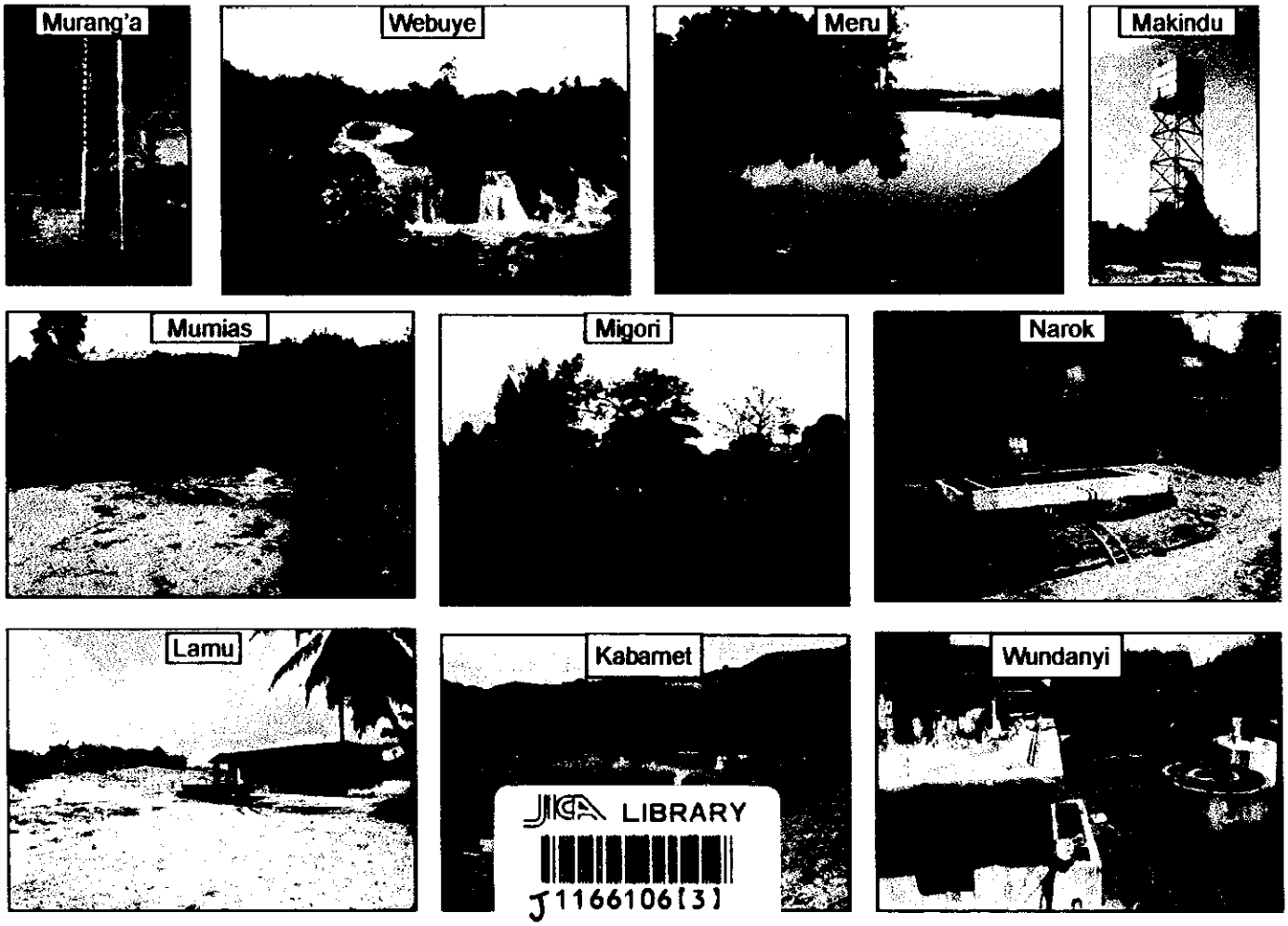
JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF KENYA

MINISTRY OF ENVIRONMENT AND NATURAL RESOURCES

THE STUDY ON INSTITUTIONAL IMPROVEMENT AND REHABILITATION OF WATER SUPPLY SYSTEMS FOR 10 LOCAL TOWNS IN THE REPUBLIC OF KENYA

