience is of all round advantage. One of the most important channels for this communication is opened by the preparation of a well

conceived operation and maintenance manuals. If properly prepared and understood by the operators, it can be the greatest single factor for encouraging efficient operation and maintenance of the system. The manual shall cover followings.

1) Design criteria and their implications, with technical detail including ratings and significant dimensional parameters
2) Operational procedures, supported manufacturer's instructions for all machinery and equipment
3) Maintenance, similarly supported by manufacturer's instructions and parts lists

(2) Tasks and Flow Charts of Operation and Maintenance

The major task charts to carry out operation and maintenance of the facilities that shall be included in operation and maintenance manual are presented in the figures below.

Figure 4.5: Tasks for Water Quality Control in Water Supply
Figure 4.6: Tasks for Operation of WTP and Pumping Stations

Figure 4.7: Tasks for Maintenance of WTP, Pumping Stations and Distribution Networks

The flow of activities for water quality control, operation and maintenance of water supply facilities has been illustrated in figures below.

Figure 4.8: Flow Chart showing Steps for Water Quality Control
Figure 4.9: Flow Chart showing Steps for Operation of Water Supply Facilities
Figure 4.10: Flow Chart showing Steps for Maintenance of Water Supply Facilities

The outline of operation and maintenance manuals has been prepared in this Study as given in Appendix-E.1 and the work process flow and record sheets for various components of the water supply system are described in Appendix-E.2. Check lists for operation and maintenance is given in Appendix-E.3.

Operation and maintenance manuals should be issued on a "need to know" basis. Operating manuals should be revised at least after one year's operating experience has been gained based on the needs and requirements.

(3) Records and Reports

Records relate to permanent construction, to operation, or to maintenance and repair. Records of permanent construction show what has been done and where it is located. They are used to locate the

components of the system on the ground; to aid understanding of the design and hence how the system is intended to operate; and to facilitate alteration or extension of the system.

Operational records provide guidance for the operation of the system, so they will very often incorporate records of permanent construction, or record operational performance to aid future design and to serve administrative purposes. Records of maintenance and repair serve to allow criteria evaluation of performance, and to facilitate planned maintenance.

Good records promote efficient operation of the water system. Specifically, records are essential to an effective maintenance program, are required to comply with certain water quality regulations, and are necessary for planning purposes. The information management system is most efficient when tailored to the particular needs of the installation. Only those records known to be useful should be kept, and records should be readily accessible to all personnel concerned with the water system's operation and maintenance. Many records would be required to be kept for a long time and should be protected from damage. Some records, such as maps, will require occasional updating. A computerized information management system can effectively meet all of these criteria. Hard copies of all records should be maintained in files. There is no substitute for good records.

1) Operating Records

Operating records should be maintained for the following unit processes: intake facilities, raw water pumps, generators, coagulation, sedimentation, filtration, chlorination, clear water reservoirs and pumps, service reservoirs and elevated tanks, etc.

2) Daily Logs

Operating data for each day should be entered in the daily operating log and then in the monthly operating report (MOR) to provide a record of daily and average monthly operations. The data recorded cover all aspects of operations including a diary of routine operational duties, unusual conditions (operational and maintenance), accidents, complaints, and visitors.

3) Monthly Operating Report

Each installation's water treatment facility prepares a monthly report compiled from daily operation data reports. Monthly reports permit technical review of current performance and comparison of performance over a long period. Accumulated monthly reports show variations caused by changes of seasons, methods of operation, and installation population.

4) Annual Reports

Annual reports generally include a description of facilities, quantity of water pumped/treated, quantity of chemicals consumed, capital costs, operating costs, and personnel status. Effective annual reports are clear, concise, and informative. It is generally recommended that the format be consistent from year to year to facilitate comparison with past performance.

5) Maintenance

Maintenance records include manufacturer's catalogs, brochures, and instruction manuals for all installed equipment. Shop drawings and as-built drawings provide additional, specific information about equipment and facilities and are used with maintenance manuals to achieve efficient O&M of mechanical systems. At a minimum, maintenance records need to document, for each piece of equipment, when service was last performed and when it will be required again. A good record system also includes a complete repair and cost history for all installed equipment.

6) Cost Accounting:

Although accounting personnel maintain cost and budget records, it is recommended that the waterworks supervisor keep records of operating costs as well. These records provide up-to-date information on expenditures and can be used to predict yearly costs and forecast budgets.

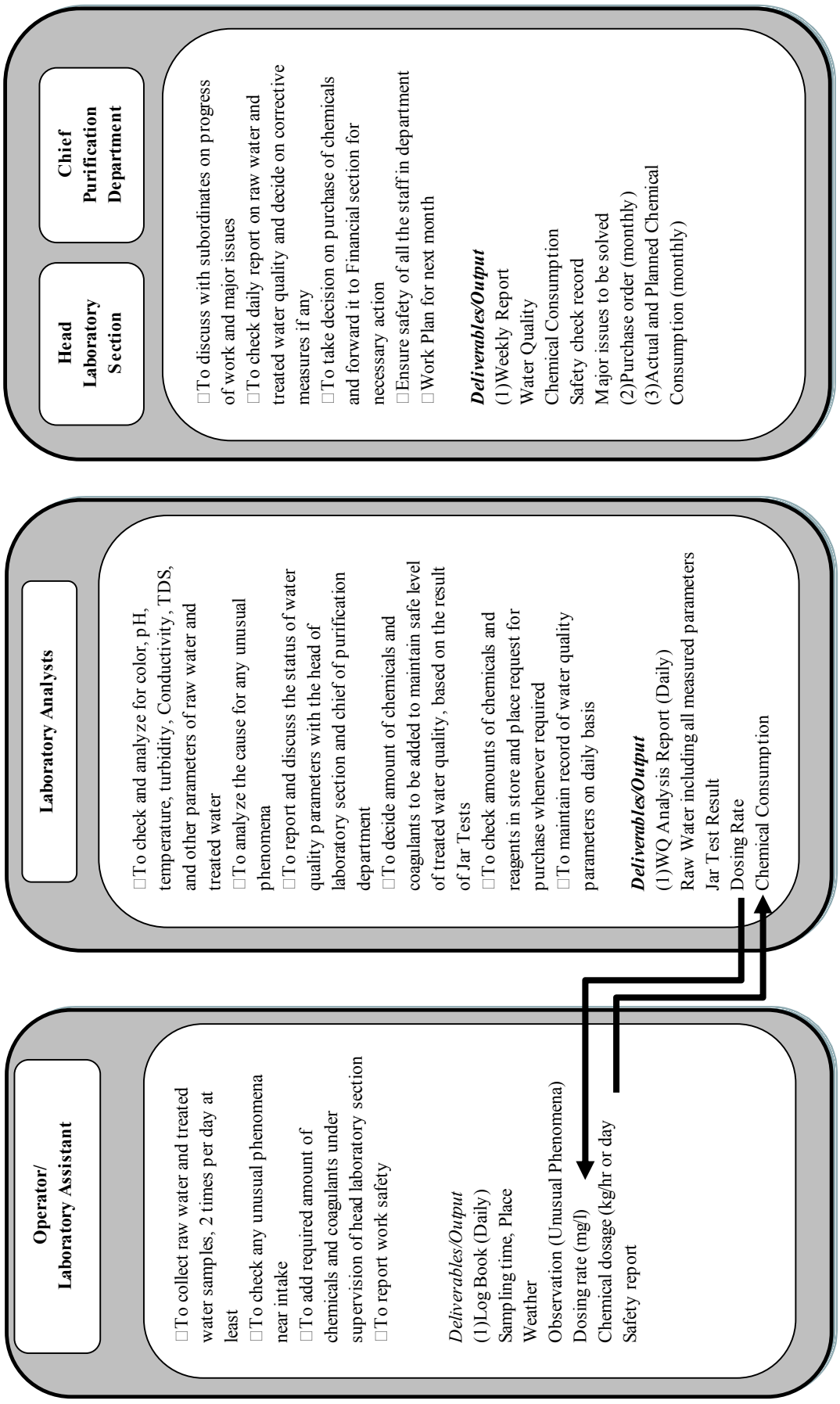


Figure 4.5 Tasks for Water Quality Control in Water Supply

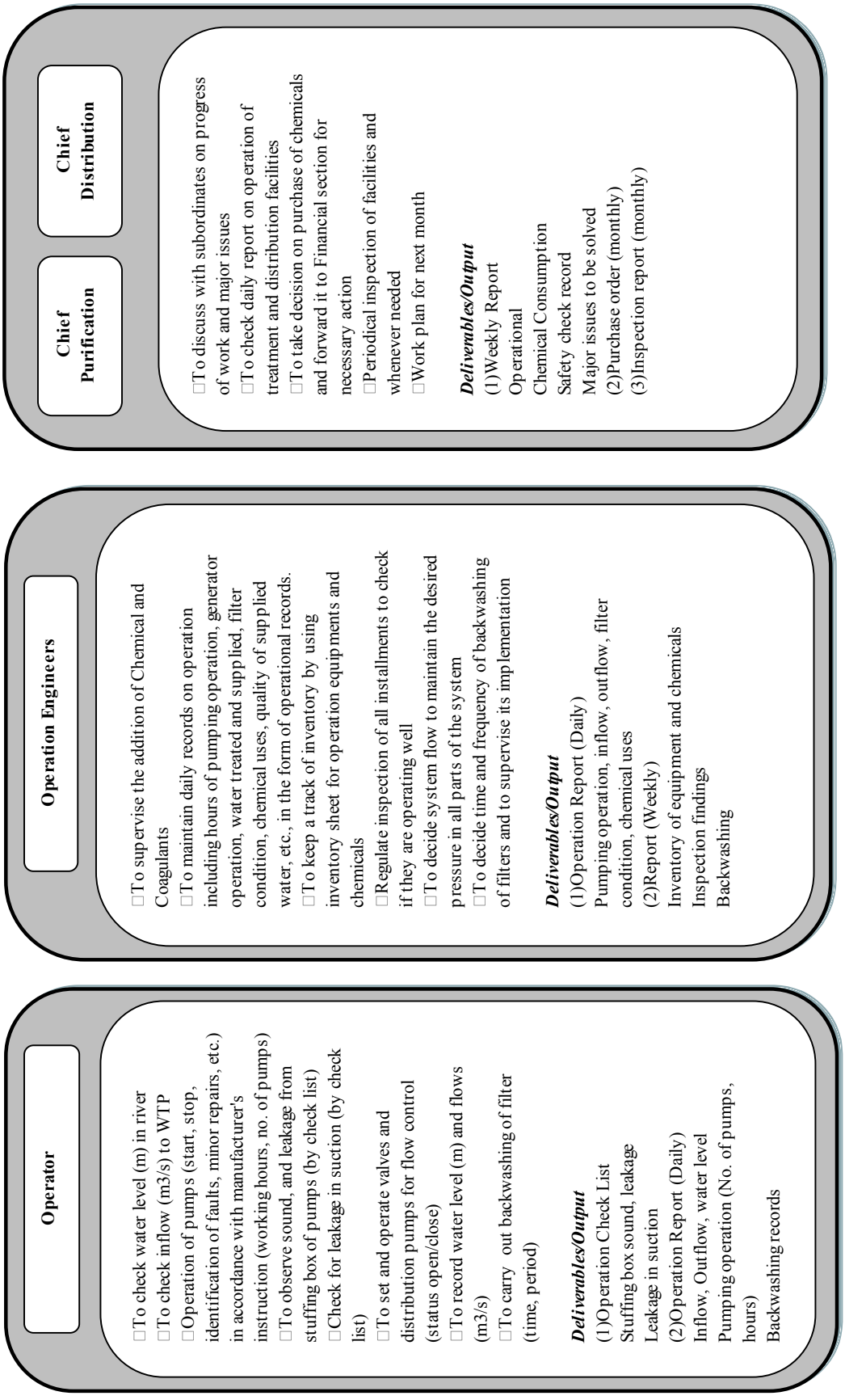


Figure 4.6 Tasks for Operation of WTP and Pumping Stations

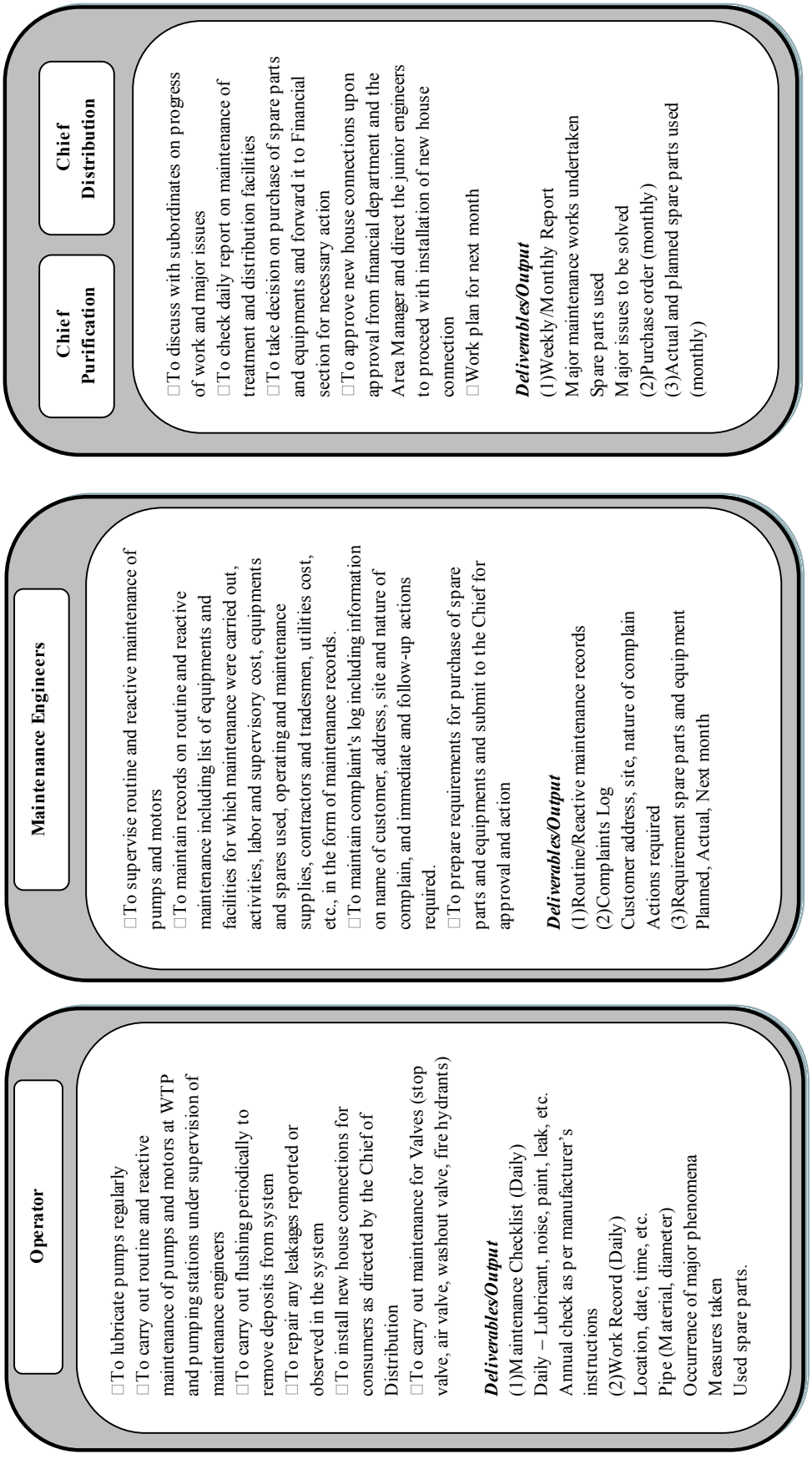


Figure 4.7 Tasks for Maintenance of WTP, Pumping Stations and Distribution Networks

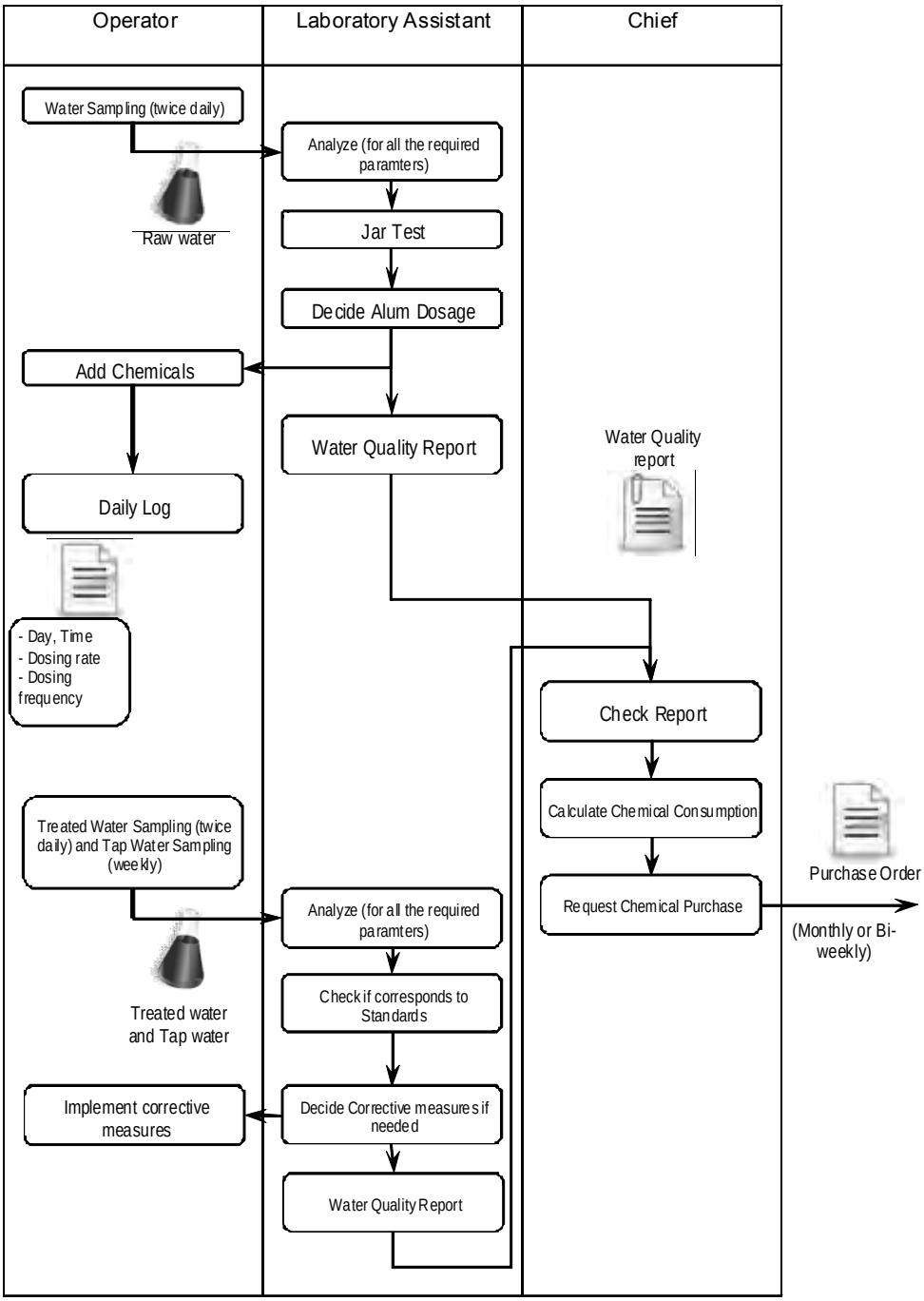


Figure 4.8 Flow Chart showing Steps for Water Quality Control

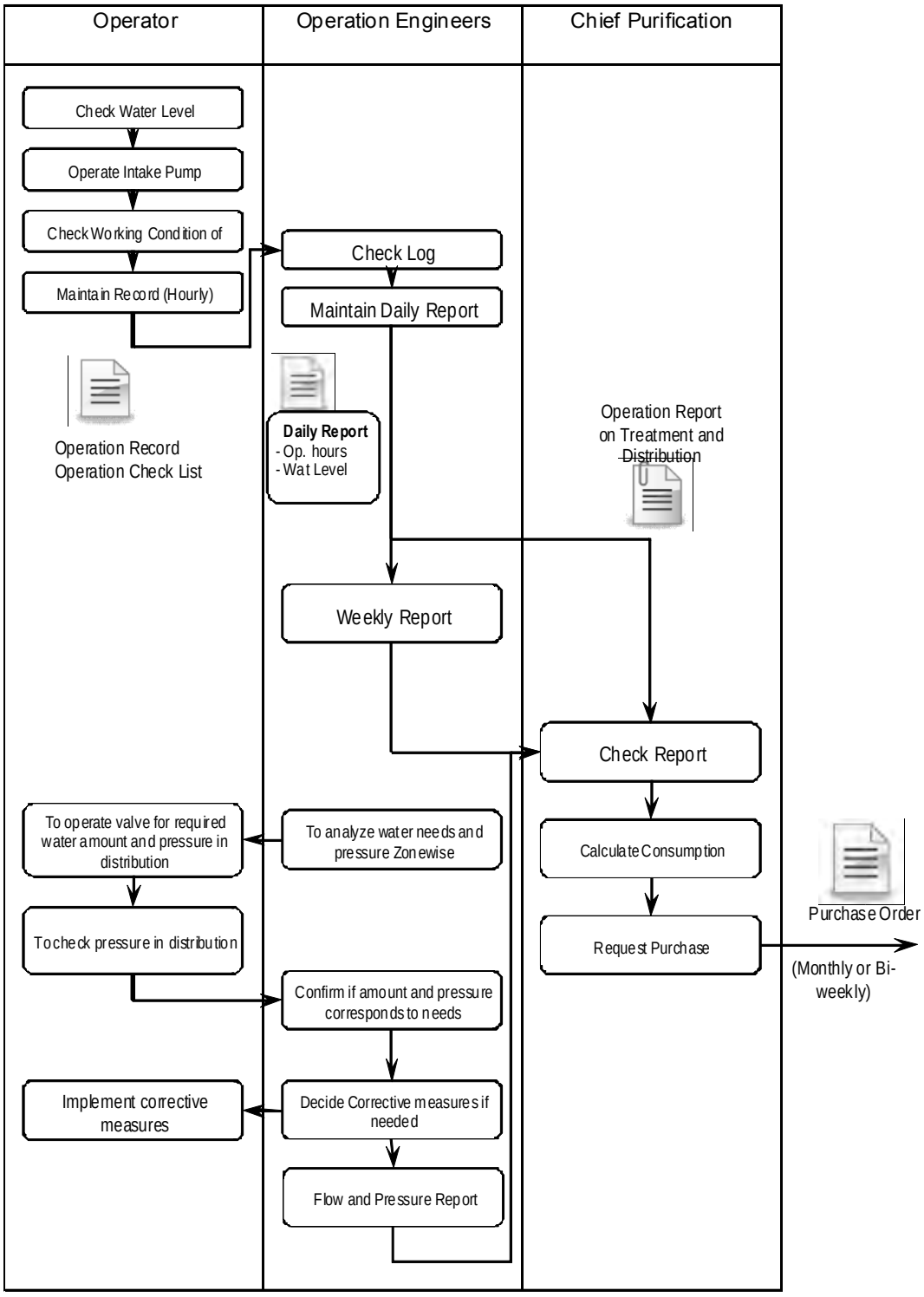


Figure 4.9 Flow Chart showing Steps for Operation of Water Supply Facilities

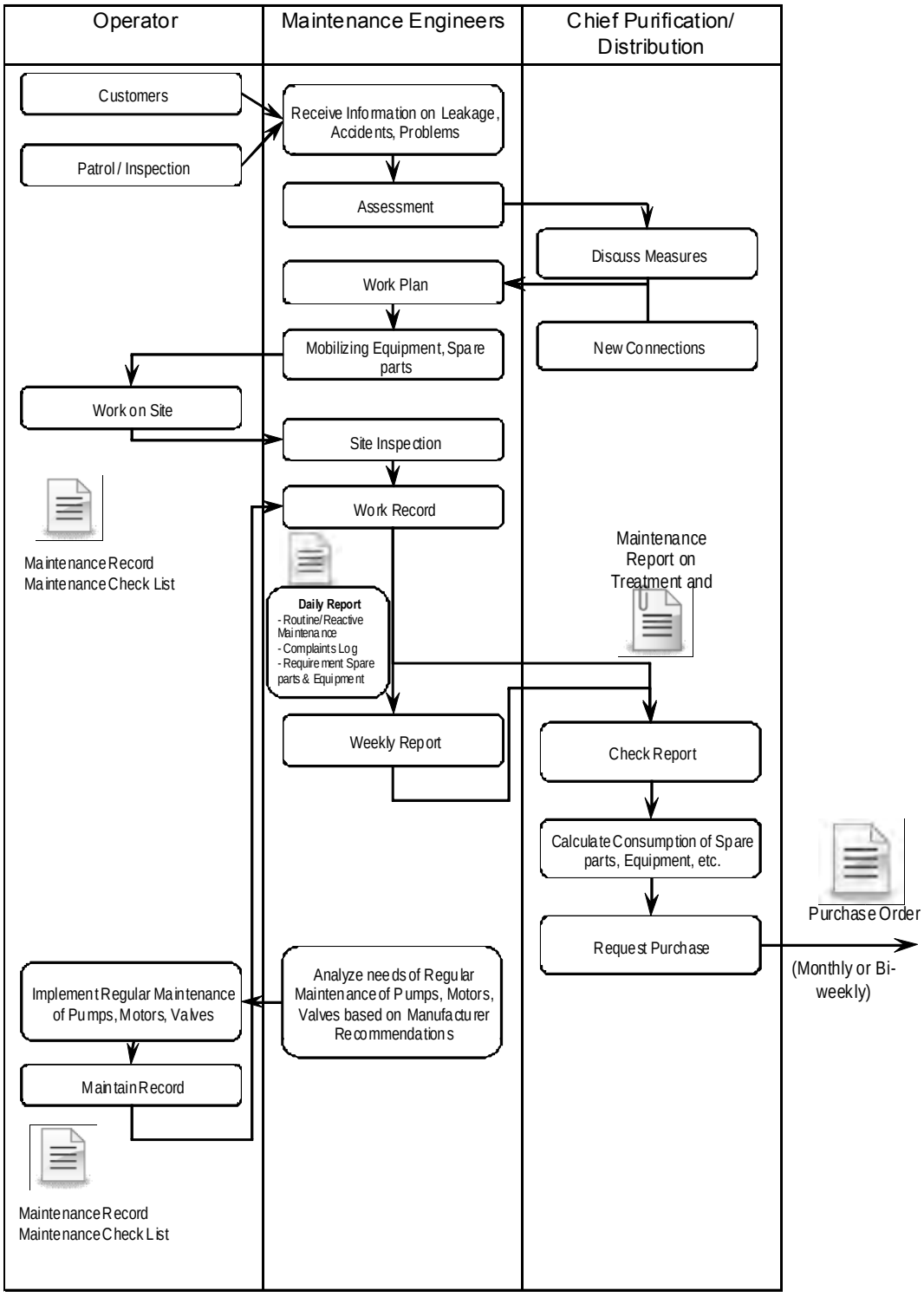


Figure 4.10 Flow Chart showing Steps for Maintenance of Water Supply Facilities

4.6 Customer Services

Customer Service is the management of all activities directly concerned with external customers. Customers, who are users of water from water supply system, should be considered as the most important component of water supply services. The success of water supply services is indicated by

the level of satisfaction of the customers.

(1) Activities under Customer Services

The main activities related to customer services are listed below.

- Customer complaints:
  - Receiving and recording
  - Response
- New connections:
  - Inspecting customers' pipe work
  - Receiving payment
  - Laying supply pipe and meter and making connection;
- Metering and billing:
  - Reading customers' meters
  - Billing
  - Collection of revenue
  - Replacing/repairing meters

(2) Level of Services

A set of levels of service should be formally established. It is recommended to include following items in the level of services:

- Water quality
- Distribution pipeline pressure (e.g., minimum of 10 meters head)
- Flow at customers' first tap (e.g., minimum of 10 liters per minute)
- Continuity of supply (24 hours supply wherever practicable)
- Speed of response to customers' telephone and written queries
- Speed of response in installing new connections
- Speed of response in repairing/replacing defective meters
- Policy relating to increase in water charges

(3) Complaints Receiving and Recording

A Customer Service Center should be established to take care of all the complaints and enquiries of customer related to water supply services. It is essential that separate telephone lines and numbers are made available for customer calls. Customer calls should be received directly by a customer service assistant, without the intervention of a telephone operator. By this means, the first person that answers a customer call will be able to deal with the customer's problem. Customer service assistants should

be available to receive customer calls 24 hour per day, 365 days per year.

All telephone and written customer complaints and enquiries of service and billing should be received in customer service centre, preferably located at the main office of UWC. The location of customer service center at main office will allow direct person-to-person communication between customer service and control room staff, which is essential in the event of system problems generating many customer calls.

It is recommended that a simple computer system is used for recording complaints and response with input of information to GIS. A simple and easy to use system should be developed considering local needs.

(4) Complaints Response

The following types of complaint / query may be received from customers:

- Leakage
- Taste/odor
- Discolored supply
- No supply
- Poor pressure
- Hardness
- Illness resulting from supply
- Billing query
- Meter defective
- New supply query

All the above types of complaint would normally receive response from a customer service centre representative. The complaints should be recorded at the customer service centre. As soon as the customer's complaint is resolved to the satisfaction of the customer, the customer service representative would 'kill off' the complaint by entering details of his actions into the computer system. Target times for response should be established for various types of complaint/query and actual response times should be monitored against the target times.

(5) Customer Service Representatives

Customer service representatives would generally operate on own and should discuss with engineers when necessary. Their responses activities would include mainly:

- General advice given to customers in person
- Meter reading

- Replacing / repairing meters
- Taking water samples
- Inspecting customers' pipe work

It is essential that full and comprehensive training is given to these personnel with attention to:

- Attitude and manner in dealing with customers
- Technical skills:
  - Network performance
  - Meter technology
  - Water sampling
  - Water quality
  - Plumbing
  - Resolving practical problems

Sufficient resource, expertise, and training facilities must be made available to achieve the target levels of service within the target response times, with the back-up of adequate:

- Vehicles and equipments
- Communication systems
- Good quality materials
- Effective personnel systems (reward, appraisal, disciplinary)

4.7 Non Revenue Water Management

4.7.1 Target NRW Ratio

The non revenue water (NRW) management plan is an important element of the overall plan for improvement of any water supply system. With a high NRW ratio, neither the produced water can be effectively used for the customers nor can water supply bodies be sustainable. Leakage, a major component of the NRW, causes the reduction of distribution pressure and consumption. Furthermore, the low pressure caused by leakage degrades water quality by intrusion of pollution in pipes. In this section, the NRW control plan is prepared for UWC Juba to achieve a sustainable water supply body and to improve current water supply conditions.

In the Chapter 5 of Part I, the current water balance was estimated based on the limited information, assumptions and experience and data in Japan and other countries. The Study Team guessed that 3,600 m^3/d or 50% of the currently produced water is not used for consumption and 4,680 m^3/d (60 %) does not earn any money after operation of MDTF facilities. Therefore, for the planning purposes, current leakage and NRW ratios were set at 50 % and 60 %, respectively.

According to experiences in Japan, the NRW ratio was reduced from 70 % to 30 % within 5 years shortly after the end of the war and then to 20 % in 10 to 15 years. Non-revenue water management should be carried out continuously by setting up the long-term targets. The targets of the management plan are set as follows, based on the Japanese experience and international best practices:

- The NRW ratio will be reduced from the current estimated level of 60 % to 44 % and the leakage ratio from 40 % to 20 % by 2015, after the entire existing network is replaced.
- The NRW ratio will be further reduced to 28 % and the leakage ratio will be maintained at 20 % in 2025 (90 % of collection rate from experience in Nairobi)

Table 4.8 Target of Non-Revenue Water and Leakage Ratios

Item	2009	2015	2020	2025
Commercial loss	20%	24 %	16 %	8 %
Leakage ratio	40 %	20 %	20 %	20 %
NRW ratio	60 %	44 %	36 %	28 %

Note: The current figures were roughly estimated by the Study Team without meter records. Therefore, there is an inconsistency between 2009 and 2015 in commercial loss.

To achieve the targets, following measure shall be implemented.

- Replacement of entire existing distribution network until 2015
- Planning NRW management measures
- Continuous activities of NRW management

4.7.2 Typical NRW Control Activities

It is essential to measure and assess various elements of water use. A lot of this information will come from flow measurement around the network and therefore requires installation and maintenance of flow metering equipment. A schematic of the inter-relation between these components is shown in Figure 4.11, for typical NRW control activities.

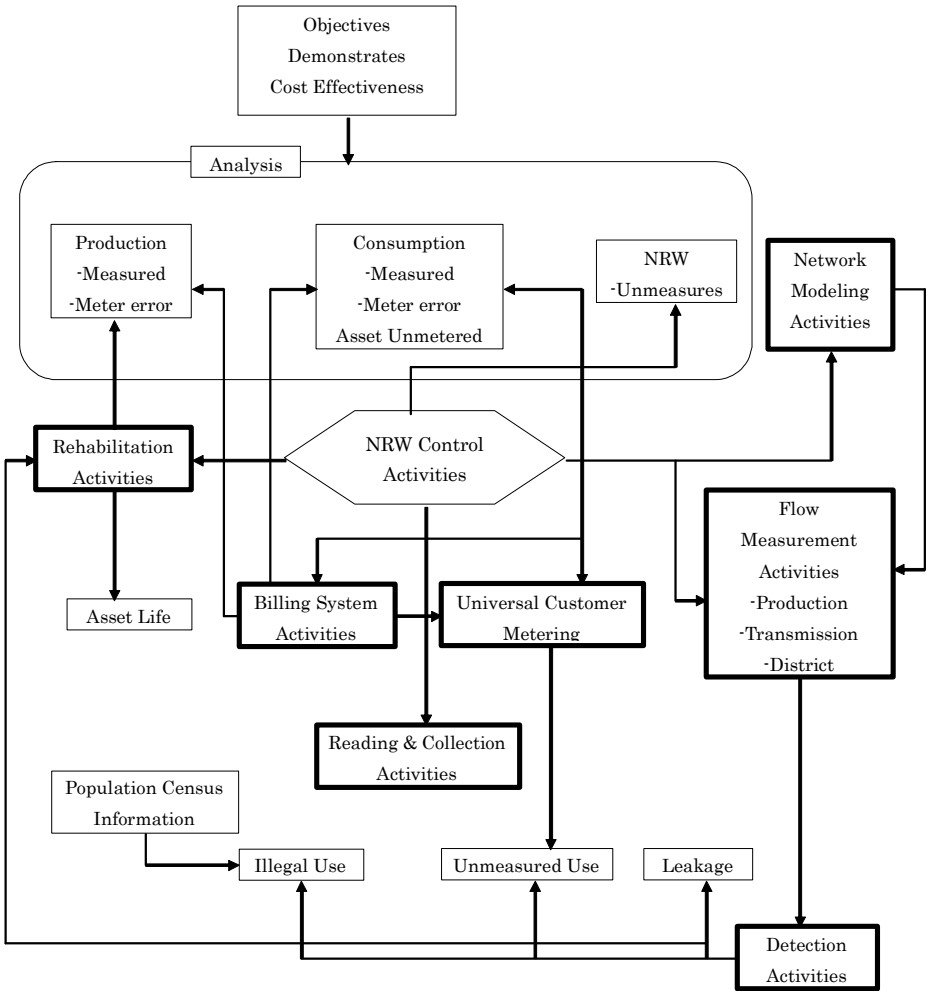


Figure 4.11 Typical NRW Control Activities

NRW reduction plans are categorized into technical and non-technical measures as follows.

（Technical measures）

- Rehabilitation of distribution and service pipe
- Leakage control
- Universal customer metering and replacement of water meter
- Eradication of illegal connection

（Non-technical measures）

- Improvement of billing system
- Improvement of reading and collection system

As a first step to introduce NRW management, following framework plan must be prepared:

- Present context (Baseline)

- Justification for NRW plan
- Outline & general approach
- Proposed sequencing
- Specific activities checklist & timeline
- Identification of priority projects and preliminary cost estimates.

Activities and initial target figures and progress rates have been cited as a basis for preliminary planning. Once implementation is under way and detailed data becomes available, the targets and planning should be reviewed and modified according to cost benefit criteria.

4.7.3 NRW Management Plan

As an overview, the three phases can be characterized as follows:

Stage 1: Preliminary

- Initiation and start up of all activities across the board
- Training and practice of basic techniques and methods
- Installation of equipment, especially production and zone flow meters
- Surveying
- Mapping of Network
- Establishment of NRW Management Unit and Team
- Work on Trial "pilot" areas
- Technical Assistance – Intensive effort for detailed planning, implementation and technology transfer

NRW management work will start in the good service areas. One or several "pilot" areas will be set up (possibly based on sub-district) and subject to the gamut of activities, including but not limited to:

- Mapping and consumer survey
- Large user identification & monitoring
- Meter repair and replacement
- Leakage survey & detection (applying different techniques as appropriate)
- Timely repair of leaks

When the pilot area has been completed, a lower level of activity will be continued to maintain the NRW management in the area.

A new set of pilot areas will be set up and the intensive efforts directed in these new areas. This sequence continues building up the area of coverage until a complete district or zone has been completed. Then the next district is started.

Stage 2: Medium term up to 2015

- Establish routine procedures
- With increasing time-based data, review NRW levels and adapt control efforts
- Progressively repeat and expand task to cover more and more of the network
- Continue and complete surveying
- Reduce and phase out technical assistance as NRW unit becomes self-sufficient
- Prioritize and direct NRW management activities

Phase 3: Long term up to 2025

On a 5 year cycle:

- Review NRW levels and management measures strategically
- Modify and prepare a plan and revise objectives
- Continue and repeat NRW management, prevention and monitoring
- Continue expansion of area covered until completion
- Continue to increase level of detail, specificity of data by progressive sub-division of the network into smaller areas (to the extent justified)

4.7.4 Resources and Organization

It is now relevant to outline the resources needed to begin implementation of the NRW Management Plan. In order to be effective over a sustained period, it is essential that adequate budgets are available for this. There are five main aspects to be considered:

1. Organization for NRW management
2. Personnel to staff the team
3. Training and skills acquisition for the staff
4. Technical assistance to the organization
5. Material and equipment resources

(1) Organization - NRW Task Force Approach

a) NRW Management Team

To implement the structures and measures needed to begin the process of reducing NRW to economic levels, a separate, dedicated section will be essential. This section and its manager need to have sufficient authority and the requisite autonomy to be able to make progress once the plan has been agreed.

The NRW management section must be set up immediately on starting the program. It should be

considered as a permanent unit, not a time limited, temporary one; though ultimately many or all of its functions may be absorbed within the operations of mainstream departments, such as distribution or customer service.

The applied methodologies should in most cases be introduced at pilot level and then applied progressively to other areas, once the method has been tested and the problems resolved.

Phase 1

During the first twelve months of operation, the NRW management unit will be set up, trained, developed and become firmly established. Within this period, it is expected that the first half will be principally occupied with setting up, preparing and training and the latter half will be practice and trial implementation.

For phase 1, the team will be kept relatively small and exclusive, so that it remains manageable and all its members can be properly trained. This is a relatively long lead-in time, because the UWC Juba is starting from almost zero and a change in approach is needed.

Phase 2

At the end of phase 1, a review will be carried out to determine the future direction of efforts and reinforcement of the team that is needed, along with the additional resources required. The role of the original core team will then be modified to include training and supervising additional staff brought in to cope with the expanded work program.

b) Repair Teams

A properly resourced repair section should also be set up and equipped at the same time as the NRW management section. Though probably part of the distribution department, the repair section will have close ties with the NRW team, mainly physical loss group, and work co-operatively.

The same principles apply to this repair section as to the NRW management team. That is to develop a small, strong competent core then review the full scale of the requirements to reduce NRW levels according to a timetable and finally provide the resources and staffing accordingly.

The size of these first stage teams should be limited to around 12 to 15 persons, though later many more staff will be involved in one way or another. The suggested composition of the NRW management team is given in the following section. The size of the repair teams does not include unskilled labor.

(2) Personnel to Staff the Team

a) NRW management Staffing

NRW Project Manager

To ensure that effective action is taken, a well qualified project manager responsible for NRW should be appointed. The project manager must be allocated sufficiently experienced staff to develop a separate NRW team and should be given suitable assistance to undertake special studies. Additionally, the task force manager may be assisted by one or more consultants or other technical assistance.

NRW Team

The typical titles of each of the members of the team are described below: The proposed NRW team structure is shown in Figure 4.12.

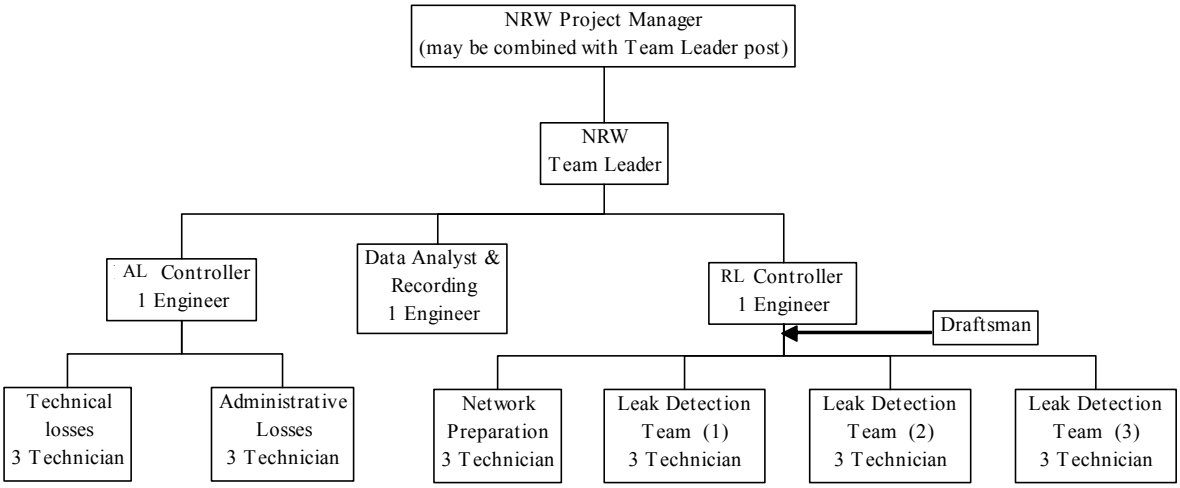


Figure 4.12 NRW Team Structure

Team Leader :	maybe combined function with the project manager
Data Management Engineer:	Co-ordinates with team for data collection and analysis

Apparent Loss (AL) Team

AL Controller:	1 Engineer:	Manages the AL team
Technical Controller:	3 Technician:	Specialized in Water Meters
Administrative Controller:	3 Technician:	Specialized in consumer issues

Real Loss (RL) Team:

RL Controller:	1 Engineer: Manages the RL team
Draftsman:	1 draftsman prepares network drawings for work and updates

Network Preparation Team:	3 Technicians: Specialized in pipe work
Leak Detection Teams:	3 Technicians Specialized in Leak Detection x 3 teams

All other manpower needed for the field surveys, and all field operation and works are to be taken from other relevant departments. Passive leakage control (repair of visible leaks and operations upon request of consumers) remains the "maintenance and repair" tasks of the UWC Juba staff.

b) Co-operation and Co-ordination

It must be emphasized that Water Loss Control is the duty of all water supply department staff and not only NRW team. Equally, all sections or departments are involved in the work and should co-operate with the NRW team.

(3) Training

To start with, about three employees should go for a period of up to three months to a developed country where they will be given special training using modern equipment and will work with trained inspectors employed by another water authority. If two or more employees working in the area of repairs could undergo similar training, it will be advantageous as they can learn the standards of workmanship required to ensure the best possible repair under difficult conditions.

One of those selected should be an engineer or technician with an aptitude for teaching. This person could provide training to additional employees required to build up the team later on. This initial training of a few selected staff should be part of an ongoing scheme. An incentive for new recruits should be the potential to be selected for training abroad.

Overseas training should provide short, formal courses at specialized training centers that include:

- theory of leakage control;
- practical experience in the use of a wide variety of equipment
- maintenance of and simple repairs to all equipment.

This is followed by a hands-on operational work during the daytime and at night, covering all forms of active control. The technical assistance consultants should also provide on-the-job training and experience, including activities on pipelines & cable location, flow measurements, tapping mains under pressure, use of insertion flow meters, repairs to pipes and service, flushing mains and sterilization, testing valves to ensure tight shut-off, the use of portable test equipment and data loggers for flow and pressure, and setting up a district metering system and a water meter district.

Arranging for such training is one of the first steps to be taken in implementing a program for improved leak control. The recommended optimum solution is that overseas training is supplemented by on-the-job training as part of the terms of reference for technical assistance.

(4) Technical Assistance

It must be stressed that leak control is not a short-term activity, which once begun can then come to an end. Experience shows that unless the control program is perpetuated indefinitely, soon after cessation the NRW figure is as high as ever. The need for appointing a competent, long-term consultant to assist the UWC Juba should be seriously considered.

A key part of any contract with a consultant is the establishment of an effective permanent organization in UWC Juba and a commitment to continue advising UWC Juba on the detailed solutions of problems encountered during the first year or longer. Of equal importance is provision by the UWC Juba of a sufficient number of suitably motivated, intelligent, and qualified "counterpart" employees to gain the necessary training and experience to take over the operation at the end of the consultant's contract.

Areas to be considered for some form of technical assistance include:
- General NRW Technical Management Assistance (e.g. Technical Assistance Unit)
- Mapping survey and capture
- Information systems
- DMA design & Implementation
- Meter sizing & selection
- Meter Testing & Calibration
- Metering Policy
- Byelaws & Technical standards Policy & Implementation

(5) Material and Equipment Resources

Having identified and trained the staff needed for the NRW management plan, it is important that due consideration is also given to ensuring that adequate materials and equipment are provided to do the job effectively.

Much equipment and material will be needed, but in three main categories:
1. Office-based drawing and data records and functional equipment for staff
2. Equipment and transport for fieldwork including specialist leak detection equipment
3. Repair materials, tools and equipment of the type and quantity necessary to get repairs implemented in a timely and effective manner.

These elements need to be considered and defined in preparing detailed budgets for the project and a first tranche will be needed at a very early stage. Sufficient allowance within these categories,

especially 2 & 3 must be made for training and practice materials, to allow staff to gain necessary skills.

The following table summarizes required equipment and machine for leakage detection team. These equipment shall be procured in the implementation stage.

Table 4.9 Leakage Detection Equipment

1	Basic network kits
2	Sound loggers (loggers + Patroller)
3	Electric Listening Stick
4	Mechanical Listening stick
5	Pressure logger with display
7	GSM pressure Logger
10	Correlator
11	Ultrasonic flow meter for pipe diameters 50 mm and above
12	Insertion flow meter with logger
13	Pipe locator - for metallic or plastic pipes
14	Boring bar
15	Accessories
16	Miscellaneous (Battery, Computer etc)
17	Vehicle (pickup truck and van)

4.7.5 Summary of NRW Control Tasks to be taken

To provide an overview of the range of activities and to provide a form of ready reference, a checklist of the tasks with the key action for phase 1 and for phase 2 identified has been compiled. This is shown in Table 4.10. It is to be noted that not all of these categories will necessarily be carried out by nor be the sole responsibility of the NRW control Unit.

Table 4.10 Checklist of NRW Control Tasks

Item	Activity	Key Action	
No.	Description	Phase 1	Phase 2
1	GENERAL MANAGEMENT & NRW CONTROL PLANNING		
1.a	NRW Control Program	Plan & Establish	Review & Modify
1.b	NRW Control Project Team	Set up & Train	Continue
1.c	Reporting & Information Systems	Develop & Establish	Keep up to date
1.d	NRW Ratio	Analysis & Review	Repeat periodically
1.e	Cost-benefit Analysis for NRW Activities	Analysis & Review	Repeat periodically
2	REAL LOSS ACTIVITIES		
2.a	Trunk Mains Leakage Investigation	Visual Inspection	Repeat annually
2.b	Service Reservoir Leak Investigation	Drop test for leaks	Repeat 4 yearly
2.c	Network Leak Detection Program	Prepare requirements	Reinforce & Expand
	ALC Leak Detection Team	Set up, train & Practice	Implement progressively
2.d	Pressure Management	N/A	Review when pressures improved
2.e	Leak Repair Program		
	Network Repair Team	Set up repair team(s)	Scale to suit needs

Item	Activity	Key Action	
No.	Description	Phase 1	Phase 2
	Network Repair Materials	Review repair items required and set up	Supply & maintain stock of repair items
	Repair Reporting	Monitor repair teams	Continue
2.f	Service Pipe Repair Program	Combine with rehabilitation program	
3	APPRENT LOSS ACTIVITIES		
3.a	Large Users (Consumers)	Define, identify & install meters	Monitor closely & check meters often
3.b	Domestic Metering Policy	Define & plan	Implement plan
3.c	Domestic Meter Testing		
	Meter Test & Repair Facilities	Set up & install test & calibration equipment	Maintain
	Meter Testing Program	Establish routine	Continue
3.d	Un-metered Use by Category		
3.e	Assessment of Un-metered Use by Sampling of Groups	Identify sample groups and monitor	Continue as required
4	MEASURING & PRIORITIXING of NRW ACTIVITIES		
4.a	Production Metering		
	Surface Water	Review & Install	Monitor
	Groundwater	Review requirements	Install & Monitor
4.b	Bulk Metering in Network	Review & Install	Monitor
4.c	District or Zone Metering in Network		Begin to Install & monitor
4.d	Waste Metering Program	Set up pilot areas	Repeat & Expand
4.e	DMA Management		
4.f	Analysis of Night Flows		Use nightlines
4.g	Prioritization of Areas for ALC & Rehab.	Use results to prioritize high leak areas	Develop and continue
5	ASSOCIATED ACTIVITIES		
5.a	Mapping of Network and Recording of Network Data	Mobilize: start in "good service" areas	Continue and finish then keep up-to-date
	Data Capture & Presentation	Set up and apply	
	Field Survey Work	Establish Methods	
5.b	Establishment and Updating of Customer Database	Combine with network mapping	
	Data Capture & Presentation	Set up and apply	Continue and finish then keep up-to-date
	Field Consumer Audit Survey	Establish Methods	
5.c	New Works and Network Rehabilitation	Maintain good co-ordination for plans & ensure NRW control included in design	
5.d	O&M Departments - co-ordination	Maintain good co-ordination for works	
5.f	Public Education & Information	Set Policy & Practice	Begin to implement
5.g	Byelaws & Technical Standards	Set Policy & Practice	Begin to implement
6	TECHNICAL ASSISTANCE PROGRAMME		
	NRW Control Management	Full-time support	Reduce level
	Including special inputs on:		
	Mapping survey and capture		
	Information systems		
	DMA design & Implementation		
	Meter sizing & selection		
	Meter Testing & Calibration		
	Metering Policy		
	Byelaws & Technical standards Policy & Implementation		

CHAPTER 5 CAPACITY DEVELOPMENT PLAN

5.1 Capacity Development (CD) Planning through PCM Workshop

Project Cycle Management (PCM) workshops were organized for each department of UWC of Juba to analyze problems and objectives of the departments of UWC. In the workshops, basic theory of PCM planning method was also presented to the participants. As a result, problem trees as well as objective trees were prepared by the participants, in which problems and objectives of UWC were logically visualized and shared among the staff. In the workshops, positive attitude and increasing consciousness were observed in every participant, which would potentially give good influence to the improvement of UWC management.

As a result of the problem analysis, detailed problem tree was prepared for each department as shown in Appendix-F. The core problem was summarized in Table 5.1.

Table 5.1 Core Problem of Each Department

Department	Core problem
Purification	Capability of producing safe drinking water is not enough
Distribution	Capability of distributing water is not enough
Financial	Capability of selling water at reasonable tariff and to manage under self-autonomous accounting is low
Human Resources	Capability of employing and developing human resources are not enough
Administration	Capability of office administration is not enough

Then objective trees were prepared by converting current negative situation in the problem tree into future positive situation. It illustrates desirable future situation with logical structure by which relationship between means and results are logically visualized to find rational approach to solve problems. The objective trees are shown in Appendix-F.

Alternative analysis was carried out by identifying and encircling project components. As a result, 33 project alternatives were identified as shown in Appendix-F.

In consideration of management target as discussed in the previous sub-section as well as the PCM workshop result, CD action plan for year 2025 is proposed as shown in Table 5.2. The CD action plan for the short term until 2015 is presented in Part III.

Among short term action plans, some CD components are implemented under the Study as described later.

Table 5.2 Proposed Capacity Development Action Plan by 2025

Category	Objective	Activity	Evaluation criteria
Autonomy	Autonomy of UWC is more enhanced	More authorities are granted; such as proposal of tariff revision, alary system, sub-contracting Empowerment to staff level	Clear statement in legally valid official documents (law, decree, ordinance, etc.)
Organization	Performance of UWC is more effective and efficient	Restructuring and redefinition of organization is done Business manner is shifted to customer-oriented mode	New organization chart Provision of UWC charter, etc.
	Information on management and facility is integrated and provided	IT section is formed to support management information and facility information	Management information system is operating
O&M	O&M work is done in proactive and efficient manner	Work plan for performance improvement by section is prepared with target	Work plan with target is prepared and monitored
	Water service is managed under quality assurance system	Work record and reporting system is integrated into quality assurance system Quality control staff is deployed	ISO9001 certification Quality assurance system is functioning
	Supply chain management is effectively done	Supply chain management section is formed in order to control procurement and stock of materials	Ave. stock of consumables in days (days for consuming) Ave. time to delivery from purchase order by O&M section(days)
Finance	Earn profit after depreciation	Water tariff is set at the full-cost recovery basis Non-revenue water ratio is decreased through technical and commercial loss management	Operating expenses to sales ratio become less than 80% NRW is less than 28%
	Fundraising capacity is improved	Financial statements are prepared according to International Accounting Standard External financial audit is carried out	Provision of accounting statement Accounting audit report
Human Resources Development	HRD is internally and continuously carried out	Human resources development program is planned and implemented by UWC In-house training course is done by internal trainers Training facility is constructed	Carrier development program for each staff is prepared and implemented Number of training course is increased Training time is increased
	Staff motivation and efficiency is improved	Performance evaluation of staff is introduced	Comparison between before and after evaluation system introducing of; staff efficiency of UWC, work performance by section, etc.
Public Relations	Public relations is well maintained	Newsletter (magazines) is published periodically in order that public information is easily accessible	Issuance of public information

5.2 Capacity Development Plan on Operation and Maintenance

The operation and maintenance system should be improved and gradually modernized for efficient and effective O&M through the following capacity building measures focusing on the selected strategies.

(1) Establishment of Adequate O&M System

After completion of construction works of the proposed project, UWC staff should operate and maintain the proposed facilities together with existing facilities efficiently and effectively by improved institutional capacity and considering guidelines/manuals prepared by the proposed project consultant and the contractor. Some of the specific areas for training are listed in Table 5.3.

Table 5.3 Example of O&M Staff Training Needs

Subject area	Examples of Training Activity
Technical capacity building	
Water Treatment Plant	▪ Prevention of contamination ▪ Monitoring of raw and treated water quality and control of treated water quality ▪ Determining correct combination/amount of water treatment chemicals ▪ Adding and mixing chemicals ▪ Checking coagulation conditions ▪ Operation of conventional water treatment and maintenance ▪ Maintaining records
Pumps	▪ Operation and maintenance of mechanical and electrical equipment ▪ Record keeping ▪ Minor repairs
Water transmission main flow management	▪ Transmission water flow management for distribution zones ▪ Daily inspection of leakage or damaged portion
Water quality analysis and management	▪ Determine sampling sites, sample collection ▪ Determine types of analyses ▪ Analyze data, frequency of sampling, reaching conclusions
Service reservoirs	▪ Water level monitoring and control ▪ Keeping and analysis of records
Distribution and Service lines	▪ Daily inspection of leakage or damaged portion ▪ Repair of defects, collection and recording data
Water leaks and non-revenue water control	▪ Training on water leakage detection using modern equipment ▪ Preparation of annual leakage reduction plan ▪ Collection, recording and analysis of data
Repairs of mechanical / electrical gadgets	▪ Upgrade repairing skill ▪ Basic records and data analysis
Meter repair	▪ Detecting problems and repairing meters using modern techniques
Non-technical capacity building	
Data collection, checking and editing, summarizing	▪ Identify data types ▪ Develop databases, preparation of formats, data checking
Corporate planning & strategy	▪ Organization vision ▪ Organization strategy, long-term and short-term plan
Targets & work programming	▪ Setting targets ▪ Program preparation to achieve targets ▪ Monitoring, program review, evaluation
Information & communication materials	▪ Determine subjects, types of materials for different situations, using IE materials
Store management & inventory control	▪ Store management principles ▪ Inventory control ▪ Creation and operation of computer-aided inventory system
Customer & client management	▪ Preparation of customer databases ▪ Identify data types, customer/client feedback ▪ Complaints management and recording
Data analysis & reporting	▪ Data analysis, preparation of tables, reporting to other related organizations

(2) Database Development and Management

Basic data and information important for management of the water supply system include all the information on existing water supply facilities comprising water treatment plant, pumping stations, pipelines, reservoirs along with their location maps, and plan drawings, records on number and types of customers, number of meters, etc.

1) Datasheet for Record Keeping and Work Process Flow

As a part of this Study, several example datasheets have been prepared for record keeping of different processes of water supply services. These datasheets should be used for maintaining records and should be regularly modified and improved based on the needs. Also, work process flow diagrams should be modified regularly according to the requirements on site to make it more suitable.

For proper O&M, the manual prepared by consultants and contractors should always be referred by the staff. The key points from manuals could be summarized for specific facility, printed on pages and posted on wall near that particular facility.

2) Application of GIS for Water Supply Management

Under this Study, a basic GIS map has been prepared using ArcGIS including information on existing water supply facilities (water treatment plant, reservoirs, trunk pipelines, etc.). This map should be updated regularly and modified based on the future requirements of O&M.

The GIS system can be utilized for efficient operation and maintenance of the water supply system. It is proposed to improve available GIS system for the water supply management. The GIS system will contribute to the following tasks:

- Maintenance of the network pipes
- Leakage control
- Estimation of water consumption
- Water distribution (water flow) management
- Maintaining customer database

3) Preparation of Customer Database

The development of a customer database should be a priority. In this regard, it is necessary to identify data needs, design proper formats for data collection and continuously update the collected data. The database should cover all customers and should include information such as names, addresses and phone numbers. The paid customers should be identified in details such as the customer type of water

connection. The database should also cover customer complaints and remedies against the complaints. These databases should be regularly updated as new and revised data are gathered. The customer database should include:

- Customer information
- Type of water use (domestic use/ commercial use/ industrial use / public use)
- Estimated / metered water consumption volume
- Payment conditions of tariff (performance of payment, payment amount, etc.)

(3) Ensuring Adequate Budget for O&M

It is recommended that the financial management be improved for ensuring adequate budget for O&M. For this purpose, the tariff collection system should be improved through introduction of tariff based on metered consumption, raising of tariff considering affordability and willingness-to-pay, introduction of strict penalty for illegal connections, introduction of incentives for collectors, and implementation of awareness campaign related to duty of customers to pay for water services.

The audit system should be established for financial statement of UWC to ensure transparency and accountability. The auditing for financial statement such as annual revenue and expenditure, and revenue from tariff collection should be carried out periodically.

Customers are the primary beneficiaries of the water supply program. They contribute to the revenue of the department to be utilized in the management of facilities. Hence, the relationship between customers and department should be managed so that both groups benefit from each other.

Information and education materials should be designed to provide information (connection procedures, regulatory matters, billing procedure, new water tariffs, etc.) and to educate (proper water habits, methods of water saving, cleaning water facilities, value of free water, etc.) water customers. These materials will have a positive impact on developing an informed group of customers and clients. The result would be the improved management of the supply system including its O&M. It is proposed that following actions be undertaken:

- Important subjects for the preparation of IE materials should be identified. Areas such as the present status of water supply system and the proposed improvements to water supply should be included.
- Useful education/communication materials (i.e., posters, leaflets, brochures, etc.) should be developed to provide publicity and to educate stakeholders
- Customer educational materials should be distributed.