No.1



FINAL REPORT

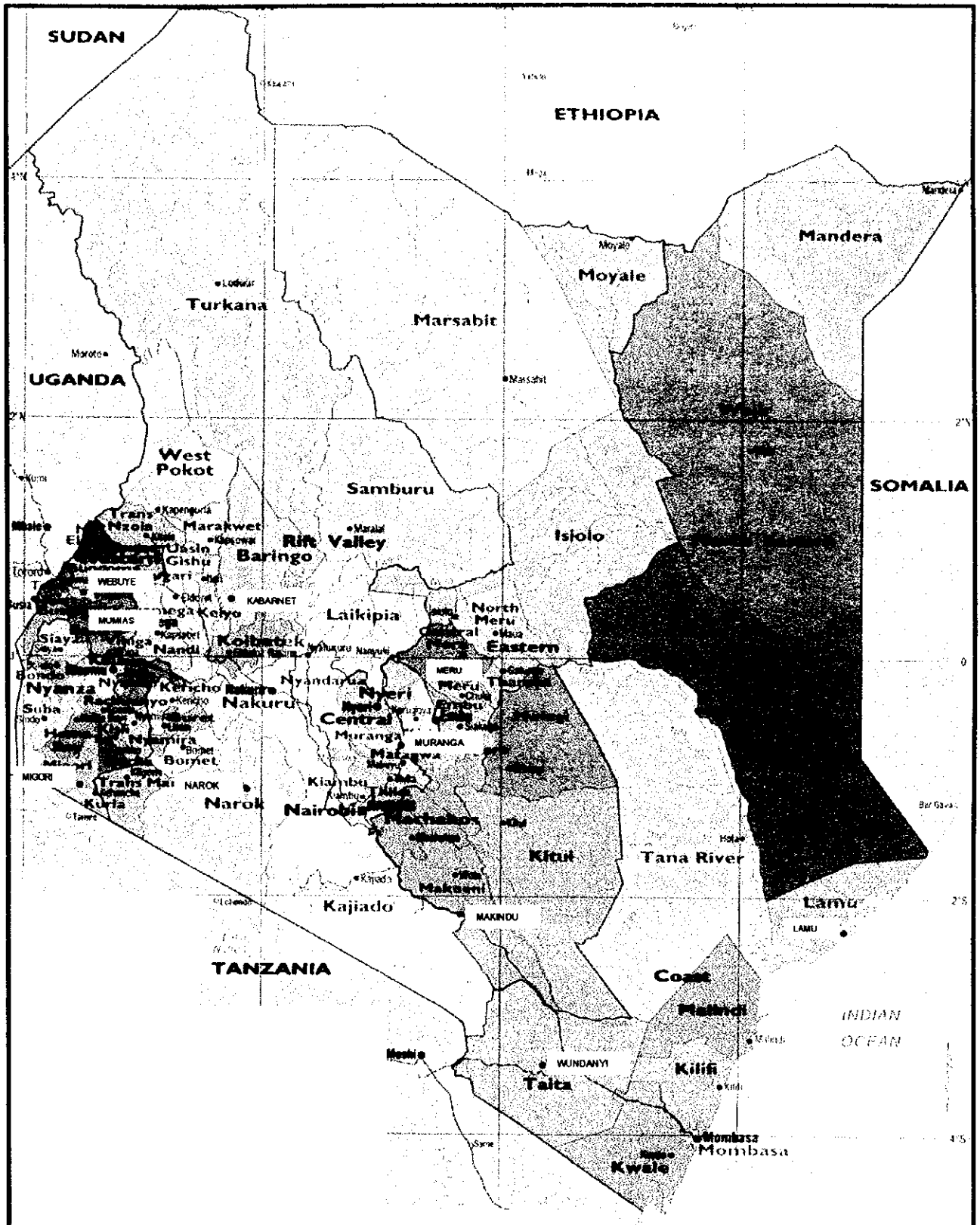
Volume 2H : Main Report (including Appendices) - Lamu Town

FEBRUARY 2001

Development Impact Consulting

Engineering and Utility Management Ltd.

Gibb Eastern Africa Ltd.



TEN TOWNS WATER & SANITATION STUDY

TOWNS LOCATION MAP

DIC Development Impact Consulting

EU

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LAMU WATER SUPPLY

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LIST OF ABBREVIATIONS

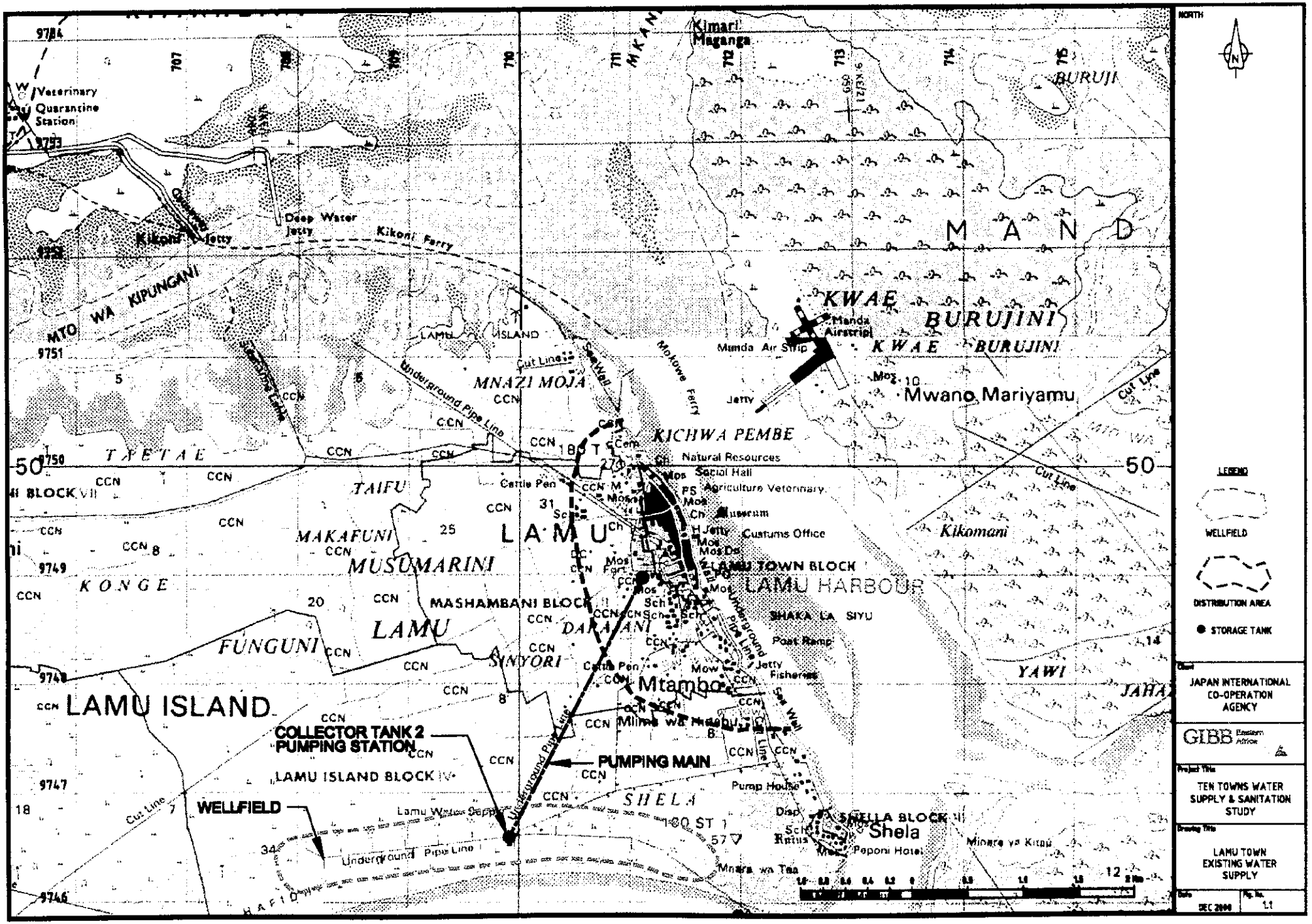
AC	Asbestos Cement (Pipe)
AFW	Accounted for water
AG	Attorney General
AIDS	Acquired Immune Deficiency Syndrome
AIE	Authority to Incur Expenditure
AMREF	African Medical Research Foundation
ASK	Agricultural Society of Kenya
ATP	Ability to Pay
bgl	Below ground level
BH	Borehole
BOT	Board of Trustees
BPT	Break Pressure Tank
CBD	Central Business District
CBR	Cost Benefit Ratio
CIM	Centre for International Migration
CMT	Core Management Team
CTB	Central Tender Board
CV	Contingent Valuation
CWS	Community Water Supplies
DAF	Daily Average Flow
DCO	District Commissioner's Office
DDC	District Development Committee