(4) Organization of Training and Establishment of Training Facilities

For efficient operation and maintenance of water supply facilities in long run, there is a need for extensive and systematic training in various areas and for different types of employees. The main areas of training include:

- Training on operation and maintenance of water supply facilities including water treatment plant, pumping stations, reservoirs, and distribution networks
- Training on the computer skills improvement
- Training of the laboratory team for the latest water quality tests
- Training on GIS and remote sensing
- Training on the financial software programs
- Training of the managers on the managerial skills

Initially, the training could be carried out using experts from overseas or by arranging visits of trainees to overseas. However, in long run training facilities should be established in UWC for different kinds of training. The training room should be equipped with personal computers, printer and copying machine to be used for training purposes. Also in future, various software that are useful for O&M of water utilities should be purchased to train staff-members on related software.

5.3 Implementation of Action Plan of Capacity Development in this Study

5.3.1 Introduction

As a part of CD plan, the CD activities have been carried out under this Study. As discussed previously, the capacity of UWC is generally weak in all levels of administration/ policy making, management, staff and workers. And the identified CD action plans contain broad ranges and require long-term efforts. Therefore, CD should be implemented strategically under long-term view. Hence, three phases are proposed to implement CD plans stepwise, as shown in Table 5.4.

Table 5.4 Proposed Capacity Development by Implementation Phase

Phase	Objective
1. Enhancement of Waterworks Management Policy	Acquisition of knowledge on proper management and setting up a future vision. Main target groups are to be administrative officials and top management of UWC.
2. Management Base Strengthening	Strengthening of critical management basis of UWC. Main target groups are to be management class and potential leaders of UWC.
3. Technical Knowledge & Skill Improvement	Upgrading O&M techniques and basic knowledge and skills. Main target groups are to be staff and worker levels.

In each phase, effective CD plan is proposed with appropriate target group, as shown in Figure 5.1. It

also illustrates probable implementation scheme, which is discussed in next sub-section. It should be stressed that potential leaders, who can lead UWC toward proper direction in future, should be fostered in UWC. In this regard, phase-2 "management basis strengthening" has a great importance, which focuses on training for these potential leaders. In this Study, CD programs for phase-1 and 2 are covered due to time constraint.

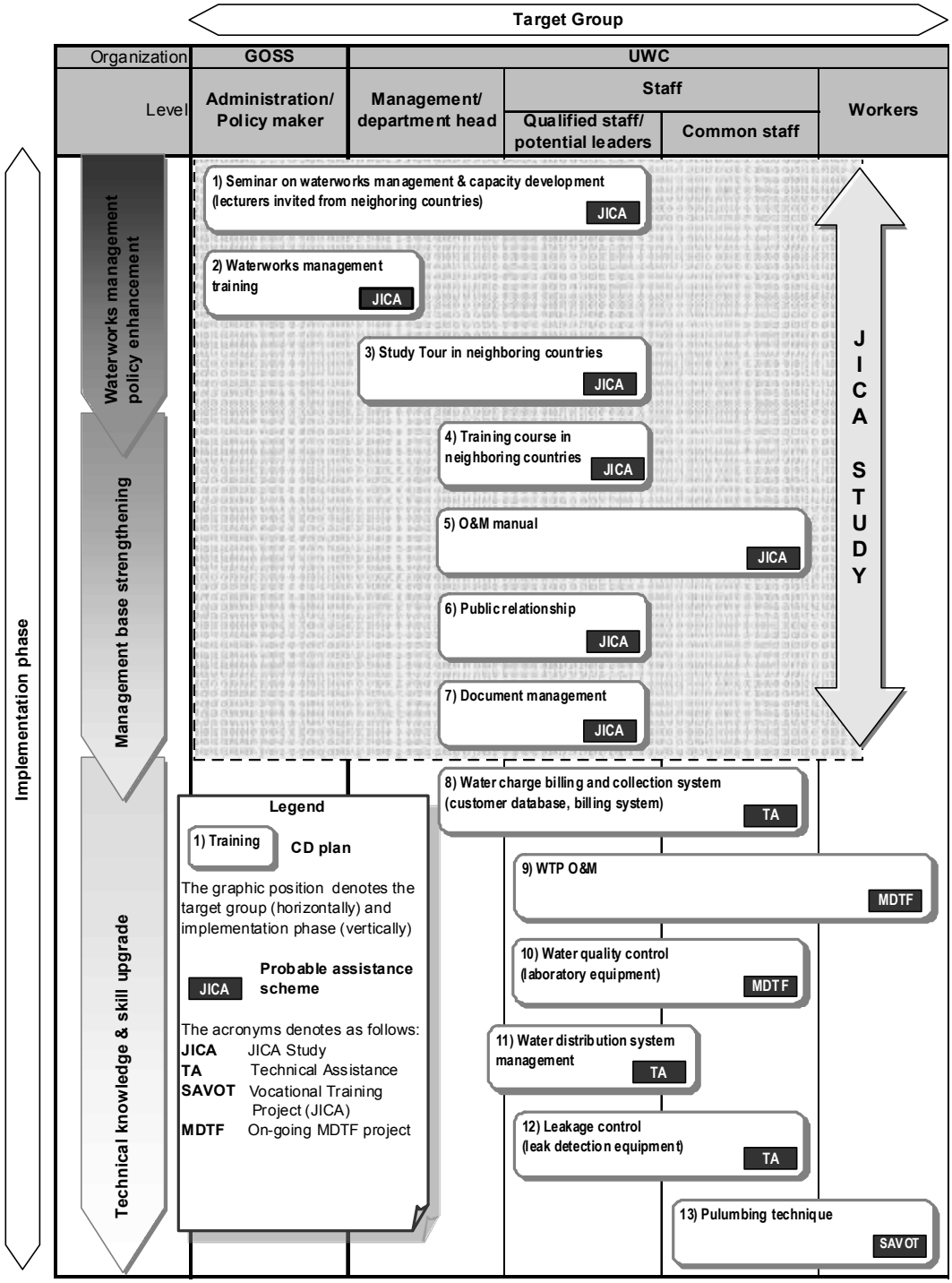


Figure 5.1 Proposed CD Implementation Plan by Implementation Phase and Target Group

5.3.2 Implementation Scheme and Schedule of Capacity Development

(4) Implementation Scheme

Since training resources of good quality do not exist in Southern Sudan, CD plans need to be implemented by foreign assistance in any ways. The CD plan and probable implementation scheme is proposed as shown below.

1) Seminar on waterworks management & capacity development

Objective	Acquiring knowledge on proper waterworks management and capacity development policy Establishing relationship with other waterworks of neighboring countries
Activity	Two days seminar in Juba Lecturer: 2-3 lecturers from waterworks of neighboring countries who have good knowledge and experience Subject: Waterworks management, water quality control, water charge collection system, non-revenue water control, human resources development, public awareness campaign, etc. Target group: Administrative officers (MWRI/GOSS, MOPI/CES, etc.) and Management officers and core staff of SSUWC
Implementation scheme	CD assistance under JICA Study
Input	Cost for lecturers (travel, accommodation, lecture fee, etc.) Cost for seminar (venue, documents, etc.) Approx. USD 15,000 in total

2) Waterworks management training (overseas)

Objective	− Acquiring knowledge on administration of urban water supply in Japan and experience in overseas assistance − Preparing strategy for developing water supply system in Southern Sudan
Activity	− Short term training course in Japan, including lectures by Japanese authorities in water supply, site visit to some waterworks and water supply facilities − Subject: Institution and administration on water supply in Japan, Water supply system, Water supply management, Water quality control, Facility management, Overseas assistance, etc. − Target group: Administrative officers (MWRI/GOSS), Management officers of SSUWC
Implementation scheme	− Counterpart training of the JICA Study
Input	− Cost for dispatching − Cost for training course

3) Study tour in neighboring countries

Objective	− Awareness-raising by visiting successful waterworks which has similar natural and social background as Southern Sudan − Acquiring knowledge on proper waterworks management and experience to solve problems − Establishing close relationship with other waterworks
Activity	− One week tour in neighboring countries (e.g. Kampala, Nairobi) − Lecture (one – two days): Water supply system and management − Site visit to successful waterworks − Exchange information and discussion on waterworks management, human resources development, etc. − Presentation in Juba on achievements through training − Target group: Management officers and core staff of UWC (7 persons)
Implementation scheme	− CD assistance under JICA Study
Input	− Cost for dispatching (travel, accommodation, etc.) − Cost for training (venue, lecture, etc.) − Approx. USD 15,000

4) Training course in neighboring countries

Objective	− Acquiring practical knowledge and skill in specific field related to water supply management − Establishing close relationship with other waterworks
Activity	− Short-term training course in neighboring countries (e.g. Kampala, Nairobi) − Lecture and practical training (three weeks): Any specific field related to water supply facility management and waterworks management. − Presentation in Juba on achievements through training − Target group: Core staff (potential leaders) of UWC (approx. 5 persons for each course)
Implementation scheme	− CD assistance under JICA Study
Input	− Cost for dispatching (travel, accommodation, etc.) − Cost for training (venue, lecture, etc.) − Approx. USD 30,000

5) O&M Manual

Objective	− Improving work process according to O&M manual to be provided. − Improving work record system by using written format − Preparation of monthly report
Activity	− Provision of O&M manual, including job description, work flow of each task and format of daily log and maintenance checklist. (one month) − Instruction of O&M manuals and formats (two weeks) − Assistance to prepare monthly report (two weeks) − Target group: Head of department and staff of purification, distribution and financial departments
Implementation scheme	− CD assistance under JICA Study
Input	− O&M expert (the Study Team) − Cost for document, material, etc. − (PC with printer is to be provided in the following item 8)

6) Public relationship

Objective	− Raising public awareness on water supply, water saving and water charge − UWC's experience on how to promote public awareness campaign
Activity	− Assistance on public information planning − Assistance to prepare public information materials − Implementing public awareness campaign (by distributing advertising papers, by using mass media, etc.) − Target group: Head and staff of UWC
Implementation scheme	− CD assistance under JICA Study
Input	− Waterworks management expert (the Study Team) − Cost for advertising paper, advertisement expenses, etc. − Preconditions: Operation of new WTP under MDTF, installation

7) Document management

Objective	− Improvement of information management system through upgrading document management and practice, such as proper documentation, update and filing.
Activity	− Training on proper document management through SAVOT training course − Training on PC operation (private course) − Assistance on preparation of document management guideline
Implementation scheme	− CD assistance under JICA Study (for procurement of PC) − Private training course for PC operation (to be borne by UWC) − Training by SAVOT project (application should be submitted)
Input	− Procurement of PC, software, printer, copy machine, desk, bookshelves − Cost for PC training (to be borne by UWC) − Cost for training course on document management (SAVOT)

8) Water charge billing and collection system

Objective	− Improving water charge billing and collection system by using computer software, including customer database
Activity	− Establishment of customer database by using computer software − Establishment of water charge billing and collection system by using computer software − Instruction on how to use software − Installation of water meters and instruction on repair and maintenance of meters − Target group: Head and staff of revenue section of financial department − Project period: approx. 6 months
Implementation scheme	− Technical Assistance (by any international donor)
Input	− Foreign experts (water supply management, financial expert, system engineer, meter installation and maintenance expert) − Procurement of computer and software (customer database and billing system) − Procurement of maintenance tools for water meters (if necessary, such as plumbing tools, equipment for meter calibration, other maintenance tools, spare parts, etc.)

9) Water treatment plant O&M

Objective	− Acquiring practical knowledge and skills on O&M for water supply facilities, including water treatment plant, pumping station, service reservoir, etc.
Activity	− Training through OJT in one-year commissioning period of new water treatment plant constructed under MDTF project.
Implementation scheme	− MDTF project
Input	− Provision of new WTP, O&M equipment, chemicals for water treatment − Trainers from the Contractor of MDTF project

10) Water quality control

Objective	− Acquiring practical knowledge and skills on water quality control
Activity	− Training through OJT in one-year commissioning period of new water treatment plant constructed under MDTF project.
Implementation scheme	− MDTF project
Input	− Provision of laboratory room, water quality test equipment, test chemicals − Trainers from the Contractor of MDTF project

11) Water distribution system management

Objective	− Improving management of water distribution system, by introducing district metering area (DMA), mapping system of pipelines, etc.
Activity	− Assistance to planning and management of district metering area (DMA) − Assistance to input and maintain pipeline mapping system by using computer software − Lecture on planning method of replacement of old pipeline − Implementation of pilot project in a small DMA (optional) − Target group: Head and staff of distribution department − Project period: approx. 6 months
Implementation scheme	− Technical Assistance (by any international donor)
Input	− Foreign experts (water facility planner, CAD/GIS expert) − Procurement of computer, printer and software (CAD/GIS) − Preconditions: UWC to employ CAD operators, staff in distribution department to learn PC operation

12) Leakage control

Objective	− Acquiring knowledge and skill on leakage control
Activity	− Lecture: water leakage type, leakage detection equipment and techniques, preventive leakage control practice, etc. − Field training: how to use equipment, how to detect leakage, etc. − Target group: Staff of distribution department − Project period: approx. 2 months
Implementation scheme	− Technical Assistance (by any international donor)
Input	− Foreign experts (water pipeline engineer, leakage control) − Procurement of leakage detection equipment, flow meter, etc.

13) Plumbing technique training

Objective	− Acquiring proper plumbing technique
Activity	− Lecture and field training on plumbing technique for public water supply, by using different pipe materials, diameters, and laying conditions. − Target group: Staff and worker of distribution department (min. 20 persons) − Project period: approx. 2 weeks
Implementation scheme	− SAVOT (special course)
Input	− Procurement of plumbing equipment (if necessary) − Cost for training (training material, course, etc.)

(5) Implementation Schedule

Implementation schedule for the proposed CD plans are tentatively prepared as shown in Figure 5.2

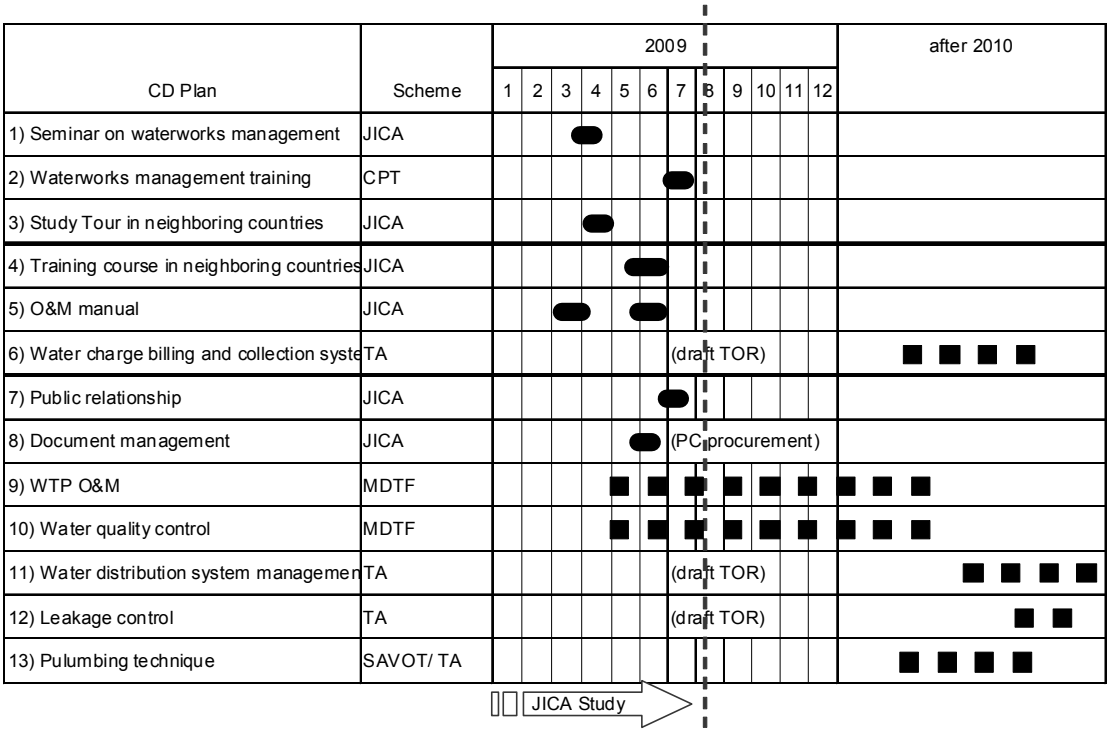


Figure 5.2 Implementation Schedule of Short Term Capacity Development (Action Plan)

5.4 Progress of Implementation of Capacity Development in this Study

(1) Seminar

Date	April 1-2, 2009
Participants	Approx. 40 people (including, Minister of MWRI/GOSS, Undersecretary of MWRI/GOSS, General Manager of SSUWC-HQ/GOSS, other participants from MWRI/GOSS, SSUWC)
Lecturer	Kenya Water Institute (KEWI) Nairobi Water and Sewerage Company (NWSC)
Subject Presented	Day-1: - Development history of waterworks in Kenya - Case study of Kenyan waterworks; organization, roles by section, good practice, etc. - Administration & legal framework in water sector in Kenya - Case study of Kenyan waterworks; financial status, fund source, subsidy system, etc. - Outline of JICA Master Plan Study Day-2: - Water quality control: legal background (water quality standard), current practice - Water billing and collection system; tariff system, billing and collection system, etc. - Non-revenue water control (A) Technical loss (B) Commercial loss - Customer care - Human Resources Development
Remarks	− At the kick-off, H.E. Minister presented keynote speech, for which press gathered − Almost all participants attended the two days program. Positive attitude of participants was observed. The program was carried out interactively. − Out of 35 questionnaires collected from participants, most respondents marked highest evaluation for the contents of the seminar − Ideas on slogan for public relationship was also collected through the questionnaire − Some participants seem to have difficulty in communicating in English

(2) Waterworks Management Training in Japan

Date	Scheduled around July, 2009
Participants	4 persons (Representatives from MWRI/GOSS, SSUWC-HQ/GOSS, SSUWC (CES)-Juba)
Program (provisional)	− Water supply in Japan and roles of government administration (MHLW, Japan) − Water supply and public health − Presentation on Country Report − Monitoring waterworks management by using performance indicator − Water quality management: Water safety plan − Water tariff and revenue − Site visit: Actual O&M work and Management practice (From water source to water tap) − Preparation and presentation of improvement plan

(3) Study Tour

Date	April 20-24, 2009
Participants	7 persons (from MWRI/GOSS, SSUWC-HQ/GOSS and SSUWC (CES)-Juba)
Program	Day-1: (All sessions were held at KEWI Conference Room) − Opening ceremony and seminar objectives by Deputy Director Training, KEWI − Lecture on Water Sector Reforms in Kenya − Lecture on the National Water Services Strategy 2007-2015 − Lecture on Water Supply in Kenya − Lecture on Waterworks Management Day-2 − Visit to Nairobi Water Company head office − Visit to Kabete Water Treatment Plant and Laboratory in Nairobi − Visit to Ngethu Water Treatment Plant and Laboratory (about 40 kms out of Nairobi city) Day-3 − Visit to Nyeri Water and Sewerage Company Head Office − Visit to Nyeri Water Treatment Plant − Visit to Nyeri Wastewater Treatment Plant Day-4 − Visit to Thika Water Treatment Plant − Visit to Thika Wastewater Treatment Plant Day-5 (Sessions held at KEWI Conference Room) − Presentations on Study Tour findings by the participants on the water supply, sanitation, and policy and management − Closing ceremony
Remarks	− All the 7 participants were very active throughout the visit. The participants were really very keen to learn. − The visits were well organized by KEWI and participants could get a very detail idea on water treatment works and sewerage treatment works − The participants expressed their desire to have more such training and collaboration with KEWI in such training. − Nairobi Water Company, Ngethu, Nyeri and Thika have good management practices for facilities.

(4) Short Training Course in Neighboring Country

Period	3 weeks around June-July 2009
Participants	10 persons in total (from SSUWC)
Course A	Water Supply Facility Management Course − Basics of water supply system − Basics of O&M waterworks (purpose, process, etc) − O&M techniques on pipeline facilities, valves, etc. − O&M techniques on water tanks, pump facilities, etc. − Plumbing techniques − Water meter installation − Trouble shooting, crisis management (repair of pipes, pumps, leakage detection techniques) − Servicing water meter − Field training − Study tour to a water scheme
Course B	Billing, Revenue Collection and Customer Care Course − Tariff setting − Meter reading − Processes of billing − Introduction of billing software − Revenue collection − Customer database − Customer care

(5) O&M Manual/ Instruction

Date	March 25-27, 2009
Participants	30 persons (Technical staff of SSUWC (CES)-Juba)
Program	Day-1 − Presentation on General Outline of O&M − Presentation on O&M of Coagulation and Sedimentation Facilities − Video presentation of capacity development materials provided by JICA Day-2 − Presentation on O&M of Filtration Facilities − Presentation on O&M of Disinfection Facilities − Presentation on O&M of Pumps and Reservoirs − Video presentation of capacity development materials provided by JICA Day-3 − Presentation on O&M of Distribution Networks − Presentation on O&M of Water Quality Monitoring − Evaluation and Feedback on Grasping Level of the Participants
Remarks	− Positive attitude of participants was observed. − English is a barrier for some participants, which caused less effects of workshop − Examination on understanding was carried out on the final day. As a result, the engineers from MWRI were observed to have good grasping ability. Many of the engineers from UWC also had a good grasping level. However, due to English language, for many of the technicians, it was difficult to understand the content of presentation. − For questionnaire about workshop, most participants responded that they need more training to acquire better knowledge.

(6) O&M Record Keeping Instruction

Date	June 22-29, 2009
Participants	10 persons (Operation staff of SSUWC (CES)-Juba)
Program	Contents of Training: − Instruction on filling up daily operation record sheets − Filling up of monthly record sheets related to operation − Filling up of periodic maintenance sheets Instructions were provided for filling up record sheets for different components including intake, coagulation, sedimentation, filtration, disinfection, storage and distribution facilities.
Remarks	− Positive attitude of participants was observed. − English is a barrier for some participants, therefore assistance was provided by one of the participants in translating all the instructions into Arabic. − The participants expressed that this kind of training is very useful and they could learn basics of the operation. They added that they need more training to acquire better knowledge.

5.5 Evaluation/Limitations of Capacity Development Activities

(A) Participants Very Keen to Learn

During all the activities of CD, it was realized that the participants are very keen to learn. The participants added that the opportunity to learn is not sufficient. The trainings for capacity development are not organized regularly as of now. Even the participants who were unable to understand English observed the capacity development activities very carefully. Hence, it is expected that the people will participate actively whenever opportunity comes to them, despite several other constraints.

(B) Tools not Available

The capacity development activity becomes more difficult due to absence of the equipments. Training system has not been established yet in the organizations responsible for operation, maintenance and management of water supply services. Therefore, tools and equipments required for demonstration and presentations are not available easily.

(C) Training Period Too Short

On the basis of the feedback from participants of various capacity development activities, it was learnt that the participants felt training period to be very short. Therefore, it is recommended that in future the capacity development activities should be organized for longer period.

(D) Power Supply Interruption

Frequent power supply interruption was observed at various stages of the capacity development activities that were undertaken in Juba. Especially during online presentation through computers, during hands-on training on the computers, and during record keeping training for proper operation and management of water supply facilities, power interruption had adverse impact on the outputs.

(E) Language Limitation

The high level officials, including management level staff and engineers are well versed in English. However, many of the lower level staff-members such as operators are not good at English. Skilled participants, who are very good both at English and Arabic languages, were used as much as possible while carrying out the capacity development activities. However, language seemed to be a bottleneck in terms of direct interaction with the participants sometimes.

(F) Test Result

A test was carried out at the end of theoretical explanation on operation and maintenance of water supply system in order to understand the grasping level of the participants. Of the 25 participants who took this test, 9 persons obtained a grade point of more than 50% and remaining had a grade point of less than 50%. The low grasping ability of participants could be attributed to poor English level and academic background of the participants. Due to internal disturbance in the region, most of the operators do not have any formal high school education and only few of them have engineering background. That makes it difficult for them to understand technological aspects.

(G) Organizational Constraints

There are some constraints that are due to organization issues. The water distribution networks are very old. Therefore, everyday multiple cases of leakage in pipes occur. As a result, a large number of distribution staff members are involved in the repair works. Hence, sometimes it was difficult for these staff members to manage free time for the training purposes.

The region has faced internal war for several decades and therefore, a big population has not been able to acquire even regular school education. Very few have obtained graduation level degree in engineering fields. Consequently, there is lack of staff-members with sound academic background. This makes it little difficult for them to understand very technological aspects. However, with stabilization in this region, many people are now attending regular schools and in future the situation is expected to improve.

Even during the capacity development activities, water treatment facilities were observed to be not in operation mainly due to financial problems. This sometimes made it difficult to explain the operation and maintenance procedure. In future, it is expected that the financial condition of organization would improve.

(H) Constraints in Overseas Training

There was a case in which, the selected participant did not possess a Passport. Even the regional passport office did not have a Passport booklet. Therefore, finally the training visit of that participant was cancelled. It would be recommended therefore, for the staff-members of the related organizations to have a Passport.

In some other cases, the participants could not participant in overseas study tours due to unavoidable reasons and it was difficult to arrange the visit for substituted members.

(I) On-the-Job Practical Demonstration

As mentioned earlier, poor level of English and academic background influences the grasping level of participants in CD activities. Therefore, on-the-job practical demonstration of CD activities will be easier for the participants to learn and therefore expected to be more beneficial.

CHAPTER 6 COST ESTIMATION

6.1 Conditions of Cost Estimation

The costs are estimated based on the following conditions and assumptions.

(1) Construction Cost

- The base year of cost estimation is 2009.
- Construction cost is estimated by categorizing into water treatment plant, transmission pipeline, transmission pump station, distribution main facilities (service reservoir, elevated tank and distribution pump), distribution main & sub-main, and distribution network.
- Common labor is procured from the domestic, and skilled labor is procured from neighboring counties such as Kenya and Uganda, in principle.
- Basic civil materials such as cement and reinforcing steel are available in the local market but most of these basic materials are imported from neighboring countries. The market price in Juba including transportation is used for these basic civil materials.
- Pipe materials, mechanical and electrical equipment are imported from neighboring countries and European countries, in principle.
- General construction machineries are procured from neighboring countries, in principle.
- Excavation for installation of pipes is done by open cut method. A certain percentage of excavation is assumed to be rock considering the geological conditions in Juba.
- The bearing capacity of soil for facilities such as water treatment plants and reservoirs is assumed to be classified into strong one. No foundation is assumed to be needed because it has sufficient bearing force and does not cause harmful uneven sinking.

(2) General Conditions

- Project cost is estimated by LC (local currency portion) and FC (foreign currency portion).
- The exchange rate of Sudanese Pound to USD is 2.21 based on the average rates in the study period starting from August 2008 to February 2009. The exchange rate of Japanese Yen to USD is 98.33 based on the average value in the same period.
- The present currency of Southern Sudan is Sudanese Pound but economy of Southern Sudan is relied on USD due to its strong dependency on other countries.

(3) Cost Definitions

- Construction Cost = Direct Construction Cost
- Project Cost = Construction + Administration + Engineering + Physical Contingency
- Fund Requirement = Project Cost + Price Escalation (Price Contingency)
- Local and foreign currency potions: the goods and labors which are procured in local market

and foreign market, respectively.

(4) Assumptions for Estimation of Indirect Cost

- Project administration cost of the Southern Sudan side is 2 % of construction cost.
- Engineering cost is 10 % of construction cost.
- Physical contingency is 10 % of the total of construction cost, administration and engineering cost, as civil works account for the major part of the construction cost.
- Price contingency is 7.0 % per year for local currency portion taking annual price increase index in Sudan into account and 4.1 % for foreign currency portion taking the index of neighboring counties and EU countries, from where the most of procurement will be carried out, into account.

6.2 Implementation Schedule

The construction schedule of the proposed water supply facilities of the Master Plan are planned as shown in Table 6.1, by dividing into 4 phases as mentioned in Chapter 3 of PART II.

Table 6.1 Implementation Schedule of Water Supply Facilities

Facility	Specifications	Phase-1	Phase-2	Phase-3	Phase-4
		-2012	-2015	-2020	-2025
1. Water Treatment Plant					
1.1 Expansion of Existing WTP	7,000 m^3/d	full			
1.2 West WTP	189,000 m^3/d		63,000	63,000	63,000
1.3 East WTP	34,000 m^3/d			34,000	
2. Pumping Station					
2.1 Transmission P/S No.1 (North)	Q=48,000 m^3/d, H=45 m		full		
2.2 Transmission P/S No.2 (South)	Q=48,000 m^3/d, H=40 m			full	
3. Service Reservoir					
3.1 West North Low Zone	24,000 m^3		10,000	14,000	
3.2 West North High Zone	16,000 m^3		10,000	6,000	
3.3 West South Low Zone	10,000 m^3			10,000	
3.4 West South High Zone	16,000 m^3			16,000	
3.5 East Zone (Gumbo)	11,000 m^3			11,000	
4. Transmission Pipeline					
4.1 Transmission Pipeline	DIP, DN200-1000mm x 29.1km	Yes	Yes	Yes	Yes
5. Distribution Main & Sub-main					
5.1 Low Zone Mains	DIP, DN200-1000m x 74.7km	Yes	Yes	Yes	Yes
5.2 High Zone Mains	DIP, DN200-900m x 80.0km	Yes	Yes	Yes	Yes
5.3 Gumbo Mains	DIP, DN200-800m x 14.0km				
6. Distribution Tertiary					
6.1 Low Zone Network	PVC, Dia.100-150 x 506.0km	Yes	Yes	Yes	Yes
6.2 High Zone Network	PVC, Dia.100-150 x 445.8km	Yes	Yes	Yes	Yes
6.3 Gumbo Network	PVC, Dia.100-150 x 131.3km				

The construction schedule should be planned in a manner to ensure proper execution of the construction work considering the conditions such as the construction procedure, capabilities of contractors and suppliers, procurement of materials and labor force. The construction schedule of the

projects is planned as shown in Figure 6.1.

Phase	2010	2011	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Phase-1																
Phase-2																
Phase-3																
Phase-4																

Figure 6.1 Construction Schedule by Phase

6.3 Estimation of Project Cost

(1) Estimation of Construction Cost (Direct Construction Cost)

The estimated costs for the Master Plan are summarized in Table 6.2 and the breakdowns of the construction cost are given in Appendix-G. The total construction cost is 278.7 million USD.