DWD	Department of Water Development
Dia	Diameter
DTO	District Treasury Office
DWE	District Water Engineer
DWF	Dry Weather Flow
DWO	District Water Office(r)
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ENEP	El-Nino Emergency Project
FIRR	Financial Internal Rate of Return
FY	Financial Year
GAA	German Agro Action
GI	Galvanized Iron
GoK	Government of Kenya
Gph	Gallons per hour
GPS	Global Positioning System
GTZ	German Technical Assistance
H	Head
Ha	Hectares
HO	Head Office
HQ	Headquarters
IEE	Initial Environmental Examination
ITCZ	Inter-tropical Convergence Zone

JICA	Japan International Cooperation Agency
KEFINCO	Kenya-Finland Co-operation
KEWI	Kenya Water Institute
Km	Kilometer
Km^2	Square Kilometers
KP&LC	Kenya Power and Lighting Company
KR	Kenya Railways
Kshs	Kenya Shillings
L	litre
LA's	Local Authorities
L/c/d	Litres per capita per day
LPO	Local Purchasing Order
L/sec	Litres per second
M^3/day	Cubic meters per day
M^3/hr	Cubic meters per hour
MENR	Ministry of Environment and Natural Resources
MoLG	Ministry of Local Government
MTB	Ministerial Tender Board
MW	Mega-watts
NAWARD	National Water Resources Database
NEAP	National Environment Action Plan
NEMA	National Environmental Management Authority
NGO	Non-Governmental Organisation

NPV	Net Present Value
NTU	Nephelometric Turbidity Units
NWC&PC	National Water Conservation and Pipeline Corporation
NWMP	National Water Master Plan
ODA	Official Development Assistance
O&M	Operation and Maintenance
PE	Polyethylene Pipe
PSP	Private Sector Participation
PVC	Polyvinyl Chloride
PWO	Provincial Water Office(r)
Q	Discharge
RDF	Rural Development Fund
RER	Revenue Expenditure Ratio
RGS	River Gauging Station
RHS	Random Households Survey
SIDA	Swedish International Development Agency
SS	Subordinate Staff
STD	Subscriber Trunk Dialing
STW	Sewage Treatment Works
TDS	Total Dissolved Solids
ToT	Training of Trainers
T-Works	Treatment Works
UFW	Unaccounted for water

UNICEF	United Nations Children's Fund
WHO	World Health Organization
WMS	Welfare Monitoring Survey
WRAP	Water Resources Assessment Project
WS	Water System
WSS	Water Supply System
WTP	Water Treatment Plant


COLLECTOR TANK 2
PUMPING STATION
PUMPING MAIN
WELLFIELD
LAMU ISLAND
LAMU
MANDA
KWAE BURUJINI
MWANO MARIYAMU
KICHWA PEMBE
MNAZI MOJA
TAIFU
MAKAFUNI
MUSUMARINI
KONGE
FUNGUNI
SINYORI
DARAJANI
MASHAMBANI BLOCK
LAMU TOWN BLOCK
LAMU HARBOUR
SHAKA LA SIYU
SHELA
SHELLA BLOCK
LAMU ISLAND BLOCK IV
KIKOMANI
YAWI
BURUJI
MTO WA KIPUNGANI
Veterinary Quarantine Station
Kikoni Jetty
Deep Water Jetty
Kikoni Ferry
Manda Airstrip
Manda Air Strip
Jetty
Mwano Mariyamu
Natural Resources
Social Hall
Agriculture Veterinary
Museum
Customs Office
Cattle Pen
Post Ramp
Fisheries
Mtambo
Shela
Peponi Hotel
Pump House
Underground Pipe Line
Cut Line
Seawall
Mokowe Ferry
Lamu Water Supply
LEGEND
WELLFIELD
DISTRIBUTION AREA
STORAGE TANK
NORTH
JAPAN INTERNATIONAL CO-OPERATION AGENCY
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TEN TOWNS WATER SUPPLY & SANITATION STUDY
LAMU TOWN EXISTING WATER SUPPLY
DEC 2000
1.1