The percentage of the construction cost of water treatment plants is 35 % of the total construction cost. Transmission facilities including transmission pipeline and pump station constitute 14 %, service reservoirs 7 % and distribution network is about 44 % of the total construction cost.

The local and foreign currency portions of the construction costs are 14% and 86%, respectively. The percentage of foreign currency is considerably high as almost all materials including pipes, equipment and basic civil materials such as cement and reinforce steel are imported from the outside.

Table 6.2 Construction Cost for Master Plan

Facility	Specifications	Cost (thousand USD)	Percentage (%)
1. Water Treatment Plant (WTP)			
1.1 Expansion of Existing WTP	7,000 m^3/d	5,538	2.0
1.2 West WTP	189,000 m^3/d	68,087	24.4
1.3 East WTP	34,000 m^3/d	23,146	8.3
Sub-total		**96,771**	**34.7**
2. Transmission Pumping Station (T-P/S)			
2.1 T-P/S in North Low SR	Q=48,000 m^3/d, H=50 m	3,408	1.2
2.2 T-P/S in South Low SR	Q=48,000 m^3/d, H=40 m	2,881	1.0
Sub-total		**6,289**	**2.3**
3. Service Reservoir (SR)			
3.1 North Low SR	24,000 m^3	7,072	2.5
3.2 North High SR	16,000 m^3	4,603	1.7
3.3 South Low SR	10,000 m^3	2,482	0.9
3.4 South High SR	16,000 m^3	5,206	1.9
3.5 Elevated Tank in Gumbo Zone	1,300 m^3	1,159	0.4
Sub-total		**20,522**	**7.4**
4. Transmission Pipeline			
4.1 Transmission Pipeline	DIP, DN200-1000mm x 27.3 km	32,892	11.8
Sub-total		**32,892**	**11.8**
5. Distribution Main & Sub-main			
5.1 Low Zone	DIP, DN200-1000m x 74.7km	32,435	11.6
5.2 High Zone	DIP, DN200-900m x 80.0km	29,040	10.4
5.3 Gumbo	DIP, DN200-800m x 14.0km	6,817	2.4
Sub-total		**68,292**	**24.5**
6. Distribution Tertiary			
6.1 Low Zone Network	PVC, Dia.100-150 x 506.0km	23,776	8.5
6.2 High Zone Network	PVC, Dia.100-150 x 445.8km	20,947	7.5
6.3 Gumbo Network	PVC, Dia.100-150 x 131.3km	6,170	2.2
6.4 Kiosk/Water Tanker Feeding Station		3,000	1.1
Sub-total		**53,893**	**19.3**
Total		**278,659**	**100.0**

Note: The total is not 100 % due to rounding.

(2) Estimation of Project Total Cost

The estimated total costs are summarized in Table 6.3 and the estimated cost by phase and yearly disbursement schedule are shown in Table 6.4 and Table 6.5. The project cost and fund requirement is 343 million and 467 million USD, respectively. The direct construction cost is about 60% of the total cost and the remaining costs including administration and engineering cost and contingencies is 41%. The largest constituent of the costs except construction cost is price escalation cost comprised of about 27 % of the total fund requirement.

The construction cost of the phase 1 is 9 % of the total construction cost. The phase 1 project is designed to return significant project benefits in a very short term and by small investment although

the project is small. It is of adequate size as a first step towards improving the existing water supply system.

Table 6.3 Project Cost and Fund Requirements

(thousand USD)

No.	Item	Local currency	Foreign currency	Total
1.	Construction cost			
1.1	Water Treatment Plant	16,621	80,150	96,771
1.2	Transmission Pipeline	3,079	29,813	32,892
1.3	Transmission Pump Station	413	5,876	6,289
1.4	Distribution Main Facilities	4,426	16,096	20,522
1.5	Distribution Main & Sub-main	11,301	56,991	68,292
1.6	Distribution Network	12,311	41,582	53,893
	Subtotal (1)	**48,151**	**230,508**	**278,659**
2.	Administration cost	936	4,610	5,573
3.	Engineering cost	4,815	23,051	27,866
4.	Physical contingency	5,393	25,817	31,210
5.	Price contingency	35,158	88,904	124,062
	Subtotal (2)	**46,329**	**142,382**	**188,711**
	Total	**94,480**	**372,890**	**467,370**

Table 6.4 Project Cost by Phase

(million USD)

Phase	Phase	Construction cost	Project cost	Fund requirement
Ph-1	Improvement of existing system +7000 m^3/d WTP	29.5	36.4	40.4
Ph-2	New system setting up + 63,000 m^3/d WTP	95	117	144.4
Ph-3	+63000 +34,000 m^3/d WTPs + expansion of network	103.6	127.7	178.9
Ph-4	+63000 m^3/d WTP + expansion of network	50.5	62.2	103.7
	Total	278.6	343.3	467.4

Table 6.5 Yearly Disbursement Schedule

(million USD)

Item	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
L.C	3.5	3.8	9.5	10.1	16.9	6.5	7.0	4.2	4.5	12.2	7.9	8.4	94.5
F.C	16.2	16.8	36.6	38.0	68.2	29.8	31.0	18.0	18.7	45.1	26.7	27.7	372.9
Total	19.8	20.6	46.1	48.1	85.1	36.4	37.9	22.3	23.2	57.3	34.5	36.1	467.4

6.4 Operation and Maintenance Cost

The operation and maintenance (O&M) cost is estimated based on the following conditions.

- O&M cost includes costs of personnel, electricity, chemical, spare parts, staff training and others.
- Personnel cost is estimated based on the staff members needed for the operation and maintenance of water supply system proposed in the Master Plan.

- Electricity cost is estimated for operating facilities proposed in the Master Plan by using the current tariff of power supply.
- Chemical cost comprises procurement cost of chemicals needed for treatment such as coagulant and disinfectant.
- Spare parts cost includes consumables and spare parts for the maintenance of mechanical and electrical equipment.
- Training cost includes cost and expense required for capacity building of staff members.

The O&M cost is estimated by the target year when the project facility is expected to run at full capacity. The result of O&M cost estimation by target year of each phase is summarized in Table 6.6. Detailed calculation is attached in Appendix-H.1.

Table 6.6 Summary of Cost Estimation of O&M by Target Year

Year	Annual revenue water (m^3/year)	O&M Cost (thousand USD/year)							O&M cost per revenue water (USD/m^3)
		Personnel	Electricity	Chemical	Spare parts	Staff training	Others	Total	
2009	851,667	0.0 (0%)	165.7 (30%)	86.0 (16%)	158.5 (29%)	0.0 (0%)	135.1 (25%)	545.3	0.64 (SDG1.41)
2012	2,044,000	630.4 (40%)	463.0 (29%)	172.0 (11%)	106.5 (7%)	63.0 (4%)	143.5 (9%)	1,578.5	0.77 (SDG1.70)
2015	13,115,667	1,899.0 (28%)	2,696.6 (40%)	946.1 (14%)	421.5 (6%)	189.9 (3%)	615.3 (9%)	6,768.3	0.52 (SDG1.15)
2020	33,872,000	3,995.7 (25%)	6,989.0 (44%)	2,137.8 (14%)	783.1 (5%)	399.6 (3%)	1,430.5 (9%)	15,735.8	0.46 (SDG1.02)
2025	51,903,000	5,749.1 (26%)	9,519.5 (44%)	2,911.9 (13%)	1,066.6 (5%)	574.9 (3%)	1,982.2 (9%)	21,804.2	0.42 (SDG0.93)

6.5 Capacity Development Cost

Unlike facility construction project, capacity development is to be carried out continuously as a part of business improvement activity. Therefore, cost estimation for capacity development is assumed to be additional 10 % of the personnel cost every year which should be allocated for staff training and expenses for training facilities. It amounts to approximately 3 % of the total O&M cost as shown in Table 6.6. This estimation seems relatively high compared to the waterworks in other countries where the ratio is around 1 to 2 % of the total O&M cost. However, it would be reasonable as current training needs are quite high and training resources have to be procured from other countries for the time being.

6.6 Disbursement and Repayment Schedule

(1) Fund Requirement by Currency Portion

The estimated project cost is summarized in Table 6.3. This total cost is divided into two categories, the foreign portion (loan) and local portion (Southern Sudan government portion). The share of local portion is assumed to be 2% of the construction cost as the administration cost to be borne by the Southern Sudan government, whereas the remaining is foreign portion which is envisaged to be financed through foreign grant or loan.

(2) Fund Source

Fund inflow is tentatively prepared based on the annual fund requirement as shown in Table 6.7.

Table 6.7 Fund Disbursement

(thousand USD)

Year	Foreign currency	Local currency	Total	Source
2011	19,466	296	19,762	Grant
2012	20,302	296	20,598	Grant
2013	45,473	633	46,106	Loan(1)
2014	47,472	633	48,105	Loan(1)
2015	**83,993**	**1,075**	**85,068**	**Loan(1),(2)**
2016	35,915	442	36,357	Loan(2)
2017	37,482	442	37,924	Loan(2)
2018	22,010	249	22,259	Loan(2)
2019	22,981	249	23,230	Loan(2)
2020	**56,727**	**586**	**57,313**	**Loan(2),(3)**
2021	34,208	337	34,545	Loan(3)
2022	35,765	337	36,102	Loan(3)
Total	39,768	592	40,360	Grant
	422,026	4,983	427,009	Loan
	461,794	5,575	467,369	Total

The terms and conditions of financing the foreign portion are based on following assumptions:

(a) Amount of funding (foreign portion): Project cost minus administration cost (to be borne by the Sudanese government). Consulting services and physical and price contingencies are included.
(b) Conditions of financing: Three scenarios are assumed as shown in Table 6.8. Grant aid is assumed as funding source for Phase-1 in each scenario.

Table 6.8 Three Scenarios of Fund Source

Phase	Project period	Finance required (thousand USD)	Fund Source		
			Scenario 1	Scenario-2	Scenario-3
Phase-1	2011-2012	40,360	Grant	Grant	Grant
Phase-2	2013-2015	144,417	JICA loan	ADF loan	AfDB loan
Phase-3	2015-2020	178,881			
Phase-4	2020-2022	103,711			

Three types of foreign loan are assumed as shown in Table 6.9. In any scenario, it is envisaged that guarantee by the Southern Sudan government is required in order to apply for loan.

Table 6.9 Type of Fund Source and Loan Conditions

Fund source	Type	Repayment term	Grace period	Interest rate
Foreign / Government Grant	Grant	-	-	-
Japanese Fund (JICA)	Loan	40 years	10 years	0.25 %
African Development Fund (ADF)	Loan	40 years	10 years	0 % (0.75% annual service charge on outstanding balance, 0.5% annual commitment fee on undisbursed commitment)
African Development Bank AfDB	Loan	20 years	5 years	4.00 %

(3) Repayment schedule

Based on the three scenarios, repayment schedule is prepared and presented in following 3 Tables. Interest rate is calculated as simple interest. And repayment method is assumed to be principal equal yearly payment.

As a result, it is envisaged that the Project would be viable in Scenario 1 and 2, considering water revenue forecast as discussed later. Taking into account that probability of JICA loan is quite low because of recent debt relief to the National Unity Government of Sudan, in this Study, Scenario-2 (Grant + ADF Loan) is employed as an assumption for financial analysis hereafter.

Funds Flow and Repayment Schedule
Scenario-1: Grant + JICA loan

(x1000 USD)

	Fund Disbursement				Repayment of Foreign Portion						
					Loan(1)		Loan(2)		Loan(3)		
	Foreign Portion	Local Portion	Total	Source	Principal	Interest	Principal	Interest	Principal	Interest	Total
2011	19,466	296	19,762	Grant	0	0	0	0	0	0	0
2012	20,302	296	20,598	Grant	0	0	0	0	0	0	0
2013	45,473	633	46,106	Loan(1)	0	114	0	0	0	0	114
2014	47,472	633	48,105	Loan(1)	0	233	0	0	0	0	233
2015	**83,993**	**1,075**	**85,068**	**Loan(1),(2)**	**0**	**326**	**0**	**118**	**0**	**0**	**444**
2016	35,915	442	36,357	Loan(2)	0	326	0	207	0	0	533
2017	37,482	442	37,924	Loan(2)	0	326	0	301	0	0	627
2018	22,010	249	22,259	Loan(2)	0	326	0	356	0	0	682
2019	22,981	249	23,230	Loan(2)	0	326	0	414	0	0	740
2020	**56,727**	**586**	**57,313**	**Loan(2),(3)**	**0**	**326**	**0**	**473**	**0**	**83**	**882**
2021	34,208	337	34,545	Loan(3)	0	326	0	473	0	169	968
2022	35,765	337	36,102	Loan(3)	0	326	0	473	0	258	1,057
2023	0	0	0		4,346	326	0	473	0	258	5,403
2024	0	0	0		4,346	315	0	473	0	258	5,392
2025	**0**	**0**	**0**		**4,346**	**304**	**6,302**	**473**	**0**	**258**	**11,683**
2026	0	0	0		4,346	293	6,302	457	0	258	11,656
2027	0	0	0		4,346	282	6,302	441	0	258	11,629
2028	0	0	0		4,346	272	6,302	425	0	258	11,603
2029	0	0	0		4,346	261	6,302	410	0	258	11,577
2030	0	0	0		4,346	250	6,302	394	3,442	258	14,992
2031	0	0	0		4,346	239	6,302	378	3,442	250	14,957
2032	0	0	0		4,346	228	6,302	362	3,442	241	14,921
2033	0	0	0		4,346	217	6,302	347	3,442	232	14,886
2034	0	0	0		4,346	206	6,302	331	3,442	224	14,851
2035	0	0	0		4,346	196	6,302	315	3,442	215	14,816
2036	0	0	0		4,346	185	6,302	299	3,442	207	14,781
2037	0	0	0		4,346	174	6,302	284	3,442	198	14,746
2038	0	0	0		4,346	163	6,302	268	3,442	189	14,710
2039	0	0	0		4,346	152	6,302	252	3,442	181	14,675
2040	0	0	0		4,346	141	6,302	236	3,442	172	14,639
2041	0	0	0		4,346	130	6,302	221	3,442	164	14,605
2042	0	0	0		4,346	120	6,302	205	3,442	155	14,570
2043	0	0	0		4,346	109	6,302	189	3,442	146	14,534
2044	0	0	0		4,346	98	6,302	173	3,442	138	14,499
2045	0	0	0		4,346	87	6,302	158	3,442	129	14,464
2046	0	0	0		4,346	76	6,302	142	3,442	120	14,428
2047	0	0	0		4,346	65	6,302	126	3,442	112	14,393
2048	0	0	0		4,346	54	6,302	110	3,442	103	14,357
2049	0	0	0		4,346	43	6,302	95	3,442	95	14,323
2050	0	0	0		4,346	33	6,302	79	3,442	86	14,288
2051	0	0	0		4,346	22	6,302	63	3,442	77	14,252
2052	0	0	0		4,346	11	6,302	47	3,442	69	14,217
2053	0	0	0		0	0	6,302	31	3,442	60	9,835
2054	0	0	0		0	0	6,302	16	3,442	52	9,812
2055	0	0	0		0	0	0	0	3,442	43	3,485
2056	0	0	0		0	0	0	0	3,442	34	3,476
2057	0	0	0		0	0	0	0	3,442	26	3,468
2058	0	0	0		0	0	0	0	3,442	17	3,459
2059	0	0	0		0	0	0	0	3,442	9	3,451
Total	39,768	592	40,360	Grant							
	422,026	4,983	427,009	Loan							
	461,794	5,575	467,369		130,380	8,007	189,060	11,088	103,260	6,318	448,113

Funds Flow and Repayment Schedule
Scenario-2: Grant + ADF loan

(x1000 USD)

	Fund Disbursement				Repayment of Foreign Portion						
					Loan(1)		Loan(2)		Loan(3)		
	Foreign Portion	Local Portion	Total	Source	Principal	Charge & Commit.	Principal	Charge & Commit.	Principal	Charge & Commit.	Total
2011	19,466	296	19,762	Grant	0	0	0	0	0	0	0
2012	20,302	296	20,598	Grant	0	0	0	0	0	0	0
2013	45,473	633	46,106	Loan(1)	0	764	0	0	0	0	764
2014	47,472	633	48,105	Loan(1)	0	883	0	0	0	0	883
2015	**83,993**	**1,075**	**85,068**	**Loan(1),(2)**	**0**	**975**	**0**	**1,062**	**0**	**0**	**2,037**
2016	35,915	442	36,357	Loan(2)	0	975	0	1,152	0	0	2,127
2017	37,482	442	37,924	Loan(2)	0	975	0	1,245	0	0	2,220
2018	22,010	249	22,259	Loan(2)	0	975	0	1,300	0	0	2,275
2019	22,981	249	23,230	Loan(2)	0	975	0	1,358	0	0	2,333
2020	**56,727**	**586**	**57,313**	**Loan(2),(3)**	**0**	**975**	**0**	**1,417**	**0**	**599**	**2,991**
2021	34,208	337	34,545	Loan(3)	0	975	0	1,417	0	684	3,076
2022	35,765	337	36,102	Loan(3)	0	975	0	1,417	0	774	3,166
2023	0	0	0		4,334	975	0	1,417	0	774	7,500
2024	0	0	0		4,334	943	0	1,417	0	774	7,468
2025	**0**	**0**	**0**		**4,334**	**910**	**6,297**	**1,417**	**0**	774	**13,732**
2026	0	0	0		4,334	878	6,297	1,370	0	774	13,653
2027	0	0	0		4,334	845	6,297	1,322	0	774	13,572
2028	0	0	0		4,334	813	6,297	1,275	0	774	13,493
2029	0	0	0		4,334	780	6,297	1,228	0	774	13,413
2030	0	0	0		4,334	748	6,297	1,181	3,438	774	16,772
2031	0	0	0		4,334	715	6,297	1,133	3,438	748	16,665
2032	0	0	0		4,334	683	6,297	1,086	3,438	722	16,560
2033	0	0	0		4,334	650	6,297	1,039	3,438	696	16,454
2034	0	0	0		4,334	618	6,297	992	3,438	671	16,350
2035	0	0	0		4,334	585	6,297	945	3,438	645	16,244
2036	0	0	0		4,334	553	6,297	897	3,438	619	16,138
2037	0	0	0		4,334	520	6,297	850	3,438	593	16,032
2038	0	0	0		4,334	488	6,297	803	3,438	567	15,927
2039	0	0	0		4,334	455	6,297	756	3,438	542	15,822
2040	0	0	0		4,334	423	6,297	708	3,438	516	15,716
2041	0	0	0		4,334	390	6,297	661	3,438	490	15,610
2042	0	0	0		4,334	358	6,297	614	3,438	464	15,505
2043	0	0	0		4,334	325	6,297	567	3,438	438	15,399
2044	0	0	0		4,334	293	6,297	519	3,438	413	15,294
2045	0	0	0		4,334	260	6,297	472	3,438	387	15,188
2046	0	0	0		4,334	228	6,297	425	3,438	361	15,083
2047	0	0	0		4,334	195	6,297	378	3,438	335	14,977
2048	0	0	0		4,334	163	6,297	331	3,438	310	14,873
2049	0	0	0		4,334	130	6,297	283	3,438	284	14,766
2050	0	0	0		4,334	98	6,297	236	3,438	258	14,661
2051	0	0	0		4,334	65	6,297	189	3,438	232	14,555
2052	0	0	0		4,334	33	6,297	142	3,438	206	14,450
2053	0	0	0		0	0	6,297	94	3,438	181	10,010
2054	0	0	0		0	0	6,297	47	3,438	155	9,937
2055	0	0	0		0	0	0	0	3,438	129	3,567
2056	0	0	0		0	0	0	0	3,438	103	3,541
2057	0	0	0		0	0	0	0	3,438	77	3,515
2058	0	0	0		0	0	0	0	3,438	52	3,490
2059	0	0	0		0	0	0	0	3,438	26	3,464
Total	39,768	592	40,360	Grant							
	422,026	4,983	427,009	Loan							
	461,794	5,575	467,369		130,020	24,567	188,910	35,162	103,140	19,469	501,268

Funds Flow and Repayment Schedule
Scenario-3: Grant + AfDB loan

(x1000 USD)

	Fund Disbursement				Repayment of Foreign Portion						
					Loan(1)		Loan(2)		Loan(3)		
	Foreign Portion	Local Portion	Total	Source	Principal	Interest	Principal	Interest	Principal	Interest	Total
2011	19,466	296	19,762	Grant	0	0	0	0	0	0	0
2012	20,302	296	20,598	Grant	0	0	0	0	0	0	0
2013	45,473	633	46,106	Loan(1)	0	1,820	0	0	0	0	1,820
2014	47,472	633	48,105	Loan(1)	0	3,719	0	0	0	0	3,719
2015	**83,993**	**1,075**	**85,068**	**Loan(1),(2)**	**0**	**5,201**	**0**	**1,879**	**0**	**0**	**7,080**
2016	35,915	442	36,357	Loan(2)	0	5,201	0	3,316	0	0	8,517
2017	37,482	442	37,924	Loan(2)	0	5,201	0	4,815	0	0	10,016
2018	22,010	249	22,259	Loan(2)	8,668	5,201	0	5,695	0	0	19,564
2019	22,981	249	23,230	Loan(2)	8,668	4,854	0	6,614	0	0	20,136
2020	**56,727**	**586**	**57,313**	**Loan(2),(3)**	**8,668**	**4,508**	**12,594**	**7,556**	**0**	**1,327**	**34,653**
2021	34,208	337	34,545	Loan(3)	8,668	4,161	12,594	7,053	0	2,695	35,171
2022	35,765	337	36,102	Loan(3)	8,668	3,814	12,594	6,549	0	4,126	35,751
2023	0	0	0		8,668	3,467	12,594	6,045	0	4,126	34,900
2024	0	0	0		8,668	3,121	12,594	5,541	0	4,126	34,050
2025	**0**	**0**	**0**		**8,668**	**2,774**	**12,594**	**5,038**	**6,877**	**4,126**	**40,077**
2026	0	0	0		8,668	2,427	12,594	4,534	6,877	3,851	38,951
2027	0	0	0		8,668	2,081	12,594	4,030	6,877	3,576	37,826
2028	0	0	0		8,668	1,734	12,594	3,526	6,877	3,301	36,700
2029	0	0	0		8,668	1,387	12,594	3,023	6,877	3,026	35,575
2030	0	0	0		8,668	1,040	12,594	2,519	6,877	2,751	34,449
2031	0	0	0		8,668	694	12,594	2,015	6,877	2,476	33,324
2032	0	0	0		8,668	347	12,594	1,511	6,877	2,201	32,198
2033	0	0	0		0	0	12,594	1,007	6,877	1,925	22,403
2034	0	0	0		0	0	12,594	504	6,877	1,650	21,625
2035	0	0	0		0	0	0	0	6,877	1,375	8,252
2036	0	0	0		0	0	0	0	6,877	1,100	7,977
2037	0	0	0		0	0	0	0	6,877	825	7,702
2038	0	0	0		0	0	0	0	6,877	550	7,427
2039	0	0	0		0	0	0	0	6,877	275	7,152
	39,768	592	40,360	Grant							
Total	422,026	4,983	427,009	Loan							
	461,794	5,575	467,369		130,020	62,752	188,910	82,770	103,155	49,408	617,015

CHAPTER 7 PROJECT EVALUATION

7.1 Water Tariff Setting

(1) Introduction

Flat rate system by user category is currently applied for water tariff as water meters are not installed in the existing water supply system. In flat rate system, water billing is charged regardless of water consumption which hardly secures sufficient water revenue for operating and managing the water supply system.

As water meters enable to measure water consumption of each customer, once water meter is installed customers can be charged according to the volume consumed and water consumption can be monitored easily, which provides base information for improving water service. Approx. 2500 water meters are procured under MDTF fund although schedule of meter installation is not yet clear, In the Master Plan, water tariff is designed on the premise that metering system is introduced.

(2) Principles in Designing Water Tariff

In designing water tariff system, three principles are taken into account, as illustrated in Figure 7.1. They are affordability, sustainability and fairness.

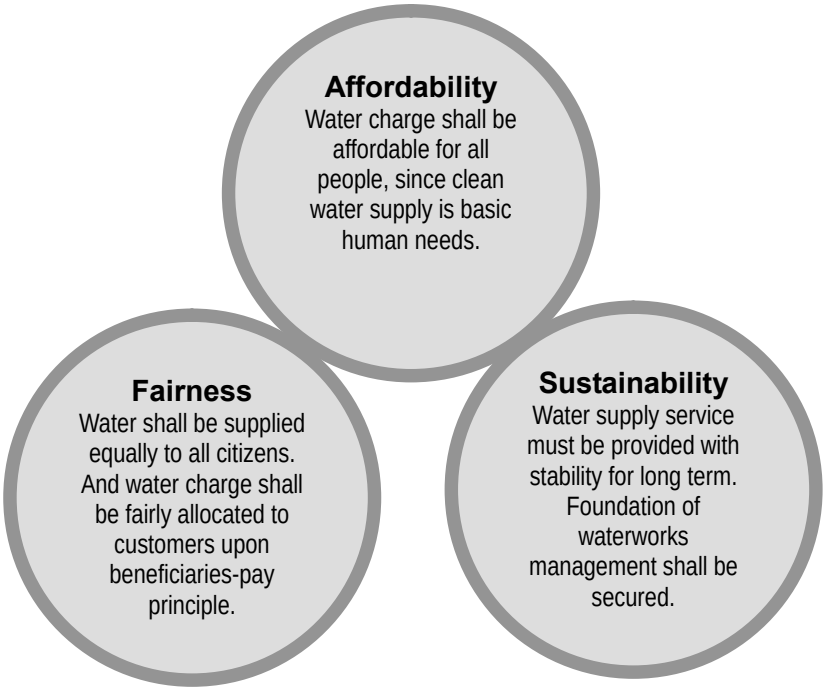


Figure 7.1 Three Principles in Designing Public Utility Charges

These three elements inherently include contradictory objectives. For example, affordable price often conflicts with cost requirement for stable water supply management. Also cross subsidizing tariff by user category sometime lose fairness among customers. Examples of negative and positive spirals caused by too much focusing on a single element and example of positive spiral are illustrated in Figure 7.2.

Proper balance among these elements should be carefully examined in designing water tariff system. The proper proportion would be different depending on management environment of the waterworks. Namely, in growing phase where increasing water supply coverage rate is particularly emphasized, factor of affordability would be firstly focused. Also in maintaining phase when water supply facilities become developed, financial sustainability would be the important factor.

This future transit should be strategically performed through improvement of management efficiency of waterworks to provide better service at reasonable price.

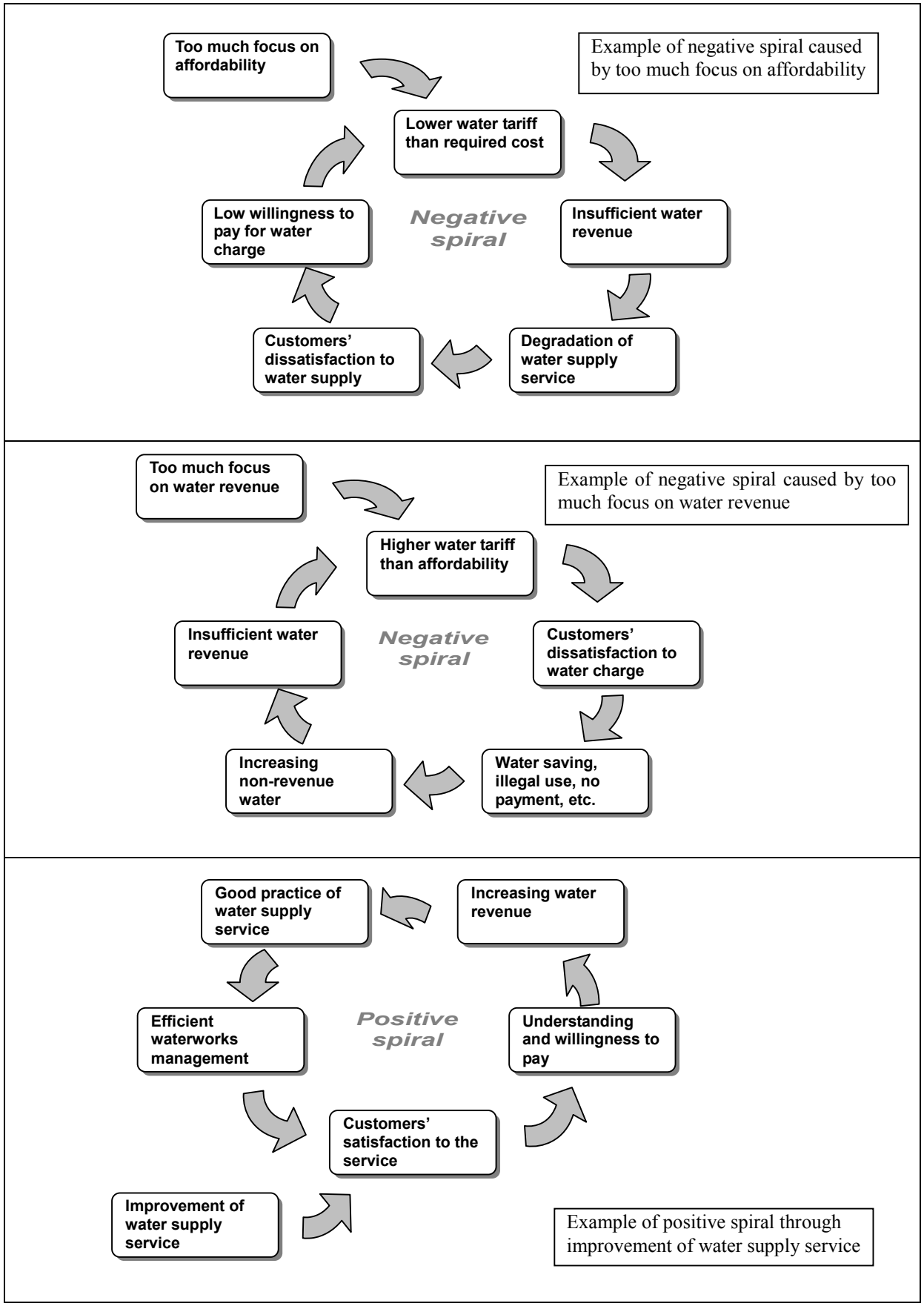


Figure 7.2 Example of Negative and Positive Spirals of Water Supply Service

(3) Approach from affordability

Under the current political unrest circumstances in Southern Sudan, consideration on affordability would be the primary concern in discussing water tariff. Particularly, poor-level households should be foremost focused.

In analysis, an affordable index of 3 % of the monthly household income (MHI) is considered which is widely used for affordability analysis of the household below the poverty level. According to level of MHI of the socio-economic survey conducted under the Study, customers can be distributed into four groups; (i) low income, (ii) lower middle income, (iii) upper middle income, and (iv) high income. Their income level and estimated affordable level are shown in Table 7.1.

As a result, SDG 7.5 per month is estimated as affordable level for poor household (referred to low income group), and it is considered that water charge for this group shall not exceed this value.

Table 7.1 User Segments by Income Level

Segments	Income level	Estimated affordable level of water charge
Low income (Lowest 12.6%)	Less than 500 SDG/hh/month	7.5 SDG/month 3% of average SDG250 is assumed.
Middle income (Middle 66.2%)	500-1750 SDG/hh/month	36 SDG/month 3% of average SDG1200 is assumed
High income (Highest 21.2%)	More than 1750 SDG/hh/month	60 SDG/month 3% of SDG2000 is assumed

Date: Monthly household income in the socio-economic survey result.

To assess the water price per unit consumption (m^3), monthly water consumption per household is estimated by using demand focused in the Master Plan and the socio-economic survey result. The estimation is shown in Table 7.2.

Table 7.2 Monthly Water Consumption per Household by Service Level

Year	House connection	Public tap	Water tanker
2008	6.08 m^3/hh/month	7.61 m^3/hh/month	8.31 m^3/hh/month
	26 l/c/d x 7.8 persons/hh x 30 days	32.5 l/c/d x 7.8 persons/hh x 30 days	35.5 l/c/d x 7.8 persons/hh x 30 days
2015	21.1 m^3/hh/month	9.36 m^3/hh/month	9.36 m^3/hh/month
	90 l/c/d x 7.8 persons/hh x 30 days	40 l/c/d x 7.8 persons/hh x 30 days	40 l/c/d x 7.8 persons/hh x 30 days
2020	23.3 m^3/hh/month	8.88 m^3/hh/month	8.88 m^3/hh/month
	105 l/c/d x 7.4 persons/hh x 30 days	40 l/c/d x 7.4 persons/hh x 30 days	40 l/c/d x 7.4 persons/hh x 30 days
2025	25.2 m^3/hh/month	8.40 m^3/hh/month	8.40 m^3/hh/month
	120 l/c/d x 7.0 persons/hh x 30 days	40 l/c/d x 7.0 persons/hh x 30 days	40 l/c/d x 7.0 persons/hh x 30 days

Source: Unit consumption: referred to forecasted demand of the Study
Family size: referred to average family size of the socio-economic survey result of the Study.

On assumption that the low income group consumes minimum water due to limitation of their affordability, this group is estimated to access public tap (or water tanker) which is planned to allow 40 liters per person after year 2015 onward.

From these assumptions, affordable level of water price per unit consumption (m^3) is estimated to be SDG 0.80 per m^3 based on the following calculation:

[Affordable water price per m^3] = [Affordable water cost] / [Minimum water consumption]
= SDG 7.5 per month / 9.36 m^3/hh/month
= SDG 0.80 per m^3

For comparison, willingness-to-pay (WtoP) based on the result of socio-economic survey is shown in Table 7.3. In general, peoples' valuation for water service is very high, considering that in the discussion made earlier affordable level is SDG 60 per month at maximum. The reason is attributed to the fact that people are accustomed to paying the current higher expenses for water, which is on average SDG 132 per household per month. In fact, the willingness-to-pays for current and improved services are lower than the current expenditure, which implies current expenditure is a heavy burden on household budget.

Table 7.3 Willingness-to-Pay for Water Supply Services

Question	Expenditure/Valuation	Index to current expenditure
Current expenditure on water supply	132 SDG/hh/month (average)	(100 %)
Willingness-to-pay to current service	80 SDG/hh/month (average) 0 SDG/hh/month (12% of respondents)	(60 %) (0 %)
Willingness-to-pay to improved service	110 SDG/hh/month (average)	(83 %)
Willingness-to-pay to 24 hours water supply	134 SDG/hh/month (average)	(102%)

Source: The socio-economic survey result of the Study

For reference purpose, unit price is tentatively calculated from the wiliness-to-pay as illustrated in the following calculation. By using the estimated monthly water consumption of house connection customer that consumes 25.2 m^3/month in 2025, willingness-to-pay level of water price per unit consumption (m^3) is estimated to be SDG 5.32 per m^3.

[WtoP level water price per m^3] = [WtoP for improved service] / [Average water consumption]
= SDG 134 per month / 25.2 m^3/hh/month
= SDG 5.32 per m^3

Although the calculated result is much lower than the current price of water tanker of SDG10 per m^3 (SDG2 per 200 liters drum can), it is still higher than the affordable level as well as the level of water rates in the other countries. This high willingness-to-pay explains intensive demand for water supply services.

(4) Approach from Revenue Requirement

The current water tariff is set at a level to cover only a part of operating cost excluding personnel cost and capital cost. The revenue from this tariff has covered only minimum expenditure to prevent the system from collapsing. As a result, major rehabilitation is now required for most of the facilities.

The scale of budget of UWC will become much larger than current one as water supply system will expand according to the Master Plan. This indicates that UWC cannot rely on the subsidy from the Government of Southern Sudan, whose financial condition is not stable and whose budget scale is small.

There seems no clear financial objective for SSUWC in the past but currently UWC is required to be financially self-sustaining in terms of managing operation cost through water revenue as stipulated in the provisional order of SSUWC (2008). For this purpose, the water tariff should be set to cover full operating costs, capital costs, tax obligations (if required), and regulated profit percentage.

The first step for determining the water tariff is to identify revenue requirements, by which financial sufficiency for the waterworks could be ensured. The operation costs that must be recovered from collection of water charges are categorized as (i) operation and maintenance (O&M) costs and (ii) capital costs. They are compared in Table 7.4 and Table 7.5.

Table 7.4 Definition of O&M Costs and Capital Costs

	O&M costs	Capital costs
Definition	Routine or periodic costs incurred in providing service during an accounting period	Costs related to capital items such as equipment and facilities that provide benefits over multiple years

Including	− Functional Costs
	  − Salaries and wages
	  − Electric power and fuel
	  − Chemicals
	  − Materials and supplies
	  − Rental of equipment
	− Pay-as-you-go capital costs (e.g. vehicle, motors, pumps, water meters, furniture and other high-use items with lives usually less than 10 years.)
	− Non-annual O&M costs for certain maintenance (e.g. painting)
		− Debt service
		  − Principal
		  − Interest
		− Reserve fund contributions
		  − Replacement for major facilities (e.g. distribution lines, storage facilities, etc.)
		  − Improvement
		  − Expansion
		  − Rate stabilization
		  − Self insurance funds

Table 7.5 Tentative Calculation on Required Cost

Year	[1] Total treatment capacity (m^3/d)	[2] NRW ratio	[3] Annual revenue Water (m^3/year)	[4] Annual O&M costs (USD/year)	[5] Capital costs (USD/year)	[6] Total (USD/year)	[7] Required cost per revenue water
2009	7,000	60%	851,667	545,297	0	545,297	0.64 USD/m^3 (1.41 SDG/m^3)
2012	14,000	52%	2,044,000	1,578,495	0	1,578,495	0.77 USD/m^3 (1.70 SDG/m^3)
2015	77,000	44%	13,115,667	6,768,325	2,037,000	8,805,325	0.67 USD/m^3 (1.48 SDG/m^3)
2020	174,000	36%	33,872,000	15,735,751	2,991,000	18,726,751	0.55 USD/m^3 (1.22 SDG/m^3)
2025	237,000	28%	51,903,000	21,804,198	13,732,000	35,536,198	0.68 USD/m^3 (1.50 SDG/m^3)
2040	237,000	28%	51,903,000	21,804,198	15,716,000	37,520,198	0.72 USD/m^3 (1.59 SDG/m^3)

(Note)

[1] Total treatment capacity:	As the facility plan of the Master Plan
[2] Non-Revenue Water Ratio:	60% is assumed for 2009. After 2012, 20% leakage ratio (constant) and revenue collection ratio (60% in 2012 to 90% in 2025) is assumed.
[3] Annual revenue water:	[1] / 1.2 x (100% - [2]) x 365
[4] Annual O&M cost:	Refer to Appendix -H for detail
[5] Capital cost:	Assumption of scenario 2 (Grant for Phase-1 and ADF Loan for Phase-2, 3 and 4) Refer to Appendix-H for detail
[6] Total:	[4] + [5]
[7] Required cost per revenue water:	[6] / [3]

In most instances, it is important to project operating and capital costs over an extended period so that longer-term fluctuations in costs and the potential impact on rates can be evaluated. It is essential that revenue requirements be sufficient to provide for adequate facilities, to allow for proper asset replacement and maintenance, to address debt service and coverage requirements, and to ensure that the utility is operated on a self-sustaining basis.

(5) Fairness in Tariff Structure

Several options for designing water tariff structure are considered in order that the required cost is fairly allocated to customers based on beneficiaries-pay principle as shown in Table 7.6. Practically, tariff structure should be designed in consultation with related stakeholders, such as representatives of customers, board of directors, ministries concerned, etc. to form consensus among them.

Table 7.6 Options of Tariff Structure

Tariff structure	Description
Increased Block Tariff (IBT)	Two or more blocks of water consumption are defined in the tariff. Unit water price (i.e. SDG/m^3) is different by block. Normally in developing countries, unit price of lower consumption is set very low whereas that of higher consumption is higher than the average price. IBT structure enables to help poor households who might use small water volume in general, by providing revenue-neutral cross-subsidies from the customers of higher consumption. It also contributes to restrain excessive water use by pricing higher rate for the block of higher consumption.
Base Tariff	Base tariff is regarded to cover fixed costs which are required regardless of customer's consumption. The fixed costs include capital cost (principal and interest) and fixed operation and maintenance costs, such as management, meter reading, maintenance of pipelines, etc. Base tariff is often set according to diameter of service pipe to customers.
Tariff by customer's category	In most instances, customers are categorized by groups, such as domestic, commercial, industrial institution, etc. Commercial and industrial customers, who earn profits by providing service, are often applied for higher rate in order to cover the relatively lower domestic rates (cross-subsidy).
Price index-linked tariff	In principle, tariff is annually or periodically reviewed by using consumers' price index of the country. This automatic process would reasonably reflect to the price escalation and reduce work process of application and examination to revise new tariff. In this case, periodical review, e.g. once every five years, is required to adjust to the cost-requirement-based price.

(6) Proposed Water Tariff

Taking into account the above discussions, the water tariff is proposed as shown in Table 7.7.

Table 7.7 Proposed Water Tariff Structure

	Base (SDG/month)	Block 1 (SDG/m^3)	Block 2 (SDG/m^3)	Block 3 (SDG/m^3)
Domestic		(0 - 15 m^3)	(15 - 30 m^3)	(> 30 m^3)
House connection	10.0	0.7	1.5	2.0
Public Tap	0	0.7	0.7	0.7
Water Tanker	0	0.7	0.7	0.7
Commercial/ Industrial	30.0	(0 - 50 m^3) 3.7	(50 - 100 m^3) 4.5	(> 100 m^3) 5.2
Institution	30.0	(0 - 50 m^3) 2.2	(50 - 100 m^3) 3.0	(> 100 m^3) 3.7

(Note)
Base price level is in March 2009.

It is also recommended to increase tariff to secure financial soundness for future. The tariff is assumed to increase at 3% per annum (real term growth) after 2015 until 2025, as shown in Table 7.8. From year 2025 onwards, water tariffs are assumed to remain same for calculation purpose.

Table 7.8 Proposed Water Tariff

Category	Type	Tariff	2012	2015	2020	2025
Domestic	House connection	Base rate per month	10.0	10.0	11.6	13.4
		Block rate per m^3 (< 15m^3)	0.7	0.7	0.8	0.9
		Block rate per m^3 (15 - 30 m^3)	1.5	1.5	1.7	2.0
		Block rate per m^3 (> 30 m^3)	2.0	2.0	2.3	2.7
	Public tap and water tanker	Base rate per month	N/A	N/A	N/A	N/A
		Rate per m^3	0.7	0.7	0.8	0.7
Non-domestic	Commercial and Industry	Base rate per month	30.0	30.0	34.8	40.3
		Block rate per m^3 (< 50 m^3)	3.7	3.7	4.3	5.0
		Block rate per m^3 (50 – 100 m^3)	4.5	4.5	5.2	6.0
		Block rate per m^3 (> 100 m^3)	5.2	5.2	6.0	7.0
	Institution	Base rate per month	30.0	30.0	34.8	40.3
		Block rate per m^3 (< 50 m^3)	2.2	2.2	2.6	3.0
		Block rate per m^3 (50 – 100 m^3)	3.0	3.0	3.5	4.0
		Block rate per m^3 (> 100 m^3)	3.7	3.7	4.3	5.0

(7) Determination of Water Tariff

Based on the above proposed tariff, monthly expenditure of domestic household in 2015 is estimated for examining appropriateness of water tariff. Three cases are assumed for examination; (I) minimum, (II) average and (III) high consumption cases as shown in Table 7.9. In each case, average family size is assumed to be 7.8 persons in 2015, based on the socio-economic survey result in the Study. Then, monthly water consumption of each case is calculated. The assumed water tariffs by each tariff block according to the water consumption is calculated as shown in Table 7.9. Finally, the assumed monthly water charges are calculated by adding base and block tariffs.

Table 7.9 Example of Water Charge Calculation

Case	Monthly household consumption	Tariff and consumption				Assumed monthly charge
		Base	Block-1 (0 - 15 m^3)	Block-2 (15 - 30 m^3)	Block-3 (> 30 m^3)	
(I) Minimum consumption	9.68m^3 (40L/c/d)	Not applicable (public tap)	0.7 SDG/m^3 x 9.68 m^3	0.7 SDG/m^3 x 0	0.7 SDG/m^3 x 0	SDG 6.78
(II) Average consumption	21.1 m^3 (90L/c/d)	(10.0 SDG)	0.7 SDG/m^3 x 15 m^3	1.5 SDG/m^3 x 6.1 m^3	2.0 SDG/m^3 x 0	SDG 29.7
(III) High consumption	37.4 m^3 (160L/c/d)	(10.0 SDG)	0.7 SDG/m^3 x 15 m^3	1.5 SDG/m^3 x 15 m^3	2.0 SDG/m^3 x 7.4 m^3	SDG 57.8

The results are shown in Figure 7.3, which illustrates relationship between monthly water consumption and monthly water charge. In the case-I (minimum consumption), water charge is calculated to be SDG 6.78 per month, which is lower than the previously estimated affordable level of SDG 7.5 per month. Similarly water charge in the case-II (average consumption) is calculated to be SDG 29.7, which is still lower than the affordable level of SDG 36.0 per month. In the case-III (high consumption), the water charge is estimated as SDG 57.8, which slightly lower than the affordable level of high income households (SDG 60.0). However, this level is much lower than the average willingness-to-pay for improved service (SDG 134 per month). And increasing higher rates according

to the volume consumed, representing by the block 3 leads to restrain excessive water use, under which people try to reduce water charge by saving water. With this evaluation, the proposed tariff structure for domestic household is regarded as appropriate and reasonable.

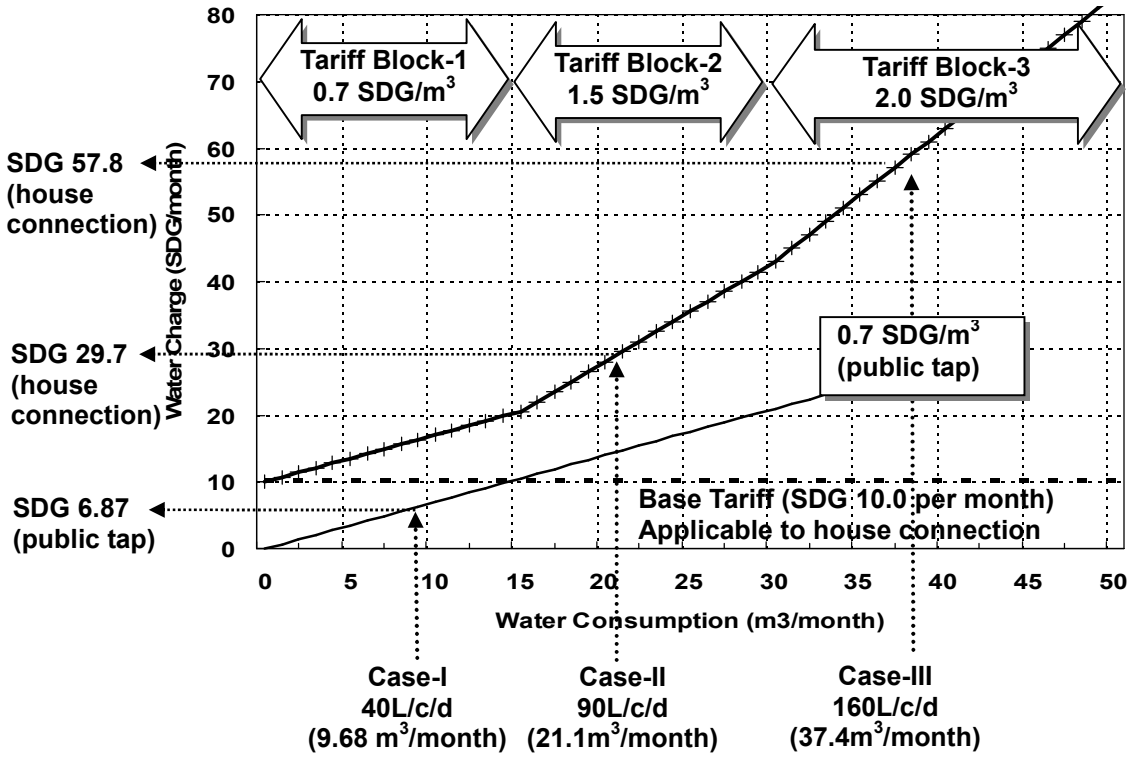


Figure 7.3 Examination on Domestic Water Tariff

7.2 Project Financial Evaluation

(1) Scope of Financial Plan

Financial evaluation on existing water supply system is difficult as available financial information for the existing facilities is very limited. On the other hand, the water supply facilities proposed in the Master Plan will form substantial part of the entire water supply system after the M/P is materialized. Insofar as the whole system together with the Master Plan projects is financially viable, the projects are also considered financially viable. Given this, financial evaluation is carried out for the whole system.

(2) Revenue Forecast

The forecast of annual revenue is summarized in Table 7.10 (refer to Appendix-H for detail).

Table 7.10 Summary of Revenue Forecast

(SDG/year)

Year	Average daily water consumption (m3/day)	Annual revenue from water sales					Service Revenue	Revenue Total
		Domestic (house connection)	Public Tap	Water Tanker	Non-domestic	Total revenue from water sales		
2009	3,923	457	61	0	643	1,162	0	1,162
2010	4,749	554	70	0	784	1,407	179	1,586
2011	5,720	694	78	0	954	1,727	229	1,956
2012	6,750	1,532	101	0	1,133	2,767	3,263	6,030
2013	12,204	2,288	126	150	2,569	5,132	1,001	6,133
2014	13,729	2,612	134	160	2,923	5,831	1,107	6,937
2015	**43,608**	**6,049**	**844**	**1,439**	**17,271**	**25,603**	**1,228**	**26,831**
2016	50,831	7,775	931	1,491	20,974	31,172	3,828	35,000
2017	58,904	10,439	1,025	1,539	25,095	38,097	3,945	42,042
2018	67,903	13,873	1,308	1,808	30,061	47,050	4,071	51,121
2019	77,911	17,210	1,429	1,851	36,213	56,704	4,199	60,903
2020	**89,033**	**21,650**	**1,553**	**1,887**	**42,476**	**67,566**	**4,338**	**71,904**
2021	100,403	27,119	1,599	1,896	49,440	80,055	4,477	84,532
2022	112,820	34,292	1,852	2,131	57,876	96,150	4,618	100,768
2023	126,393	41,769	1,943	2,113	66,661	112,486	4,769	117,255
2024	141,189	50,249	1,986	2,081	76,470	130,786	4,923	135,710
2025	**157,238**	**58,807**	**2,030**	**2,032**	**88,158**	**151,026**	**5,087**	**156,114**
2026 ～ 2040	157,238	58,807	2,030	2,032	88,158	151,026	0	151,026
	157,238	58,807	2,030	2,032	88,158	151,026	0	151,026

(3) Free Cash Flow Analysis

Free Cash flows for the period of 40 years are presented in Table 7.11, in which investment cost of phase 1 is deducted from the cash flow since that portion would be financed by grant aid. The calculated cash flow resulted in reasonable FIRR of 10.52%.

Table 7.11 Free Cash Flow Analysis

(in thousand USD)

Year	Cash In Flow	Cash Out Flow		Free Cash Flow
	Total Revenue	Investment	O&M	
2011	885		1,234	-349
2012	2,729		1,578	1,151
2013	2,775	39,006	3,308	-39,539
2014	3,139	39,006	5,038	-40,905
2015	**12,141**	**66,243**	**6,768**	**-60,870**
2016	15,837	27,237	8,562	-19,962
2017	19,024	27,237	10,355	-18,568
2018	23,132	15,314	12,149	-4,331
2019	27,558	15,314	13,942	-1,698
2020	**32,536**	**36,058**	**15,736**	**-19,258**
2021	38,250	20,744	16,949	557
2022	45,597	20,744	18,163	6,690
2023	53,056	0	19,377	33,679
2024	61,407	0	20,591	40,816
2025	**70,640**	**0**	**21,804**	**48,836**
2026	68,338	0	21,804	46,534
2027	68,338	0	21,804	46,534
2028	68,338	0	21,804	46,534
2029	68,338	0	21,804	46,534
2030	68,338	0	21,804	46,534
2031	68,338	0	21,804	46,534
2032	68,338	0	21,804	46,534
2033	68,338	0	21,804	46,534
2034	68,338	0	21,804	46,534
2035	68,338	0	21,804	46,534
2036	68,338	0	21,804	46,534
2037	68,338	0	21,804	46,534
2038	68,338	0	21,804	46,534
2039	68,338	0	21,804	46,534
2040	68,338	0	21,804	46,534
2041	68,338	0	21,804	46,534
2042	68,338	0	21,804	46,534
2043	68,338	0	21,804	46,534
2044	68,338	0	21,804	46,534
2045	68,338	0	21,804	46,534
2046	68,338	0	21,804	46,534
2047	68,338	0	21,804	46,534
2048	68,338	0	21,804	46,534
2049	68,338	0	21,804	46,534
2050	68,338	0	21,804	46,534
Total	2,117,156	306,903	720,654	1,089,599
			FIRR	10.52%

(4) Profit & Loss Statement

On assumption that the aforementioned Scenario-2 is employed for funding source, the profit and loss statement until 2050 based on the calculation above is presented in Table 7.12, which shows break-even point would be year 2015 which is early due to sufficient revenue to be generated by increasing water sales.

Table 7.12 Profit & Loss Statement

(in thousand USD)

Year	Total Revenue	O&M	Depreciation	Interest	Profit & Loss	Operating Ratio
2011	885	1,234	222	0	-571	165%
2012	2,729	1,578	222	0	929	66%
2013	2,775	3,308	1,404	114	-2,051	170%
2014	3,139	5,038	1,404	233	-3,536	205%
2015	**12,141**	**6,768**	**1,404**	**444**	**3,525**	**67%**
2016	15,837	8,562	5,203	533	1,539	87%
2017	19,024	10,355	5,203	627	2,839	82%
2018	23,132	12,149	5,203	682	5,098	75%
2019	27,558	13,942	5,203	740	7,673	69%
2020	**32,536**	**15,736**	**5,203**	**882**	**10,715**	**64%**
2021	38,250	16,949	9,348	968	10,985	69%
2022	45,597	18,163	9,348	1,057	17,029	60%
2023	53,056	19,377	11,368	1,057	21,254	58%
2024	61,407	20,591	11,368	1,046	28,402	52%
2025	**70,640**	**21,804**	**11,368**	**1,035**	**36,433**	**47%**
2026	68,338	21,804	11,368	1,008	34,158	49%
2027	68,338	21,804	11,368	981	34,185	49%
2028	68,338	21,804	11,368	955	34,211	49%
2029	68,338	21,804	11,368	929	34,237	49%
2030	68,338	21,804	11,368	902	34,264	49%
2031	68,338	21,804	11,368	867	34,299	49%
2032	68,338	21,804	11,368	831	34,335	49%
2033	68,338	21,804	11,368	796	34,370	49%
2034	68,338	21,804	11,368	761	34,405	49%
2035	68,338	21,804	11,146	726	34,662	48%
2036	68,338	21,804	11,146	691	34,697	48%
2037	68,338	21,804	11,146	656	34,732	48%
2038	68,338	21,804	9,964	620	35,950	46%
2039	68,338	21,804	9,964	585	35,985	46%
2040	68,338	21,804	9,964	549	36,021	46%
2041	68,338	21,804	6,165	515	39,854	41%
2042	68,338	21,804	6,165	480	39,889	41%
2043	68,338	21,804	6,165	444	39,925	41%
2044	68,338	21,804	6,165	409	39,960	41%
2045	68,338	21,804	6,165	374	39,995	41%
2046	68,338	21,804	2,020	338	44,176	35%
2047	68,338	21,804	2,020	303	44,211	35%
2048	68,338	21,804	0	267	46,267	32%
2049	68,338	21,804	0	233	46,301	32%
2050	68,338	21,804	0	198	46,336	32%

(Note) Depreciation is assumed by straight line method with lifetime 25 years for all construction cost.
- Existing facility: Referred to construction cost of expansion of WTP planned in phase-1 USD 5,538,000 / 25 years = USD 221,520 (2010-2035)
- Facility of phase-1: USD 29,550,000 / 25 years = USD 1,182,000 (2013-2037)
- Facility of phase-2: USD 94,983,000 / 25 years = USD 3,799,320 (2016-2040)
- Facility of phase-3: USD 103,614,000 / 25 years = USD 4,144,560 (2021-2045)
- Facility of phase-4: USD 50,511,000 / 25 years = USD 2,020,440 (2023-2047)

7.3 Project Benefits

Through implementation of the Master Plan, safe and clean water supply is materialized and following direct and indirect benefits of the Master Plan projects are expected.

1. The service population provided with treated clean water shall be drastically increased.
2. The current very low water consumption per capita will be improved.
3. The quality of supplied water will be improved.
4. Improvement in water supply conditions mentioned above shall contribute to reduction of occurrence of water related diseases such as cholera, typhoid and diarrhea, and skin & eye diseases and is expected to improve health conditions of the people.
5. Water use will be more convenient, i.e., 24 hours supply with sufficient quantity in case of house connection.
6. Water fetching time and efforts, especially of women and children, will be reduced and mitigated. As a result, working and education opportunity for them will be enhanced.
7. Internally displaced persons (IDPs) are located in the service area and the improvement of the water supply service will contribute to improved living conditions of these disadvantaged people. This will further contribute to the stabilization of people's livelihood in the area and political stability.
8. Working opportunities will be created during construction and operation & maintenance of water supply facilities
9. The industry and business that are now affected by dirty water supply will be activated and contribute to the development of the country.
10. The current cost for obtaining water will be significantly reduced and the household expenditure on water will be reduced, which will indirectly contribute to improvement in the livelihood of the people.

The benefits of UWC are identified as follows:

1. The current degraded distribution network, which results into high percentage of water loss, will be rehabilitated and leakage will be reduced. This has benefits in terms of increasing water supply volume and improving revenue. In addition, leakage repair works will be mitigated.
2. The capacity of UWC will be developed by implementation of capacity development program.
3. Revenue of UWC will be enhanced to great extent and UWC will be self-sustaining entity under the implementation of tariff system reform with meter system.
4. Image of UWC will be improved through the implementation of public awareness campaign.

5. Involvement of the private sectors will ease UWC management burden.

7.4 Contribution to Millennium Development Goals

Eight goals in the Millennium Development Goals (MDGs) in case of Southern Sudan and contribution of the Master Plan to MGDs are listed and summarized in the same table. The MGDs for Southern Sudan is given in Appendix-H.

Table 7.13 Contribution to Millennium Development Goals

MGD goals	Contribution to MGD through the Master Plan
1. Eradicate extreme poverty and hunger	The current high costs of water fetching for the poor people can mitigate poverty by improved water supply through reduction of water costs, mitigation of hardship to fetch water and reduction of infectious rate of water related diseases.
2. Achieve universal primary education	Once water fetching time is reduced after the project implementation, primary education attendance of children will be improved.
3. Promote gender equality and empower women	Water fetching is currently responsibility of wife and daughter in household. The improvement of water supply service would promote gender quality and empower women through reduction of fetching time and labor.
4. Reduce child mortality	In the JICA survey, 97 % households responded that they have infected with any of water related diseases or malaria. On average 2 persons per household infected water related diseases. Improvement of water supply would reduce child mortality.
5. Improve maternal health	As stated above, improvement of water supply improve the maternal health.
6. Combat HIV/AIDS, malaria and other diseases	As stated above, improvement of water supply mitigate infection of water related diseases.
7. Ensure environmental sustainability	The details are explained in the next table.
8. Develop a global partnership for development	Through technical cooperation project proposed in the Master Plan, a global partnership for development of water supply will be enhanced by least developed countries, the developing countries and the private sectors.

Regarding Goal 7: Ensure environmental sustainability, the following target on water supply are prescribed.

Target 10: Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation

In the MDGs, the existing conditions are described as follows:

It is reported that by 2005, only about 27% of the population (about 8 million) had access to improved water supplies, while only 15% has access to basic sanitation. Many communities use unsafe water during the rainy season and need to travel long distances when surface water dries up in the dry summer. Due to lack of safe water and absence of sanitation, many endemic diseases such as diarrhea, guinea worm, and trachoma, are prevalent.

The condition of urban water supply, where a considerable population settles down due to major economic activities and job opportunities, is also very poor. Juba is one of the most important urban centers of Southern Sudan, still the water supply services in the city and its surrounding is in pathetic condition. Upon the construction of new water treatment plant by MDTF, only a fraction of the population is served by clean treated water. The remaining mainly depend on private water tankers and other venders for domestic water needs and the water tankers and vender distribute untreated river water only with the application of chlorine.

To improve the condition of access to safe water in line with the MDGs, in this Study, the target coverage of treated water supply has been set as 80% by 2015, 90% by 2020 and 100% by the year 2025. If the proposed projects under this Study are undertaken, it is expected that access to safe water and the living condition of informal settlements shall be improved.

CHAPTER 8 INITIAL ENVIRONMENTAL EXAMINATION

8.1 Environmental Legislation Policy, Legal and Administrative Framework

(1) Environmental Impact Assessment Law

The Republic of Sudan (ROS) established "Environmental Protection Act, 2001 (EPA)," which prescribed that any developer or proponent must conduct "Environmental Feasibility Study (EFS)" with environmental mitigation and monitoring plans. For actual use, ROS is currently preparing the guidelines of environmental impact assessment (EIA).

The Government of Southern Sudan (GOSS) has not established any laws on EIA. However, GOSS in association with USAID has been preparing Environmental Policy for Southern Sudan since February 2008 and EIA guidelines will be prepared after establishment of this policy.

According to the Directorate of Environmental Affairs of Ministry of Housing, Physical Planning & Environment (MHPP&E), new EIA policy and guidelines will be issued in 2009. Draft EIA process is shown in Appendix I.

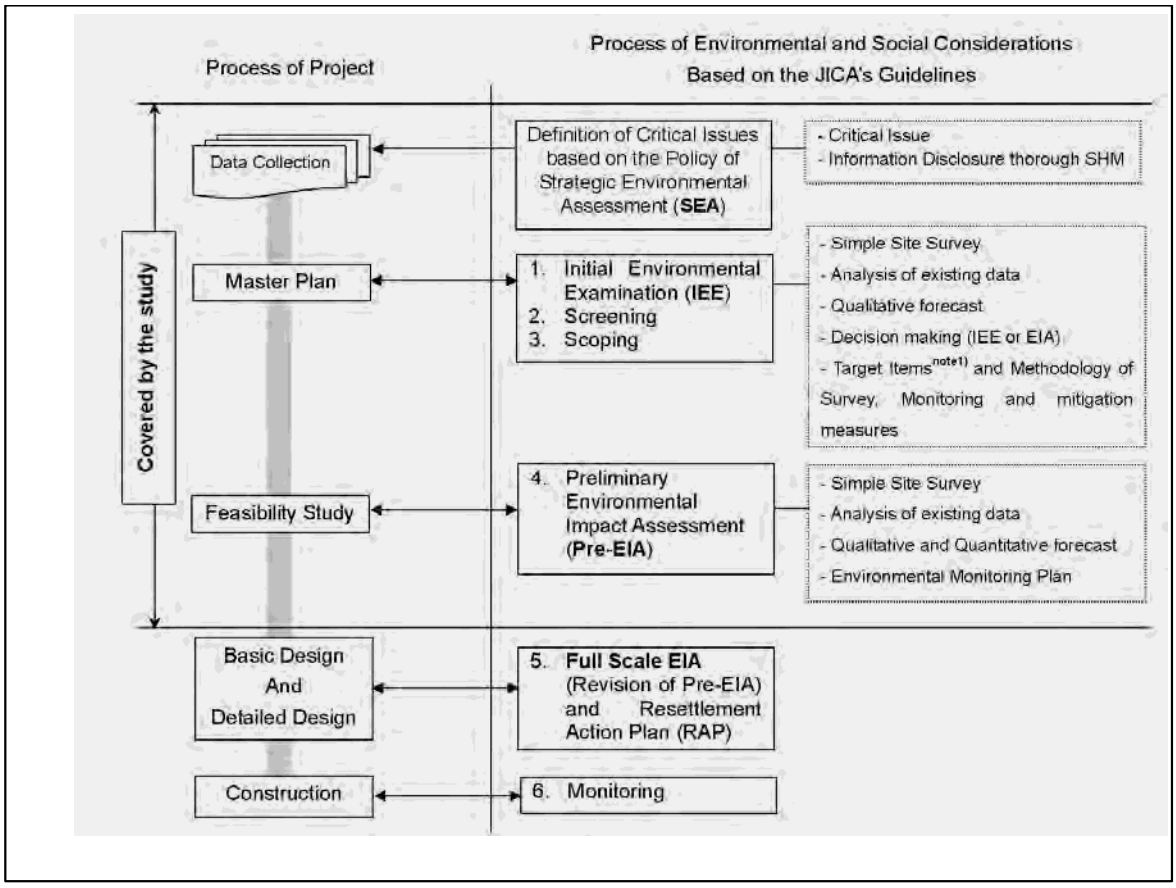
Without EIA law for Southern Sudan, GOSS follows EPA at the moment but EPA does not mention any detailed items and methodology of EIA. Most of the EIAs for infrastructure project therefore, have been carried out based on EIA guidelines of relevant donors.

Other laws and regulations on environment and land acquisition along with major environmental activities of donors are described in Appendix-I.

(2) Environmental Impact Assessment Process adopted for this Study

Based on the discussion with the Department of Environment of MHPP&E, JICA's Environmental and Social Consideration Guidelines is adopted for this Study.

The process of an environmental study based on the JICA's guidelines is shown in Figure 8.1. In general, a water supply project has 4 main stages, i.e. preparation of a master plan, implementation of a feasibility study, preparation of design, and construction of facilities. This Study covers preparation of a master plan and feasibility study. Therefore, an initial environmental examination (IEE) and preliminary EIA (pre-EIA) has been carried out as a study on environmental and social considerations.



Note: Terminologies in the figure are described in Appendix- I.

Figure 8.1 Process of Environmental Consideration for the Study

8.2 Initial Environmental Examination

8.2.1 Scope of the Project for Initial Environmental Examination (IEE)

The scope of the Master Plan covers the expansion of the existing water treatment plant, and the construction of two new water treatment plants, five service reservoirs, five pump stations, one elevated tank, transmission mains to connect these main facilities, and distribution network. The proposed main facilities are shown in Figure 8.2. The detailed location of the proposed water supply facilities with picture of the sites are shown in Figure 8.3 and Figure 8.4.

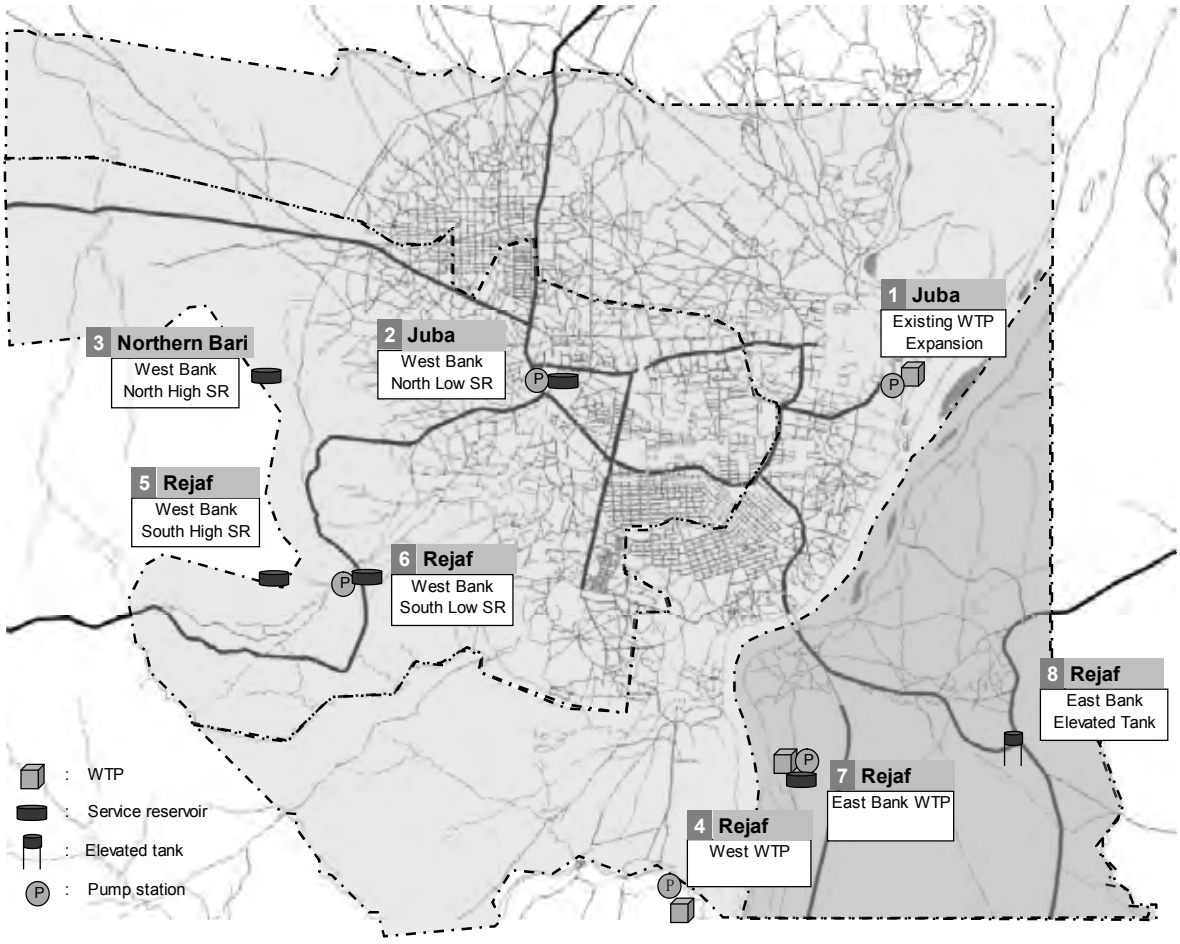
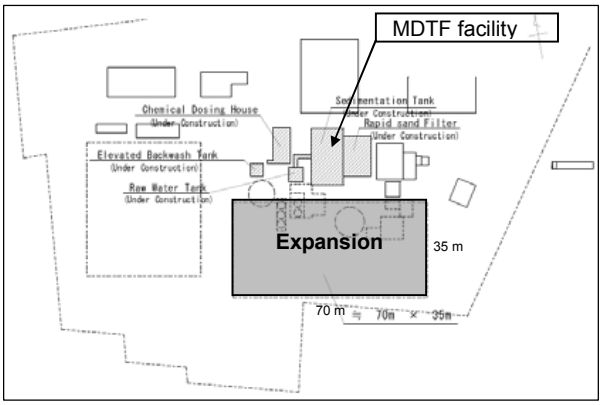
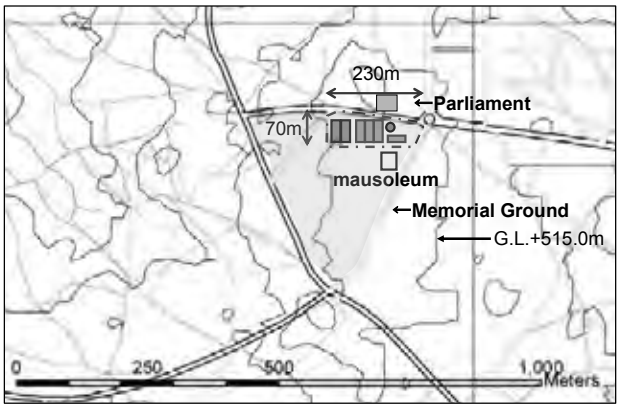


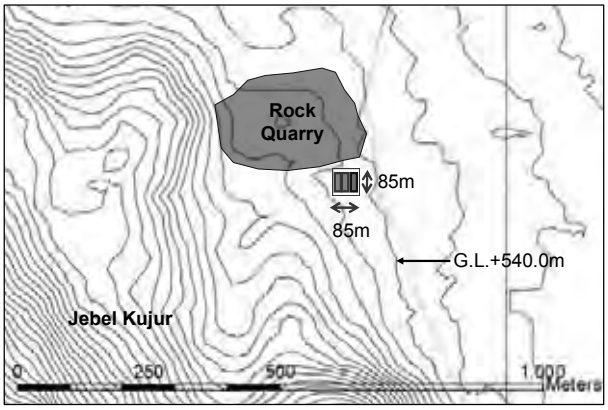
Figure 8.2 Location Map of Main Facilities in the Master Plan



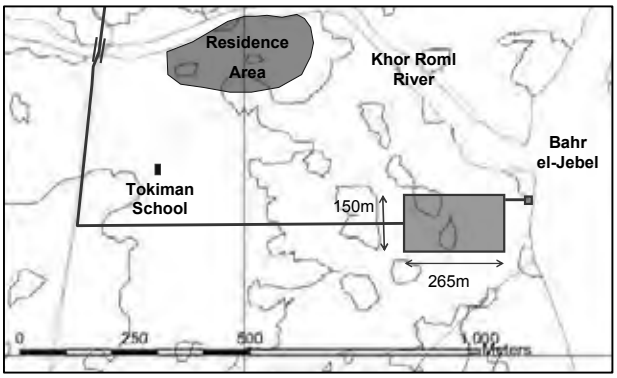
1. Existing Water Treatment Plant



2. West Bank North Low Service Reservoir

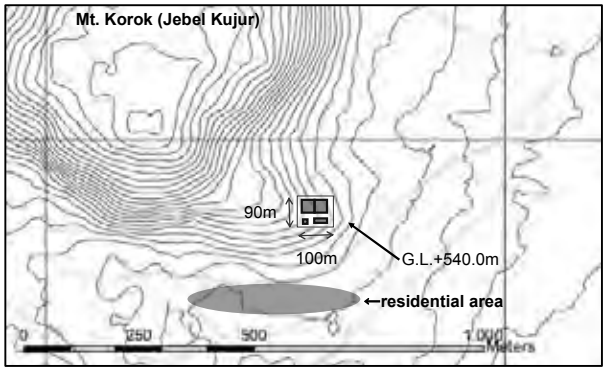


3. West Bank North High Service Reservoir

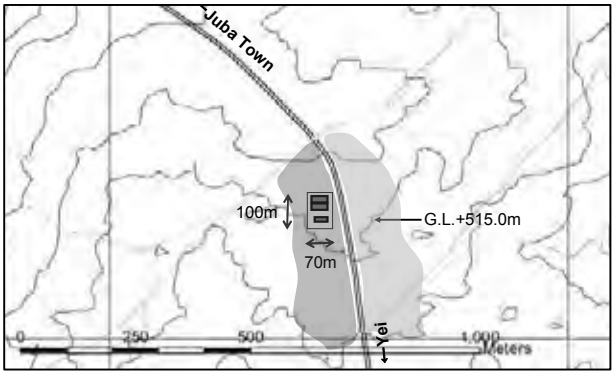


4. West Water Treatment Plant

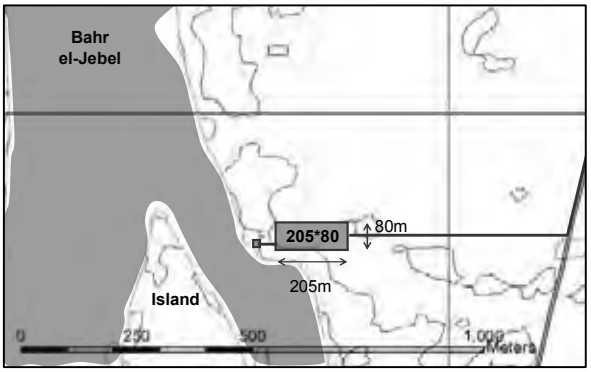
Figure 8.3 Detailed Locations of Planned Facilities in Master Plan (1/2)



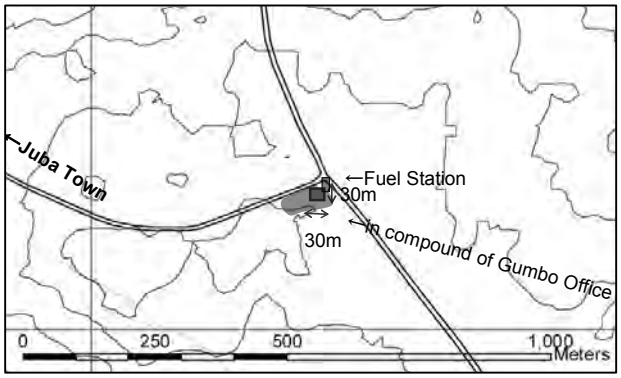
5. South High Service Reservoir



6. South Low Service Reservoir



7. East Water Treatment Plant



8. East Elevated Tank

Figure 8.4 Detailed Locations of Planned Facilities in Master Plan (2/2)

8.2.2 Screening

There is no mandatory list for environmental screening in relevant laws in the Republic of Sudan and Southern Sudan. The screening was made by the Study Team and the result is shown in Table 8.1. As a result, in general, the magnitude of negative environmental and social impacts of the Master Plan project is not serious.

Table 8.1 Project Major Activities and Predicted Impact Level

Major activities		Impact level	Main reasons
Planning	1. Land acquisition (Compensation and resettlement)	B+	Proposed facility sites are not in residential area. Required areas for construction of facilities are not of very large scale as in projects such as building roads or dams. However, inhabitants who rely on agricultural products may have negative impact in the form of loss of properties such as crop fields and fruit trees.
During Construction	1. Land clearance	B	
	2. Cutting and filling land	B-	Cutting and filling land may cause dust which could affect the surrounding area.
	3. Operation of equipments and heavy vehicles	B-	Construction machines may cause noise, vibration, dust and traffic accidents.
	4. Influx of construction workers, construction of base camp	B	Many workers will come to the project site. Most construction workers may be hired from the surrounding villages, while other technicians from other areas or countries. The increased chance of interaction may spread infectious diseases through sexual interaction.
Post Construction	1. Increase of water supply	B	Clean water supply may give negative impact to the existing water venders who obtain raw water from the river.
	2. Increase of discharged water (Wastewater)	B+	The increase of water supply means the increase of wastewater polluted by organic matter from users. The increase of discharged wastewater may cause deterioration of water environment of the Bahr el-Jebel and living environment. Discharged wastewater may also create a suitable habitat for malaria-infected mosquitoes even during dry seasons.
	3. Operation of facilities	B-	Operation of water treatment plant and pump may increase the level of noise and vibration. Discharged solid waste from water treatment plant may cause negative impact through its dumping.
	4. Operation of water tankers	B-	Increased operation of water tankers may increase the level of noise, vibration and dust along the road.

Note: A: Serious impact expected; B: Certain impact expected
+: the strength of impact is bigger; - the strength of the impact is smaller.

It is identified that land acquisition and increase of wastewater are major negative impacts of water supply project, although the magnitude and area of impact are generally not regarded as severe. To examine further these impact items including other items, an initial environmental examination (IEE) in preparation of the Master Plan, followed by preliminary EIA in a feasibility study, are required. This result was confirmed through discussion between the Study Team and Environmental

Department of MHPPE in March, 2009.

8.2.3 Impact Items and Factors

Impact factors and degree of negative and positive impacts are checked in the scoping matrix in Appendix-I and summarized in Table 8.2.

Table 8.2 Result of Scoping for Master Plan Facilities

Impact items				Impact factors by stages											
				Planning phase	Construction phase						Post construction phase				
	No	Likely impacts	**Overall Rating**	Land acquisition/Compensation	Deforestation/land clearance	Alteration to ground by cut land, filling, etc.	Operation of construction equipment and vehicles	Construction of facilities	Influx of construction workers, construction of base camp	Removal old pipelines	Increase of water supply	Increase of discharged water	Appearance/occupancy of facility and related building structures	Operation of facilities	Operation of water tankers
Social Environment	a	Resettlement (or loss of properties)	**B+**	B	B										
	b	Land use and utilization of local resources	**B**	B	B										
	c	Misdistribution of benefits and damages	**B**								B				
	d	Cultural heritage	**C**												
	e	Sanitation	**B**									B			
	f	Hazards (Risks), Infectious diseases	**B**						B	B	B	B			
	g	Accidents	**B**				B								B
Natural Environment	h	Flora, fauna and biodiversity	**B**		B										
	i	Landscape	**B**										B		
	J	Air pollution (dust)	**B**			B	B								B
Pollution	k	Water pollution	**B+**			B						A			
	l	Waste	**B**		B									B	
	m	Noise and vibration	**B**			B	B	B						B	B

Rating: A: Serious negative impact is expected. B: Some negative impact is expected. C: Extent of impact is unknown (Examination is needed. Impacts may become clear as study progresses.) No Mark: Little impacts are expected and IEE/EIA is not necessary. +: the strength of impact is bigger; - the strength of the impact is smaller.

Construction of each facility has some factors causing negative impacts during construction and post construction phase. The water treatment plant requires large clearance of construction site, which may have a significant impact on the inhabitants due to resettlement and/or loss of properties. The required land for each proposed facility is less than 4 ha and proposed construction sites of proposed facilities

are located in non-residential area. Therefore, negative impacts may not likely be significant. Four proposed sites for the service reservoirs are located in customary land which belongs to traditional community.

In addition, operation of water treatment plant and pumping station may generate noise and water supply through distribution network may increase water pollution during post construction phase if generated wastewater is not collected and treated appropriately.

8.2.4 Outline of Activities for Initial Environmental Examination

IEE is a study including analysis of alternative plans, projected assessment of environmental impacts, and the preparation of mitigation measures and monitoring plans on the basis of secondary data and simple field surveys. An IEE has been carried out by the Southern Sudan side and the Study Team through following activities with following participants.

Table 8.3 IEE Related Activities and Participants

Date	Activities	Participants
1st Sept. 2008	・ Site survey for the entire city area	・ (Study Team)
20th Mar. 2009	・ Site survey for proposed facilities ・ Interview with inhabitants related to proposed facility sites	・ Urban Water Corporation (UWC)
4th Apr. 2009	・ Carrying out of a stakeholder meeting for the Master Plan and priority project	・ Minister of MOPI, Juba Payam Mayor, Paramount Chief Tokiman, Payam representatives, NGOs, UWC, MWRI, international donors and other relevant persons (Memorandum of meeting is given in Appendix-O.)
8th Apr. 2009	・ Field survey for confirmation on landowners of proposed facilities with the stakeholders	・ Paramount Chief Tokiman, Payam Representatives of Kator, Rejaf and Munuki, and UWC
17th Apr. 2009	・ Field survey for confirmation on landowners of the proposed site of North High Service Reservoir	・ Representatives of Northern Bari Payam
21st Apr. 2009	・ Field survey for proposed facilities	・ MWRI
24th Apr. 2009	・ Carrying out of stakeholder meeting for the proposed site for West Water Treatment Plant.	・ Paramount Chief Tokiman and Tokiman Community (Memorandum of meeting is given in Appendix-O.)

A basic consensus to implement the plan was built in the several field surveys and in stakeholder meetings on 4th April, 2009 with the stakeholders. The memorandums of meetings for the stakeholder meeting are attached in Appendix-O. The following are major issues raised and discussed in the meeting.

- Project monitoring and evaluation shall be carried out using log frame
- Training is required for sustainability of the Project
- Involvement of local people and training in the Project is required
- How to take-over the Project?
- Step-wise improvement of water supply will be implemented
- No facility in Northern Bari, no water to this area?
- Water has not reached to Munuki in previous JICA Munuki public water tap project
- Is population underestimated?
- Role of international organizations or NGOs in the Projects shall be considered.
- Information (reports) disclosure
- Project cost shall be informed
- Does locating water reservoir on the top of mountain expand service area?

8.2.5 Result of Initial Environmental Examination for Master Plan

The results of IEE, or predicted impacts along with basic environmental and social aspects, are described in this section.

a) Resettlement

Ministry of Physical Infrastructure (MOPI/CES) is an organization for land management, and the Directorate of Lands and Town Planning of MOPI keeps registration records of landowners in maps, which mainly covers existing organized Juba urban area only and registration records do not exist for land outside of the urban area.

The land acquisition process is described in Appendix-I. This process is also applied for the areas outside of Juba urban area without registration records. The description and landowner of proposed sites for proposed water supply facilities are summarized in Table 8.4.

The outline of field survey for confirmation of landowners is summarized in Appendix-O. A basic consensus for project implementation was built during these field surveys with stakeholders.

Resettlement and loss of properties will be minimized since proposed facility sites are not located in existing residential areas. Pipelines will be constructed under/along existing roads and therefore, installation of pipe will not require land acquisition. However, adequate application of the land acquisition process should be taken place under relevant land laws, and compensation and information disclosure through stakeholder meetings should be carried out by the proponent.

Table 8.4 Facility Location and Landowner

No.	Location	Area (ha)	Facility				Landowner	
			WTP	SR	ET	PUMP	Government	Community
1.	UWC premises	-	●			●	UWC	
2.	John Garang Memorial Site	1.7		●		●	President Office/GOSS	
3.	North of Jebel Körök	0.8		●				Nyaing Boma in Northern Bari Payam
4.	Tokiman Area (Khor Ramla River Crossing Point)	4.0	●			●		Tokiman community in Rejaf Payam
5.	Southeast of Jebel Körök (for south high zone reservoir)	1.0		●				Tokiman community in Rejaf Payam
6.	East of Jebel Körök (for south low zone reservoir)	0.7		●		●	GOSS(1st class housing plot, Block K and other)	
7.	Gumbo in East Bank	1.7	●	●		●		Gumbo Boma in Rejaf Payam
8.	Center of Gumbo in East Bank	0.1			●		Rejaf Payam office	

WTP: Water treatment plant, SR: Service reservoir, ET: Elevated tank, Pump: Pump station, FS: feasibility study, MP: Master plan

b) Land use and utilization of local resources

The existing land use of the proposed facility sites is summarized in Table 8.5. Most of sites consist mainly of seasonal grass area in flat land or rocky area in Jebel Körök, and are separated from the existing residential area. In most of the sites, land use will be changed from grazing ground to facility site. In southwest of Jebel Körök for the site of South Low Service Reservoir, the site is planned for residential or market plot. Therefore, the land use in this site shall be changed and this request shall be carried out at the early stage of the project as early as possible. Also, the part of the John Garang Memorial Site shall be used for site for a service reservoir, and the permission shall be taken from the presidential office for this purpose.

Table 8.5 Land Use and Main Local Resources

No.	Location	Area (ha)	Existing land use	Main local resources and utilization
1.	UWC premises	-	Old facility and parking space	Nothing
2.	John Garang Memorial Site near the parliament	1.66	Government ground	Nothing
3.	North of Jebel Körök	0.72	Grass and rocky area (Restricted zone by GOSS)	Grazing ground, quarry site
4.	Tokiman Area (Khor Ramla River Crossing Point)	3.97	Seasonal grass / swamp area	Grazing ground
5.	Southeast of Jebel Körök (for south high zone reservoir)	0.90	Rocky mountain (Jebel Körök)	Grazing ground and informal quarry site.
6.	East of Jebel Körök (for south low zone reservoir)	0.70	The mountain side is planned as residential or market plots and the city side is commercial industrial plots.	Nothing
7.	Gumbo in East Bank	1.64	Seasonal grass ground with acacia trees	Grazing ground
8.	Center of Gumbo in East Bank	0.09	Compound of Gumbo village office	Nothing

c) Distribution of benefits and damages

Supply of safe and clean water after the project will give positive impacts from a basic human needs point of view and shall benfit all users through improving hygiene and health.

On the other hand, it is expected that current private water venders including hand or bycycle water carrying workers, water tanker and water sellers by pumping at the river side may lose their job.

In the project, water supply stations and public tap stands will be provided. Therefore, private vender can get water from these points but river water sellers may lose the job.

Pumping and Chlorination Sites for Water Tankers

d) Cultural heritage

There are generally no registered cultural heritage sites in the planning area. However a well- known cultural heritage site in the town of Juba is the rock entitled “Pita” in Juba na bari, north of the airport. The community of Juba na bari claims to depend spiritually on this rock for the protection of its

people during difficult times. Community members perform traditional rituals facing this rock, requesting for rain and good harvests. Furthermore, there is a forest in Kworijik Luri called "Yubo na ko sabur," which is considered by all of the community members as "a forest which must be respected, for whoever cuts the trees of this forest will die." Additionally, the so-called "Guri" at Rejaf, Kolia is also to be respected. Finally, cemeteries are also part of the cultural heritage site of the town; especially since there are many graveyards along Bahr el-Jebel. The proposed facility sites are not to be located in these cultural heritage sites.

e) Sanitation

In Juba, private household latrines are limited. The majority of the people defecate in open fields, open spaces or near public markets, where some individuals sleep. Moreover, limited waste collection vehicles make it difficult to collect this waste, which is brought to the dumping site outside the town of Amadi along Yei road.

Shortages of sanitation facilities cause contamination from toilets, causing waste matter to be absorbed into the aquifer and the boreholes.


Typical Toilet

This project will provide safe and clean water and will decrease the threat of water related diseases. However on the other hand, discharged water will also increase organic polluted water, and may impact the water environment and living environment without a sewerage system.

f) Hazards (Risk) and infectious diseases

Around 700 to 500 cases of HIV/AIDS per year are reported in all of Sudan according to the Statistical Yearbook for the year 2004. However, this disease may spread more in Juba area since the neighboring countries such as the Democratic Republic of Congo, Uganda and Kenya have very high infectious rate and many people from these countries are working in Juba area. The town's socio-economic conditions as a commercial center of Southern Sudan may increase the frequency of this disease.

In the construction phase of the project, most construction workers may be hired from the surrounding villages, while other technicians may be hired from outside areas or neighboring countries that have relatively high infection rate. There is a possibility that these workers may infect sexually transmitted diseases (STDs) through interaction with the local people.

The project will provide safe and clean water and will decrease the threat of water related diseases.

On the other hand, discharged wastewater without proper sewerage system will increase the amount of puddles surrounding the residential areas and provide a nest of malaria-carrying mosquitoes even during dry seasons.

g) Traffic Accidents

According to a traffic survey in the JICA's road master plan, the traffic volume is more than 16,000 vehicles for 12 hours during the daytime. The busiest road in terms of traffic volume is the Juba Town Road. Traffic accidents seem very frequent in Juba because of the poor roads conditions, traffic congestion due to shortage of road capacity, generalized driving under the influence of alcohol, and the presence of untrained drivers, although statistical data of traffic accidents and cases are not available at the moment.

After the provision of clean water by this project, operation of water tankers will be increased, which may increase the frequency of traffic accidents without an appropriate traffic education and regulations to drivers.

h) Flora, fauna and biodiversity

Large trees and shrubs within the savanna area are regarded as the main vegetation of this area. According to Sudan's vegetation map, the Juba area constitutes an "Edaphic grassland mosaics with trees" vegetation community. More than 10 years ago, this area was a rich forest. However, during the wartime, the people cut down several trees to produce fuel and firewood for cooking, which has contributed to the destruction of Juba's ecosystem. This also caused many small wildlife animals to relocate and living birds that had not any main specific at that particular time. Some of the medicinal trees were also destroyed for the sake of firewood.

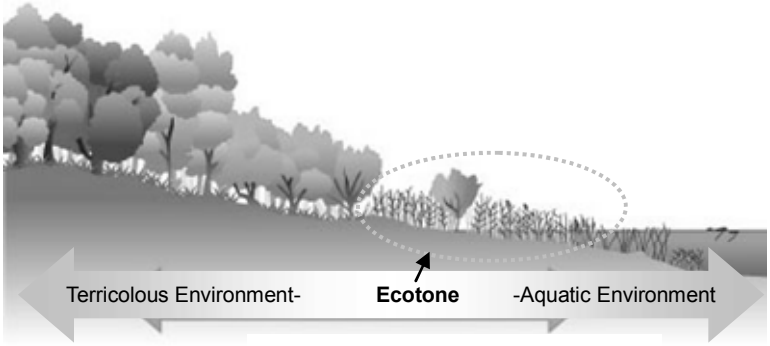
Seasonal grass with bushes area at candidate site of WTP near the Khor Ramla river

Natural vegetation is limited along the Bahr el-Jebel as Juba area is a developed area. Protected conservation areas such as national parks, forest reserves and game reserves are not found in the area. Furthermore, this natural vegetation area does not have any particular ecotone from land to water body with various fauna and flora habitats. Swamp vegetation throughout the year is not found along the riverside. Few rare and endangered species such as those listed in IUCN (International Union for the Conservation of Nature and Natural Resources) and CITES (Convention on International Trade in

Endangered Species of Wild Fauna and Flora) may be found in the area. Nile crocodile is listed in IUCN.

Construction of water treatment plants in nearby land of the Bahr el-Jebel in west and east banks may affect the habitat of Nile crocodiles, but the area of proposed land is small and such individual can easily escape to surrounding area with same environment in the Bahr el-Jebel. Therefore it is evaluated that the impact on biota is not major.

Note) Ecotone
An ecotone is a transition area between two adjacent ecological communities (ecosystems). It may appear on the ground as a gradual blending of the two communities across a broad area, or it may manifest itself as a sharp boundary line. Ecotone is particularly significant for mobile animals, as they can exploit more than one set of habitats within a short distance. This can produce an edge effect along the boundary line, with the area displaying a greater than usual diversity of species.



i) Landscape

The common landscape in Juba area is categorized into four:

- Urban area in the center of Juba
- Surrounding agricultural area near traditionally shaped houses called “Tukulu house”
- River and its riverbank
- Open mountain area

The Nyarkenyi (Jebel Lodu) to the north, Krok (Jebel Körök) and Nyarjua to the west, Logwek (Rejaf) and Longe to the south, and Bilinyang and Luluriet hills to the east give the shape of the evident hilly landscape.

Hilly Area (Jebel Körök) along the Yei Road

Agricultural Area in suburb of Juba Town

River Nile and bank area in Rejaf Payam

Urban Area in Juba Town

Picture 8.1 Typical Landscape in Juba

Most of the proposed facility sites are located in low density or no residential areas. Water treatment plants in west and east banks and two of four service reservoirs are located in rural landscape. Building of these facilities will change the landscape. The height of the elevated tank in the east bank is about 30 m. It changes the landscape surrounding area without an appropriate design and color. It can be a landmark in the surrounding area.

j) Air pollution

In the Juba area, the pollutants of air are the dust particles blown by the wind, and smoke caused from burning grass in the outskirts during the dry season. In the dry season, main air pollution comes from dusts from roads. However, dusts from roads may decrease depending on the progress of road pavement in near future.

In proposed facility sites, operation of construction machines and equipments will generate dust in the surrounding areas during construction. But this negative impact is not significant because most of proposed facility sites are located in low density or no residential areas.

k) Water pollution

Surface water pollution in Juba originates mainly from domestic solid waste and defecation along

streambeds and in the bushes. These wastes are directly carried into the river and pollute the water. In case of groundwater, the latrines in place have polluted about one third of the boreholes in residential areas, according to an interview of the Directorate of Environmental Affairs. This wastewater contains pathogenic bacteria, which is a cause of water related diseases such as cholera, amebic dysentery, liver inflammation and other diseases. These water related diseases are common in households according to the JICA socio-economic survey since the people use the water taken from the river and existing boreholes for drinking and cooking.

On one hand, the water supply project provides positive impacts. On the other hand, an increase of water supply amount increases discharged wastewater. Discharged wastewater is polluted by organic matter and will affect the water quality of the river without proper sewerage system.

A quantitative analysis of the impact of discharged wastewater will be given in the preliminary environmental impact assessment (EIA) in the feasibility study.

l) Waste

Generally, per-capita volume of solid waste in Sudan is approximately 1 kg/d based on information obtained through an interview with the Directorate of Environmental Affairs. However, it seems less than 0.5 kg/d as industrial and commercial activities are quite limited at the moment. There is currently no public waste collection system in Juba.

Major components of household waste are ordinary garbage, plastic bags and empty plastic bottles. These solid wastes spread over open spaces along neighboring communities and dry riverbeds, and is washed away into the river.

Commercial and industrial solid waste is produced mainly from restaurants, campsites and markets, and collected by private garbage collection trucks that transport it to a designated or un-designated dumping site in the Amadi area, Munuki Payam along Yei Road. It is said that industrial waste is mainly composed of general garbage and construction waste. It is to be noted that there are a few waste pickers in the dumping sites available, which means a recycle system does not exist in Juba.

The water supply project increases wastewater and cause degradation of living environment and pollution of the river without proper sewerage system.

Water treatment plant generates sludge in operation phase. This waste should be properly disposed of. The degree of impact of the sludge generation will be analyzed in the preliminary EIA.

m) Noise and Vibration

The level of traffic noise and vibration increases with economic growth in Juba, particularly, along the paved roads to the parliament and the airport, which is heavily congested daily, and the main business area of the Juba Town, which is the busiest street. It seems the sound level is not less than 65 dB(A) along the roads during the daytime. Most of the proposed facility sites are located in suburb areas and the sound levels are lower than these areas.

In the water supply project, construction machines and dump trucks will become source of noise and vibration during construction. Operation of the water supply facilities such as pump stations will cause noise and vibration during post construction stage if constructed without proper sound-proof measures. However, these impacts on residential area are not likely to be significant since the surrounding areas of proposed water supply facilities are not major residential area.

8.2.6 Key Environmental Issues for the Master Plan

As a result of IEE, there are two major issues; land acquisition and increased wastewater due to increase of water supply volume. Land acquisition for the proposed facilities during planning and construction phase is the most concerned issue from social view point, although it is not likely to cause a serious impact. Increase of wastewater discharge in the residential area and natural environment may cause the most significant negative impact in the implementation of the Master Plan. This may cause water pollution and deterioration of living environment.

8.3 Proposed Mitigation Measures and Monitoring Items of Impact Items

The mitigation measures and monitoring items of negative impacts of the Master Plan project are proposed and given in Appendix-I. The key issues (resettlement and water pollution) are summarized in the following table.

Table 8.6 Proposed Mitigation Measures and Monitoring Items of Major Impact Items

Items	Mitigation Measures	Monitoring Items
Resettlement (or loss of properties)	• Do not select residential and forest areas as project site • Hold stakeholders meeting for information disclosure • Establishment of a complaint window by the relevant bodies in implementation stage • Appropriate compensation for land acquisition	− Land acquisition and compensation process
Water pollution	• Prepare a sewerage management plan • Construction of sewerage system	− Water quality of the river

As for land acquisition for the proposed facilities, forming of trust with stakeholders is important mitigation measure. Trust shall be formulated through information disclosures, exchange of opinions, and consensus formulation in adequately organized stakeholders meetings. Furthermore, adequate compensation is one of the most important issues in land acquisition. A tentative schedule and major considerations for land acquisition are shown in the following table.

Table 8.7 Schedule of Mitigation Measure for Land Acquisition

Stage	Implementation activities	Mitigation measures
Master plan and feasibility study	The facility sites were proposed and surveyed in the MP/FS by the Study Team	The candidate locations should be confirmed by relevant stakeholders and land owners. (done)
Basic design based on MP and FS (this stage can be skipped in most cases.)	Detailed locations are identified under agreement between stakeholders and GOSS or CES.	Stakeholder meeting should be held with inhabitants at each location, and their consensus shall be confirmed with them again.
Implementation stage (Detailed design and construction)	GOSS or CES shall conduct a detailed measurement survey and take the process of land acquisition and compensation.	The process of land acquisition and compensation during construction shall be monitored whether it is carried out according to the respective laws adequately.

Note) Detailed measurement survey includes followings
- Declaration of implementation of detailed measurement survey to communities and the deadline of identification of target properties
- Measurement of site location and pegging of boundary of construction yard
- Evaluation of price of properties such as agricultural products and buildings based on the respective laws.

Natural environment of the Bahr el-Jebel are considered as valuable resources for Juba's economical and social promotion as well as development. Therefore, it is considered that keeping the river clean is mandatory for sustainable development in Juba. Wastewater and solid waste management shall be adequately addressed in near future preferably before the operation of the proposed water supply system.

CHAPTER 9 MUNUKI COMMUNITY WATER AND SANITATION MANAGEMENT

9.1 Water Management Committee in Munuki

9.1.1 Background of Water Management Committee

JICA constructed a pilot scaled water supply system in Munuki from 2006 to 2007 as part of *EMERGENCY STUDY ON THE PLANNING AND SUPPORT FOR BASIC PHYSICAL AND SOCIAL INFRASTRUCTURE IN JUBA TOWN AND THE SURROUNDING AREAS IN THE SOUTHERN SUDAN*. One elevated water storage tank and eight (8) tap stands were constructed in Block A, B, and C. The location of the project is shown in Figure 9.1.

The system was designed to supply the groundwater to total of 2,300 people at the rate of 13-20L/c/d via twenty-four (24) faucets/outlets (3 faucets/tap stand x 8 tap stands). The groundwater extracted through two deep wells which were developed by the pilot project was, however, found to be contaminated with naturally existing toxic mineral, Arsenic. The idea of using well was abandoned for health concern and the community has never received water from the tap stands since the completion of the pilot project. People were frustrated to see the tap stands that did not yield water to the community and chief of each block received complaints from community members. Since the water was not supplied to the tap stands, responsible body to manage and operate the water distribution system was not formulated. Without having caretakers of the tap stands, eventually all 16 faucets were vandalized, broken off and were no longer serviceable. Meanwhile road rehabilitation project had laid a road through block B in such a manner that seven tap stands are situated in the middle of the road and became a road hazardous. By 2008 the tap stands became nothing but a nuisance of the community.

The next opportunity to provide water to the pilot project site arose in 2008. GOSS and other donor agencies commenced construction of a rising main, a water storage tank, a transmission pipe from the existing water supply network, and a water treatment plant. Coordinating with completion of these facilities, JICA also initiated to improve the current situation by restoring the vandalized tap stands.

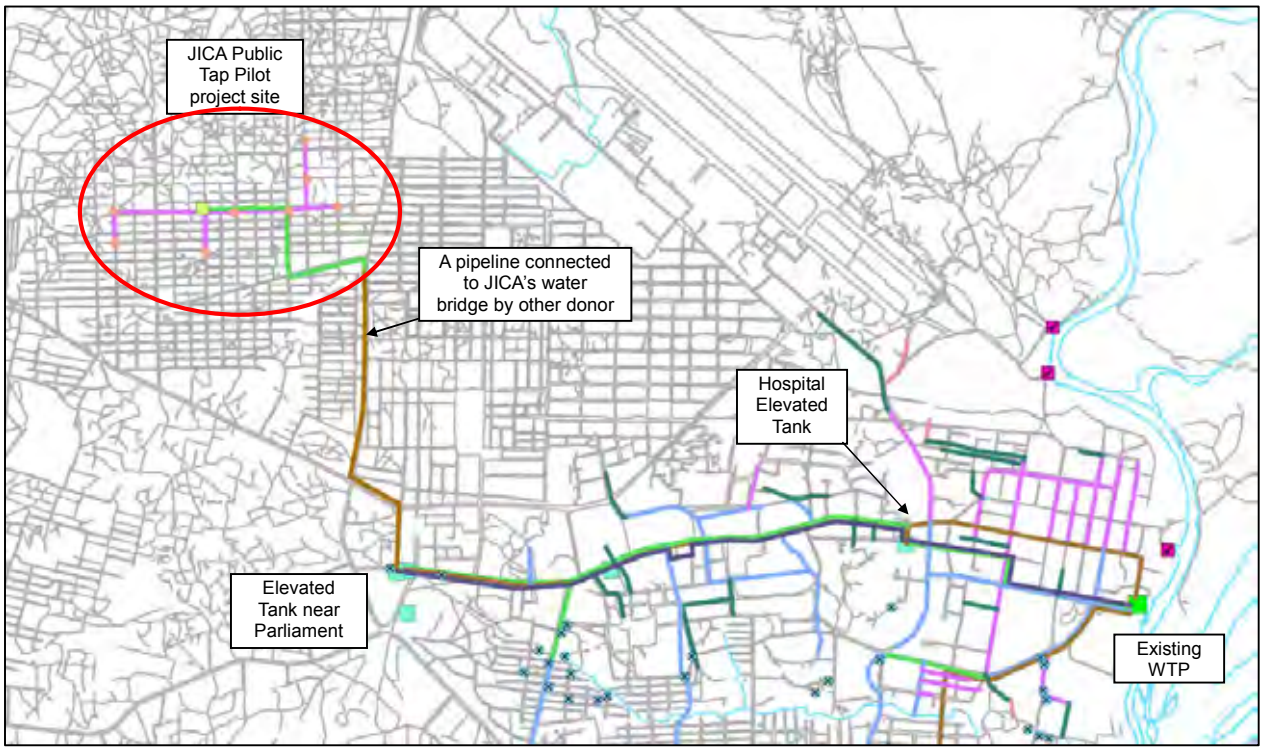


Figure 9.1 Project Site Location

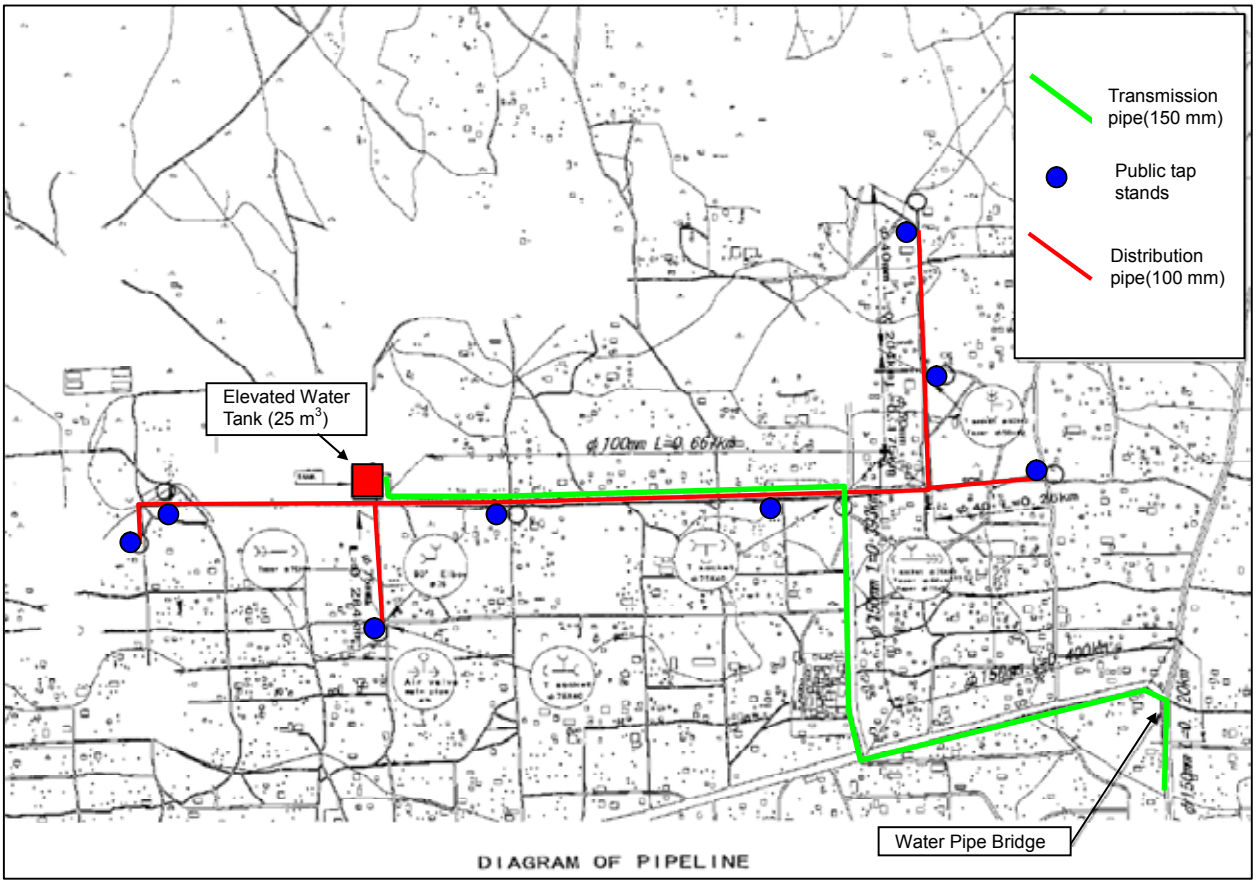


Figure 9.2 Locations of Eight Tap Stands in the Pilot Project Area

9.1.2 Reconstruction of Public Tap Facilities

The 8 tap stands were not taken cared by the beneficiaries. Faucets of all the tap stands were cut and stolen in the last 2 years. Furthermore all the locations of the tap stands, except No.1, were found inadequate or even illegal after three road surveys were performed by the Study Team, CES land surveyor and Munuki payam representative: tap stand No.2 and No.4 through No.8 were located in a few meters inside of the land reserved for roads while tap No.3 was happened to be situated in a private property. Hence not only replacing the broken faucets and valves but most of the tap stand structure were also necessary to be relocated. New locations were carefully discussed and consulted with the local stake holders and CES surveyors before relocation sites were finalized. By June of 2009 all 8 tap stands have been restored and functional. Estimated population of block A, B, and C are 18,324 or 3,054 households according to Payam's census of 2008. Actual beneficiaries who can physically access to the tap stands are presumed to be much lower than total population of 3 blocks.

9.1.3 Overall Plan of Activities

Objectives of activities in Munuki pilot project are shown below. Objective 5 was changed to "school latrine construction" from "a public latrine" after assessment of existing needs. Following the change in objective 5, objective 6 was also altered accordingly. The detailed activities schedule is given in Appendix-J.

1. Assistance to establish water management committee and formulate action plan on operation and maintenance
2. Public awareness survey for water tariff
3. Preparation of operation and maintenance manual
4. Assistance and training to prepare activity schedule on sanitation and hygiene education program
5. Assistance to build a school latrine and preparation of operation and maintenance manual
6. Assistance to establish a management body for school latrine and to help developing management capacity
7. Evaluation and workshop

9.1.4 Achievements

Objective 1. Assistance to establish water management committee and formulate action plan on operation and maintenance

Three water management committees, one for each block, were formulated in block A, B and C in

Munuki Payam by the following process.

1) The purpose of and cooperation to the Project were explained to and agreed upon by Munuki Payam's director and UWC.
2) Representatives of each block, where the 8 tap stands are located, were informed about the project and asked to chose candidates for members to formulate water management committee.
3) The leader of Block B, his selected 5 people, the payam director, and UWC staff attended the first meeting to discuss about formation of water management committee.
4) 10 candidates for each block, the total of 30 candidates, were selected by each block's leader. Of these candidates, 5 people per block were elected democratically by the people who live around each tap stand.
5) The 15 committee members to formulate water management committee held a weekly workshop to constitute the organogram and job descriptions of water management committee.
6) Importance, functions, roles, and responsibilities of the water management committee, a necessity of paying and managing tariff, and the cost of water treatment were explained to potential tap water users.
7) Block leaders and counselors chose water management committee members for each block, instead of each tap stand, according to the TOR that was formulated at step (5). In this selection process a democratic election was not held regardless of recommendation.
8) Water management committee for each block was formulated and inauguration was accomplished by Payam's Senior Inspector, witnessed by UWC's engineer.
9) Weekly meeting was held on Saturday for the committee members' convenience. Issues such as amount of tariff, roles and responsibilities of UWC, payam, and individual, detailed constitution of committee for each block, and inactive members were discussed.
10) All the decisions made in the meetings were taken back to the community and shared. No objection and feedbacks were expressed by the community.
11) Counselors, advisors, and elders were assigned to participate in the meeting and help the committee members to be active.
12) Water management committee's TOR was revised and improved by the committee members.
13) Some inactive members were replaced. However, committee members in general were not accepted by the community.
14) Study trips to UWC and to other community where a water management committee was active were organized in order to help understanding water distribution system and management structure better.
15) A capacity assessment was done on each member and found that many of them did not possess criteria to perform their duties. By this point more than half of committee members

stopped showing up for the meetings. Recruitment of capable members were requested to the director of payam and leaders of each block but neglected.

16) Several community meetings were held in each block to share information and decisions made by the committee and to discuss issues such as inactive committee members and tariff. However, replacement of members of committee with other incapable set of people occurred frequently and became less active.
17) Remaining committee members were trained for their duties. Those who were trained are part of treasurers, tariff collectors, public health officers, and repair persons.
18) An action plan was made only for construction of fences around tap stands without having chairmen of block B and C.
19) General operation and management plan were made for treasurers, tariff collector, and public health officer.
20) The amount of tariff proposed by UWC was again discussed by the community members at all-community meeting in each block. They agreed to the amount of tariff, 3 SDG for 200 L.
21) Water user training was given with the treasurer, tariff collectors, and part of public health officers. They simulated how and where to buy tokens and pay money and exchange the tokens with water.

Names of water management committee members decided are shown in Appendix-J.

Objective 2. Public awareness survey for water tariff

The community is well aware of their obligation to pay for a service to receive water: they are used to paying 5 SDG for 200L of water from a private water tanker. Hence there is no objection against paying tariff to UWC. One (1) SDG for 200L were proposed under UWC's old flat rate rule for a class 4 low income residential area. UWC, on the other hand, requested 1SDG for 80L under new rule after installation of water counters/flow maters to water supply lines in Munuki. The community agreed to pay 3 SDG for 200L to cover both bill and the cost for water management and operation. However, the cost was objected by the signatories who were assigned to sign the agreement with UWC on behalf of the water users in June, 2009, two months after the water users agreed to the price. UWC and community representatives agreed to pay 2 SDG for 200L to UWC on June 19, 2009.

Objective 3. Preparation of operation and maintenance manual

The first draft of the manuals for a tap stand operation, management and maintenance were formulated. Trainings were given by using the manuals to tariff collectors, treasurers, and public health officers since most of them are illiterate and not able to follow the manuals alone. On-the-job training was given by UWC to the repair persons of the committee. Tap stand repair persons of the committee were not active and hardly responded to call for a meeting and training. Although they

received OJT from UWC, it is unrealistic to expect them to be able to perform a repair work of a water system since all of them have no training for plumbing prior to the OJT. The general rule for an event of any problem with a tap stand is that the repair persons are noticed about a problem by water users or public health officers, then to report to a water engineer at UWC for proper maintenance. The repair persons would assist UWC technicians under water engineer's command. The manuals are presented at the Appendix-J.

Objective 4. Assistance and training to prepare activity schedule on sanitation and hygiene education program

GOSS and UNICEF issued "Health education manual for Southern Sudan" in 2005 which is a mere collection of various health promotion methods. The Ministry of Health of GOSS also issued draft copy of "Sub-Directorate of Health Education and Promotion: the Strategic Framework and Policy" in January 2008. UNICEF held comprehensive workshop to consolidate IEC and promotion method in October, 2008. However, there was no noticeable hygiene education program at payam level and CES level. According to the payam's public health officer, hygiene and health promotion is given to the community during implementation of a project such as cholera prevention campaign by MSF but not by CES or GOSS itself. The public health office also observed that many of people staying at home in day time were moved from a country side and not accepting life style in city (Munuki) and kept practicing "unhygienic" life style that are common in country side. Students of a basic school also knew major hygiene practices and chlorination of drinking water. Such knowledge was mainly given by their parents and NGOs. Since the public sector do not have capacity, budget, and motivation, the public health officers of the water management committee was thought to be a carrier of a program for sanitation and hygiene targeting "village-minded people".

Total of 57 households around the 8 tap stands were selected by the systematic random sampling method and interviewed for hygiene and sanitation. Seven to eight compounds, which are viewed as "households", were selected for the survey from four different directions from each tap stand. About 1/3 of all the interviewees did not give correct answers where water can be contaminated or key times of washing hands. However, 96% knew how to use a chlorine tablet (Waterguard®) to disinfect drinking water correctly. About 20% did not have latrines while in 96% of cases, their compounds are clean and hygienic. One community health worker who has worked in his position for 22 years did not have a correct knowledge of when and where water contamination could happen. This survey results implies that possessing a right knowledge does not necessary lead to sound hygiene behaviors.

The counterpart of UWC was not a part of hygiene promotion at the ministry if there is any. Nonetheless the counterpart was replaced to a person whose function is not assigned for improving of public health. Payam and the school do not have their own health program either. Health promotion activities are dependent on NGOs' campaigns that are carried out only during the season of Cholera.

Payam's health officer and a community leader who used to work with the ministry of health were invited to participate in the training. However, they did not take part in the training. Consequently the public health officers of the water management committee were the remaining option for hygiene promotion activities in payam.

In order to correct and reinforce knowledge about hygiene and sanitation and to enhance their practices, the PHAST training method was chosen to be carried out by the public health officers of the water management committee. First, a series of trainings to use the PHAST method and to train the water users were given to the public health officers (PHOs) of block A, B, and C. Second, the trained PHOs went to the community and performed PHAST. The PHOs also enforced hygienic practice such as clean water storage and washing hands at each tap stand.

School health program was formulated for and with FFEDA Basic school of Munuki through the pilot project. Detail of the program is discussed later.

Objective 5. Assistance to build a school latrine by a participatory approach and preparation of operation and maintenance manual
Objective 6. Assistance to establish a management body for school latrine and to help developing management capacity

The fifth and sixth objectives were altered to support a "school latrine" from a "public latrine" since it was found that there was a little need and weak support from Munuki community to public toilets. Objectives 5 and 6 are discussed later.

9.1.5 Evaluation and Lessons Learnt

(1) Current Status

It is doubtful if the water management committees (WMCs) function as a reliable management body after withdrawal of the project team. First and most, they are not respected nor supported by the water users despite their democratic election. Second, WMCs are lacking able members: all the WMCs do not have active assistant chairman, assistant treasurer, secretary, information officer, repair persons, and security. Block C does not have its responsible chairman at all while the chairman of block A is on a process to transfer to out of Munuki and that of block B was just picked up in late June. Many of appointed committee members have been replaced every time they showed up in a meeting. WMC of block C has never been formed solid with a reliable set of committed people and hardly attended meetings and activities. Furthermore, the chairman of C is not only non-supportive but also sometimes sabotaged the committee activity. Third, capacity of the committees to operate and manage the tap stands is questionable. Most of WMC members who came for the final meeting were those

who were not in the original list, not aware of responsibility of WMC member, and did not receive trainings.

(2) Situation Analysis

Despite of all the trainings, campaigns, study tours, meetings and dialogues, the water management committee did not gain recognition and support from the community. Weak office enforcement power, lack of motivation, and conflict of interests are thought to be major factors of difficulty in formulating an active water management committee.

- Weak office power

The payam has a local administration structure and traditional political power that practically drives community's function. A director of Munuki Payam who is sent from the CES and therefore temporally does not seem to have as much support and recognition from the community as a traditional chief does. Community development office, traditional chief, block counselor, and popular committee members that directly influence community exist in each block ("boma"). However, the payam office did not appoint these functions to be members of the water management committees.

- Lack of motivation

Water is still important commodity of life. However, the local situation has been changed in last two years since the time when the tap stands were first constructed in Munuki. The community has developed bitter and hostile feeling toward the water distribution system that does not convey water for last 2 years. Disappointment and frustration developed an untrusting relationship to the project. While they cannot receive the water from the tap stands, they now get water delivered by water tankers at cost of 5 SDG per 200L of water. This is not free but water is at least available to their door steps and reduces work loads of women. Water disinfection by chlorine tablets is also common knowledge in the community now. People are used to drinking river water purchased from a water tanker or well water by disinfecting it with chlorine tablets. JICA's tap stands are no longer the life line of the community but an additional source that require too much work to do: not only have to pay tariff but also have to fetch water from the tap stands, to support or be a part of water management committee without receiving incentives, and to bear responsibility to take care of the tap stands. The community members are not interested in carrying out such burden.

- Conflict of interests

Those who are capable or members of local functions have day time jobs and house chores to do. They cannot participate in the project activities in the way the project was laid out. The water management committee chairman of block C has never participated in the meeting or any activity but protested against demand of the work load of the water management committee and not

receiving incentives. Bottom line of their demands to the project was "water" and "incentive".

The boma (block) chairman of block B (not the water management committee chairman) refused to cooperate to the water management committee because water has never come for last 2 years which caused him loss of confidence from the community. According to a member of the water management committee of block B and some committee members of block C, they were told by the chief of block B that they should not perform as committee members if JICA did not pay their salary. Some meetings were deliberately interfered and sabotaged by him and not being able to hold. He was demanding some incentives to have committee meetings.

(3) Evaluation

Focus group discussion among the committee members was planned to evaluate the project. However, by the end of the project, more than half of the committee members who had involved into activities and trainings quit being part of the committee, while no more than 1/3 of the original set of committee members remained. Hence, it is not valid to evaluate their activities and accomplishment. Chairmen, whose duties are to lead the committee, sign a contract, and to pay a bill had hardly participated in the activities and meeting. They have never led the committee nor initiated a meeting except in case of block A.

A few remaining trained committee members, i.e. public officers, tariff collectors, and repair persons, demonstrated their skills sufficiently during the testing period of water vending in a real situation. All the treasurers except one who is also a treasurer of payam office, were absent at the end of the project.

(4) Lessons Learned

The concept of "community base" and dependency to the community's good will and solidarity might be applicable to a remote agricultural community where community's kinship and daily life are closely tied and no other managerial service to a water system is available. Munuki is growing to be part of capital city's function where many private services and economic activities are taking place. People are not heavily depending on each other or a single water source. On the other hand, it was observed that people are willing to pay for convenience, such as buying water for delivery, and has financial capacity in some extent. For example, people in Munuki prefer to pay 5 SDG for 200L from tanker than paying 3 SDG tariff for 200L at the tap stands. It can be said that a private company to sell and manage water is more suitable in Munuki.

(5) Suggestions and Recommendations

- UWC needs to establish a strong, reliable, and trusting function that channels to water users in

order to ensure well management of a water supply system (such as tap stands) and to collect tariff
- Business based water supply M&O in city setting like Munuki is encouraged
- Target women if it has to be community based but need an intensive training, long term support from public funding such as UNICEF and frequent follow ups
- Careful preliminary study and update of information before formulating a follow up project
- Earlier involvement of appropriate stake holders who have good moral and dignity

9.2 School Sanitation Pilot Project

9.2.1 Background of School Toilet

FFEDA Basic school was selected for the pilot project since this school is located in Munuki and did not have a proper hygiene and sanitation facility such as hand washing basin and hygienic latrine. However, the school possessed plenty of land that can be used for the project and shown cooperative attitude. The school collects annual tuition of 205 SDG from each pupils of the nursery section and 257 SDG from primary education section

Total number of beneficiary i.e. pupils and teachers are about 500: Eight teachers, about 315 below 5 years old, and the remaining between 5 and 12. More than half of the pupils are girls.

Table 9.1 Numbers of pupils at FFEDA in June 2009

Grade	Boys	Girls	Subtotal
Nursery	175	140	315
Primary 1(A)	34	21	55
Primary 1(B)	25	36	51
Primary 2	22	45	67
Total	256	242	488

The school has a pit latrine with three rooms, of which 1 is reserved for teachers. The latrines do not have a ventilation function, the doors do not close properly, faeces and urines are spilled around and other miscellaneous garbage is scattering on the floors. The toilet holes are not covered and flies infest. Bad odor is detected even from a few meters outside of the latrine building. Numbers of latrine rooms are also not sufficient. Two useable latrines are in very bad condition. Typically 3-4 children rushed into the “better” latrine of the two at the same time and those who had to wait ended up going behind the building to urinate or defecate. There is no proper hand washing facility but a jug of water.

9.2.2 Overall Plan of Activities

A capacity development project for improving hygiene and sanitation condition was targeted to

general population of Munuki at first. After discovering lack of need in a public latrine and willingness of its management in January 2009, however, the target was narrowed to the school children instead.

Due to change in the target and school recess/holiday time between October and April was allocated for the activities. The table below summarizes the activities at the school.

Table 9.2 Summary of activities for FFEDA School Training

Activities		Outputs: Expected results	Timeline		
			February-April	May	June
0.0 Preparation					
0.1 Site selection		A project site			
0.2 Contractor selection		Construction company			
1.0 Facilities constructions					
1.1	Construction of facilities for hygiene and sanitation	6 composting latrines			
		Hand washing facility& rain water harvesting system			
1.2	Latrine walls painting	Educational messages			
2.0	Formulating manuals and training to use them	Trained teachers and pupils, manuals			
(a)	Composting latrine	Latrine O&M manual			
(b)	Hygiene and sanitation	lesson plans, manual			
(c)	WASH Club manual	WASH Club activity guideline			
(d)	Urine& compost-fed gardening workshop	Gardening plan			
3.0	Formulation and training of WASH club	A governing body of water and sanitation of the school			

9.2.3 Achievements

The project activities started late April when suitable contractors were selected to build a latrine and a hand washing facilities. Prior to reopening of the school a meeting was held for PTA and teachers to explain about the project and latrines in February. The type of latrine and the participation of school were confirmed in this meeting. A 6-room urine diversion composting latrine was built according to UNICEF/GOSS construction guideline in May and June.

Trainings to the teachers and students on hygiene and about latrine use were done throughout the month of June. A body of students, called “WASH Club” was formulated to manage the latrine and to conduct pee-to-peer hygiene education. CHAST (Children’s hygiene and sanitation training) method

was used for hygiene promotion activity of WASH Club.

Manuals for latrine use, posters for hygiene and sanitation, a workshop about compost gardening, and school program for hygiene and urine fed gardening were made. A poster painting session to promote hygiene was held in which 100 students participated. Seminars to sensitize and promote alternative toilet systems were given to PTA and other stakeholders.

Hoe, plow, pickax, shovel, buckets, shovels, wheelbarrows, seeds, and other starting-up tools were donated to the school for compost removal and gardening in the future.

9.2.4 Preliminary Evaluation and Future Evaluation Items

Before the project started the school did not have decent hygiene facilities. Like any other household of Munuki, dirty pit latrine and barrels of water from the river purchased from a water tanker were the means of hygiene and sanitation.

One hundred-seventy students except the nursery were interviewed to assess current level of knowledge, attitude, and practice of hygiene and sanitation.

(1) Latrine Use

53% answered to using latrine and 36% for bush/field. Only 6% answered that they knew about “urine diversion composting latrine”. However, this answer is questionable since they could not identify the correct figure of the latrine slab. 38% practiced adding ash into a latrine vault after defecation which is the only option for the urine diversion composting latrine while 15% added water (assume this means “flushing toilet”), and 4% answered to adding OMO® (detergent) or soap.

(2) Disease Transmission

Only 10% of pupils believed that faeces can get into their mouths. All the 10% experienced that they put their fingers that could have attached faeces into their mouths by accident after defecation. Other possible transmission paths such as ingesting water contaminated with human excreta and flies infested foods were not mentioned. While they could not identify flies as faeces carrier to their mouths, 83% of them knew that flies cause cholera and other diarrheal disease. Also 83% of them answered that they share a cup to drink water. Only 56% were served safe foods that are just cooked and covered at home. 98% of them practice washing hands before meals while 86% did so after using latrine.

(3) Hygiene Practice

72% had finger nails cut and clean. While 82% identified that flies cause cholera only 20% agreed to "not washing hands after defecation" and 12% said that eating foods without washing hands causes cholera. More than half, 66%, answered that unhygienic environment causes cholera.

Total of 84% of the pupils used soap and/or OMO® to wash their hands. 69 % use water stored in a barrel to wash their hands.

Although most of the pupils know the end results of causes of diseases, it seems that most of them are not aware of various paths to transmit diseases. They received information about hygiene and cholera from family members, NGOs, and/or people working for health sector, but not at school.

(4) Lessons Learned

- Insufficient time: Teacher's training, formulation of WASH committee not accomplished
- Teachers are not available / dependable and often absent except the school master.
- Degree of teachers' commitment and ability to educate students is insufficient
- Students and PTA to be the target of hygiene and sanitation promotion activities
- The design of latrine (by UNICEF, MIWR, and MWRI) needs to be improved: ventilation, more lights sources, easier access to vaults, vaults to 2 latrines were missing
- The latrine slab is very small; difficult to use for anyone taller than 160 cm and adults

(5) Suggestions and Recommendations

The following actions are suggested.

- Observation and follow up for a long time of period
- Need to formulate WASH committee (PTA and other stake holders) to support WASH Club
- Support to the WASH club by receiving technical support from and tapping into UNICEF& M/Health's School hygiene program
- Input of a specialist for the urine and compost fed school gardening and operation of the urine diversion composting latrine
- Support to the teachers to develop skills to carry out hygiene education program and students-led school activity

CHAPTER 10 RECOMMENDATION OF WASTEWATER MANAGEMENT

In general, the condition of sewerage and sanitation is very poor in all parts of Southern Sudan. It is very likely that organized sewerage system does not exist in any of the major cities in Southern Sudan. According to the *Sudan Household Health Survey Report* published by the Government of Southern Sudan in 2006, on average only 6% of households use sanitary means of excreta disposal (including flush or pour flush to a piped sewerage system, septic tank, latrine, ventilated improved pit latrine, pit latrine with slab, and composting toilet) in Southern Sudan. Most of the remaining households use either a pit latrine without slab or practice open defecation. There is no accurate data available for Juba City and its surrounding. However, it is reported that in the State of Central Equatoria, about 14% of households are likely to use sanitary means of excreta disposal.

10.1 Existing Conditions of Wastewater Disposal and Management

In Juba, in the existing condition, the provision of wastewater collection, treatment, and disposal facilities is very poor. The entire Juba town and its surrounding are unsewered except two areas that are connected to very small sewerage systems. One of the sewerage systems is for government offices at the Ministerial Complex and consists of internal plumbing and drainage to external manholes (Figure 10.1). It has been reported that it is connected to sewers of a total length of about 2.3 km and diameter 100 and 150 mm, finally discharging into a stabilization pond for treatment. This network was established in 1974 and operated until 1984 and thereafter had not been functional for more than twenty years. However, under the MDTF project, this network has been rehabilitated and made functional. The collected wastewater in this network is conveyed through gravity to the waste stabilization pond (WSP) that is composed of anaerobic pond, facultative pond, and maturation pond. This WSP is reported to have a very small capacity. The treated effluent from these ponds is discharged into a natural stream in Gabat which finally discharges into the Bahr el-Jebel.

The other sewerage system was established in 1972 and had been operated until 1983. This sewerage system is reported to collect wastewater from 90 Ministerial houses and consists of about 2.8 km sewers (with diameters 100 mm, 150 mm, and 200 mm) and the treatment facility (Figure 10.2) The treatment facility comprises one train of stabilization ponds including anaerobic, facultative, and maturation ponds, and has a very small treatment capacity. After 1983, for more than twenty years, this sewerage system was not in use. To make it functional, rehabilitation works have been carried out under MDTF project, and it is understood that this network is operational now. The treated effluent from this WSP is also discharged into the natural stream in Gabat which finally drains into the Bahr el-Jebel.

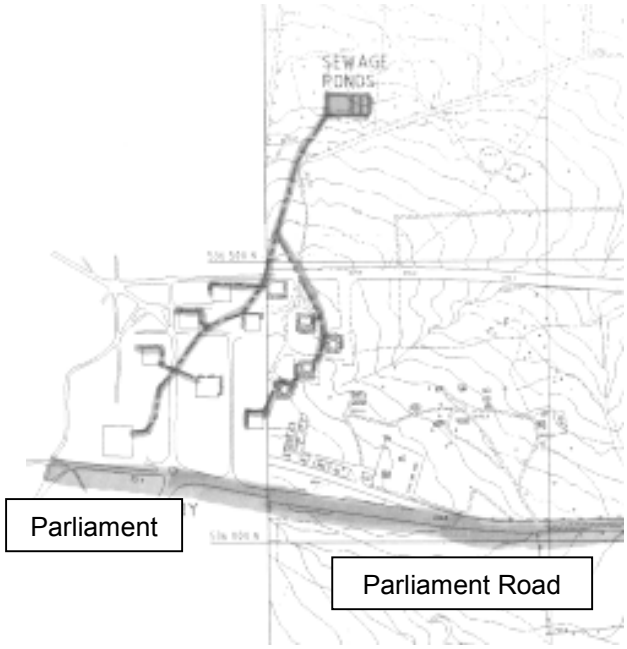


Figure 10.1 Sewerage Network for Ministerial Complex

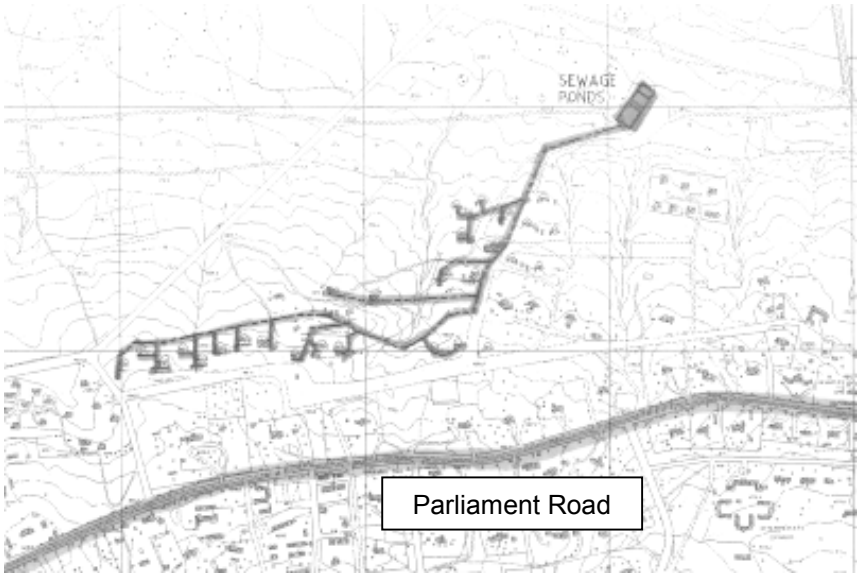


Figure 10.2 Sewerage Network for Ministerial Houses

It is important to emphasize here that in the existing condition, the water uses is not sufficient and therefore significant amount of wastewater is not generated from domestic uses. As a consequence, the discharges from houses are observed only at few locations normally along the roads, or in the form of natural drains. However, with the improvement in water supply system, it is anticipated that the amount of water uses for domestic and other purposes will increase significantly and subsequently will result into increased wastewater generation. This will lead to wastewater logging along the roads

and in natural drains and finally all the wastewater will contribute to pollution of the Bahr el-Jebel. If the provisions are not developed for the collection and treatment of generated wastewater in future, it is going to deteriorate water environment and result into poor sanitary and living condition in many areas of Juba and its surroundings.

In terms of the sanitation facilities, hotels, government offices, and state government departments have their own latrines. Many of the households use pits (about 1.5-2.0 m deep) without slabs for defecation and when the pits get filled up, it is covered with soil and new pit is dug for further use. Most of the households in IDPs areas still do not own toilet facilities and open defecation is commonly practiced.

The human waste stored in the latrine tanks is collected periodically by vacuum tankers owned by several individual enterprises. It is estimated that there are around 50 vacuum tankers owned by private owners. Each tankers makes 2-3 rounds to the disposal site every day and charges about SDG 150-200 for one tanker of sullage withdrawal. The collected human waste is disposed off in the field on the south side of Mt. Jebel Körök without any regulation. The wastewater dumping area is located along the Juba-Yei main road in the south of the road (Picture 10.1). The distance from the Parliament roundabout to the dumping area is far and it takes about one hour for these tankers to reach the disposal site through the Yei Road.

Picture 10.1 Different Views of Disposal Site Located on South of Juba-Yei Road

Based on the discussion with official of MWRI, there is also a plan to procure 3 vacuum tankers to be used by the Public Health Department of the Commissioner's House that could be utilized for emptying filled up septic tanks and disposing into Waste Stabilization Ponds newly constructed at Roton expected to be commissioned by the end of this year.

The location at which the vacuum tankers dispose off their collected sullage is situated in the catchment area of the Khor Ramla River, which is a small tributary of the Bahr el-Jebel. It is possible

that during rainy season, the runoff from this location could carry pathogens finally to the river. The river being a major source of water uses for domestic and other purposes, this could have a hazardous impact on health and sanitation of people in Juba.

In future, the households that are not connected to sewers shall also discharge sullage (wastewater from kitchen/bathing and grey water from septic tanks) directly to street drains or natural streams that ultimately discharge to the river. If comprehensive plan is not prepared for the development of sewage collection and treatment system in Juba and its surroundings at this stage, pollution due to the untreated discharges to the natural streams and finally to the Bahr el-Jebel may result into severe pollution in river water and deterioration in sanitary and living conditions and subsequently will also pose negative effect on the health of residents.

At present, solid waste is just collected by private trucks and disposed of at location along the main Juba-Yei road. A little after Mt. Jebel Körök on Juba-Yei main road the place has become a dumping ground for garbage including plastic bottles, soft drink cans, metal scraps, carrier bags, etc. It may not be possible to quantify the damage done but the environmental damage and health hazard could be significant. Solid waste management is equally important for sound functioning of the wastewater collection networks. In case when the storm water and domestic wastewater is collected through combined sewerage system, after the rain normally, solid waste would enter the sewerage system and result into difficult operation of sewage pumps and treatment facilities. Therefore, it is important to prepare comprehensive plan towards proper management of solid waste collection and disposal.

10.2 Future Wastewater Discharge

In Juba and its surroundings, the estimated population of 406,000 in 2009 is expected to increase to 680,000 in 2015, and is projected to increase almost threefold to 1.161 million by 2025. Growing population will result into increased water demand. In case of improvement in water supply services, there will be an increase in water uses and consequently an increase in wastewater generation is expected. As described earlier, in the existing condition, there is very small coverage for wastewater collection and treatment, just to cater to the needs of the ministerial complexes and ministerial houses. Also, the capacity of existing networks in terms of wastewater collection and treatment is very small. Therefore, it would not be possible to handle the increased amount of wastewater using the existing sewerage systems. A rough estimate of wastewater generation is presented in the Table below. The return ratios as wastewater are assumed to increase as the projected per capita consumption is increased.

Table 10.1 Estimated Amount of Wastewater Generation

Years	Population	Average daily water demand (m^3/d)	Net average daily water demand (m^3/d)	Return ratio	Estimated amount of wastewater generation (m^3/d)
2015	680,000	57,500	46,000	0.6	27,600
2020	910,000	111,100	88,900	0.7	62,200
2025	1,161,000	196,000	156,800	0.8	125,400

Note: Net average daily water consumption is estimated by deducting leakage amount from water demand.

Based on the above estimates, it is expected that generated wastewater will be about 27,600 m^3/d in 2015. The amount of wastewater generated in 2020 and 2025 is estimated as 62,200 and 125,400 m^3/d. As of now, there is no plan to develop any sewerage system except the two existing very small networks. If additional sewerage system is not planned and established in Juba, in year 2015, about 27,600 m^3 of sewage will be discharged untreated into the Bahr el-Jebel.

With the rapid economic growth in Juba and its surrounding, it is expected that industrial developments would also occur. The industrial effluent discharges shall further add to the pollution loads discharged into the river. It is expected that with development in due course of time, several cattle farm might be established for human consumption. The discharges from high population of livestock are also significant in terms of BOD loads. Consequently, every day significant amount of BOD loads will be discharged into the Bahr el-Jebel, if collection and treatment facilities are not planned and constructed in time. This will result into rapid deterioration in river water quality and poor sanitary and living environment. In past, the outbreak of cholera has been reported and about one thousand people were infected and 35 persons died of it. Considering the fact that, still a large ratio of population is using untreated river water for domestic purposes, it is inevitable to pay attention towards improvement of sewerage and sanitation services in Juba and its surroundings.

10.3 Recommendations on Wastewater Management

Preparation of Comprehensive Master Plan

Upon improvement in water supply condition and provision of improved water supply systems, water uses is expected to increase and thereby the wastewater generation will also increase. The existing sewerage facilities are not sufficient for generated amount of wastewater in Juba and it surrounding and it would not be able to handle generated wastewater in future also. Therefore, it is recommended to plan towards establishment of new sewerage system for proper sewage collection, treatment and

safe disposal.

The generated amount of wastewater presented in this Study is just the estimated ones. Therefore, it would be advisable to initially prepare a comprehensive master plan in order to estimate more accurate figure on generated wastewater and pollution loads from various sources such as domestic discharges, cattle farms, industries, etc. Considering the total actual wastewater generation and pollution load estimates for future, it is recommended to design wastewater collection and treatment facilities. The development of facilities should be planned in phases, considering the minimum requirements. A comprehensive Master Plan could include, but not limited to, the following main points:

1. Assessment of Existing Wastewater Systems
2. Population Projections
3. Water Supply - Present and Future
4. Sewerage Planning Framework
    a. Planning Horizon
    b. Planning Capacity
    c. Level of Services
    d. Sewer Service Areas and Populations
    e. Wastewater Return Factor and Per Capita Contribution
    f. Total Wastewater Quantity
5. Wastewater Treatment Plant Design
    a. Wastewater Characteristics
    b. Treated Effluent Quality Standards
    c. Effluent Discharge Alternatives
    d. Choice of Treatment Technology
6. Sewerage Networks Design
    a. Sewer Design Criteria
    b. Network Alternatives
7. Evaluation of Alternatives
    a. Qualitative comparison
    b. Selection of Treatment Process
    c. Cost comparison
8. Proposed Master Plan
    a. WWTP
    b. Trunk Sewers
    c. Branch Sewers
9. Implementation Strategy and Phasing
    a. WWTP
    b. Sewers
    c. Priority Projects
    d. Implementation Schedule
10. Cost Estimates
    a. Capital cost estimates
    b. Annual O & M Costs
    c. Implementation and Cost Schedule
11. Initial Environmental Examination

<u>Laws and Regulations</u>

The formulation and establishment of laws and regulations is equally important for monitoring air and water quality. There is Environmental Protection Act (2001) practiced for the case of Sudan. However,

there is no specific laws and regulation in case of Southern Sudan for regulating safe handling and disposal of sewerage and solid wastes. It is essential to formulate and establish Environmental Protection Act including such laws and regulations for conservation of air, water and land environments.

It seems the Effluent Discharge Standard is in the process of formulation and still in draft stage. Effluent discharge standards should be specified with reference to the type of industry, process or operations and in relation to the receiving environment or water body such as inland surface water, sewers, land or sea. The standards vary depending on the nature of the receiving environment or water body. For instance the limits imposed for discharge into inland water bodies are most stringent followed by those specified for discharge onto land for irrigation, and then marine outfalls. The most relaxed standards are specified for discharge into public sewers that are leading to a sewage treatment plant. Upon the establishment of effluent discharge standards, monitoring should be carried out for discharges from major pollution contributors including industries, commercial buildings, big cattle farms, etc.

Institutional

The Ministry of Water Resources and Irrigation (MWRI) is the lead organization in the water sector for policy and planning. However, sewerage service planning in urban centers is still under the responsibility of the Ministry of Housing, Physical Planning and Environment (MHPP&E). The MHPP&E also shares responsibilities for sanitation with the Ministry of Health such as health promotion and emergency interventions. It has been reported that MWRI would like to take responsibility for both sewerage and sanitation sectors. However, decision has not been taken by the Government yet in this direction. The inconsistencies in the institutional set up and the lack of coordination influence the performance of sanitation and hygiene subsector. It would be desirable to combine institutional responsibilities for water supply with those of sanitation at the policy and operational level for effective planning, operation, and management.

Until the full responsibility of sewerage sector is transferred to the MWRI, the allocation of responsibilities for urban and rural sanitation between MWRI, MHPP&E and MoH and the Council should be clearly defined.

Public Awareness

To mitigate negative impact of increase of wastewater generation and discharge, reduction of water supply amount or per capita consumption use is a measure to be considered. This measure will reduce wastewater generation and thus reduce negative impact of wastewater. It also contributes to reduce the capacity of sewerage system or investment cost for sewerage system development.

Reduction of water use requires mainly public awareness on water conservation or demand management measures or it can be said simply to use water wisely at home and in working places. Water demand management measures shall start on completion of universal installation of micro (customer) and macro (supply) meters, which is a basic requirement and the first thing to be completed by UWC. Others include pricing, retrofit program (diffusion of low water flow fixtures) and water recycles at home and in industry, and education and information activities.

Target and Priority

It is reported that the challenging target of MDG for environmental issues focuses on 58% of the population in Southern Sudan having access to improved sanitation in 2015, and it focuses on 82% of the population in North Sudan. Considering the population growth and economical and strategic importance of Juba, it would be advisable to consider initially 60% of population as target for sewerage and sanitation services by 2015 and should be increased to 80% by 2025.

It is evident that sanitation and hygiene development projects have not been given high priority during the recovery period. In the past years, higher attention has been paid to the immediate needs in the water supply subsector. To conserve water quality in water bodies and to provide better living conditions to the residents in Juba, it is inevitable to plan towards development and establishment of proper sewerage collection and treatment system for improved sanitary and living conditions in Juba and its surroundings.

CHAPTER 11 CONCLUSIONS AND RECOMMENDATIONS

The Water Supply Master Plan for the Juba urban area targeting the year 2025 has been formulated and the conclusions and recommendations on the Master Plan are given as follows:

11.1 Conclusions

1. The planning area or the Target Service Area of the Master Plan is composed of Juba urban areas including Juba Town Payam, Kator Payam, Munuki Payam, Gumbo and Lologo in Rejaf Payam and Gudele in Northern Bari.

2. The current estimated population in the Target Service Area is 406,000 in 2009 and the future population in 2025 is projected as 1,160,000. The target of the Master Plan is that all population can access safe and clean water supply by means of house connection, public taps/kiosk or water tanker by 2025.

3. It is concluded that the groundwater in Tokiman Paleochannel is not a feasible source as water supply for the Juba urban area in terms of water quality and quantity. On the other hand, it is confirmed that the surface water of the Bahr el-Jebel is a feasible source considering long-term perspectives. Therefore, the Bahr el-Jebel is selected as water supply source for the Juba urban area.

4. The current treatment capacity is 7,200 m^3/d. The projected total water demand and the proposed treatment capacity in 2025 are planned as 237,000 m^3/d.

5. The major components of the Master Plan project are as follows:
   - Expansion of existing water treatment plant (7,000 m^3/d)
   - Construction of a water treatment plant in the west bank (189,000 m^3/d)
   - Construction of a water treatment plant in the east bank (34,000 m^3/d)
   - Construction of 4 service reservoirs (16,000 m^3, 24,000 m^3, 16,000 m^3, and 10,000 m^3)
   - Construction of transmission pipelines (27 km)
   - Construction of 2 transmission pump stations (48,000 m^3/d x 40 m head and 48,000 m^3/d x 50 m head)
   - Replacement and expansion of distribution network (1,252 km)

6. The following management policies are proposed for Urban Water Corporation (UWC) to be financially and technically sound organization.
   - To be self-sustaining organization with autonomy

- To concentrate and unify the decision making system
- To improve work efficiency
- To enhance fund-raising capacity

7. Management targets are proposed as follows:
   - Staff efficiency improvement defined as staff number per 1,000 connections
   - Redefining of business units of UWC for seeking internal profit responsibility
   - Establishment of customer service office to improve customer services
   - Involvement of the private sectors including water kiosk management and private water venders

8. Operation and maintenance plan including work process flow, record keeping formats and reporting system is formulated in the Master Plan.

9. Non-revenue water (NRW) control plan is formulated to increase revenue and improve efficiency of water supply services. The ratio of NRW is projected to be reduced to 28% in 2025 from the current estimated high ratio (60 %).

10. The capacity of all staff levels in UWC including administration, policy making, management, and workers have been identified as very weak. An action plan of capacity development for the year 2025 is proposed to improve management policy, management base and technical knowledge and skills by target group.

11. The construction cost up to 2025 is estimated at 278.6 million USD, project cost including administration and engineering and physical contingency is estimated at 343.3 million USD, and the total fund requirement including price contingency is estimated at 467.4 million USD.

12. The annual operation and maintenance cost in 2009 is 545,300 USD with the estimated unit cost of per revenue water at 0.64 USD/m^3. The current cost does not include personnel costs, which is currently paid by GOSS. The annual operation and maintenance cost in 2025 is estimated as 21,804,000 USD with the estimated unit cost per revenue water at 0.42 USD/m^3.

13. New water tariff is proposed in consideration of affordability of customers, sustainability of waterworks and fairness among customers. As a result, increased block tariff with base tariff by customer category is proposed.

14. Financial internal rate of returns (FIRR) of the Master Plan project resulted in 10.52 %. The breakeven point in a profit and loss projection will be in 2015. The entire operation and maintenance costs and all or a part of depreciation can be covered by water revenue through the

project period. The proposed water tariff would be acceptable from the viewpoint of affordability. Consequently, it is judged that the project is financially viable.

15. As a result of an initial environmental examination (IEE), two major impacts were identified; land acquisition and increased wastewater due to increase of water supply.
    - Land acquisition for the proposed facilities is the most concerned issue from social view point, although it is not likely to cause serious impact, as all proposed sites are not involved with resettlement.
    - Increase of wastewater discharge to the living and natural environment may cause water pollution and deterioration of living environment, which may be the most significant negative possible impact of the implementation of the Master Plan.

16. Two pilot projects; water management committee and school latrine and compost gardening projects, were carried out in Munuki Payam. In the projects evaluation, it is understood that management of public tap stands by forming a community based organization was a difficult task, but business based management is probably more suitable in the urban settlements like Munuki. School latrines were constructed and the use of the latrines was just initiated, but the gardening has not yet started. Simultaneously, hygiene education was carried out in the Study, forming a school WASH club.

17. The Master Plan contributes to eight goals in the Millennium Development Goals (MDGs) of Southern Sudan; i.e., eradicate extreme poverty and hunger, achieve universal primary education, promote gender equality and empower women, reduce child mortality, improve maternal health, combat HIV/AIDS, malaria and other diseases, ensure environmental sustainability, and develop a global partnership for development, directly and indirectly.

11.2 Recommendations

1. Capacity development is identified as significantly important for Urban Water Corporation. To implement the proposed capacity development plan effectively, foreign technical cooperation should be invited. In training of the staff, also, training resources in Khartoum or neighboring countries such as Kenya and Uganda that have similar background and experiences on the improvement of water supply sector should be utilized.

2. Fund procurement will be one of the most critical issues to realize the project. The Government of Southern Sudan should seek for funding source. Practically, soft loan offered by external official funds is most preferred. To encourage financing, basic requirements such as financial statements according to International Accounting Standard should be prepared along with sound financial and technical conditions. In addition, external private fund should be considered as the

second option.

3. Preparation of wastewater management plan and its implementation is required to mitigate the impact of increased water supply volume. The acquisition process of the land for the proposed facilities sites should be followed immediately after the Study.

4. Both Munuki pilot projects have been just initiated by the Study Team. Further supports are required for both Munuki pilot projects to be a successful model.