1 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Kenya's water and sanitation sector is in critically poor condition. Like in many developing countries, the sector is plagued by a series of problems. These problems have arisen because of lack of technically sound operation and maintenance practices resulting in a backlog in rehabilitation, and above all, poor utility management. The existing institutional framework and organizational procedures result in bottlenecks and failure to create required authority and responsibility capacity at the most beneficial levels. Lack of autonomy for the managers of water utilities at all levels is one of the key causes for sustained inferior performance.

The tremendous pressure occasioned by population increase, rural-urban migration and unplanned settlements have strained the water and sewerage schemes beyond the original design capacities.

Periodic technical and financial reviews of water services in Kenya and the Aftercare Study on Kenya's National Water Master Plan have revealed that there is need for serious re-evaluation of management of water and sanitation utilities to meet the targets of effective service delivery in support of the integrated development plans. Decentralization of decision making and management to the local levels and transferring to the private sector activities that can be carried out without compromising social, health or vital economic requirements of the population are of cardinal importance.

Against this background, the Government of Kenya recently approved the National Water Policy paving the way for legislative changes in the Laws of Kenya that touch on water activities. The changes aim at rationalizing management, decentralizing operations to the local level, creating the necessary regulatory framework and activating private sector participation in the sector, in order to obtain a more responsive management system that ensures efficient service delivery and project sustainability at the most economical cost.

JICA, one of Kenya's leading development partners, would like to help create a sustainable environment for water and sanitation service delivery systems, by supporting formulation and development of workable management arrangements in the water sector.

The Study on Institutional Improvement and Rehabilitation of Water Supply Systems for Ten Local Towns is being undertaken in order to provide Kenya with feasible, viable and implementable options that are sensitive to local conditions, especially social, environmental, economic and political.

The findings, recommendations and work plans derived from this study may then be used to develop a more comprehensive framework for rehabilitation and extension of water services to meet development objectives as enshrined in the National Poverty Eradication Plan for the rest of the nation.

The use of local initiatives such as Kitale and Nakuru to investigate the potential and/or constraints for commercialization of water services within local authority setting will be a useful barometer for the future of the National Water Policy, which envisions decentralization of water activities to local authorities in urban areas. Malindi, which is under a partnership between the National Water Conservation and Pipeline Corporation and Gauff Utility Services, will provide another alternative for comparison of performance and benchmarking.

1.2 OBJECTIVES OF THE STUDY

The objectives of the study are:

(1) To obtain the baseline information regarding the water supply systems for the ten local towns;

(2) To recommend the institutional arrangement for effective water service delivery and rehabilitation plan of the relevant facilities in the project areas;

(3) To give advice on the application of the recommendation to the other areas in the Republic of Kenya.

1.3 SCOPE OF THE STUDY

The fundamental philosophy of this study hinges on the fact that without appropriate intervention in the water supply and sanitation sector, no major improvements in service delivery will be realized. This study focuses on ten (10) towns in the Republic of Kenya namely: Meru, Lamu, Kabarnet, Webuye, Mumias, Migori, Narok, Muranga, Makindu, and Wundanyi as a pilot programme of implementing the desirable interventions which will serve as a show case for replication in the rest of the country.

The interventions entail three main components, which must go hand in hand:

(1) To restore the water supply and sanitation facility to its original technical and functional capacity by undertaking the necessary physical rehabilitation.

(2) To put in place an appropriate institution to run the water supply and sanitation facility. This institution should be more responsive to the needs of, and directly answerable to the consumers. The institution should have the legal backing and formed in line with the current National Water Policy, which advocates active private sector participation in the water sector for more efficient service delivery.

(3) To put in place an appropriate technical team of operators, with the necessary skills and equipment and tools to take over the day to day operation and maintenance of the rehabilitated facility. It is envisaged that a team starting with an efficiently functioning facility free of major repairs and replacements, and with a good management backing,

stands a better chance of achieving a self-sustaining facility within a reasonable time span.

In order to achieve the foregoing intervention goals and the overall project objectives, the study entails a two-phase strategy for collecting the relevant data and information: a Preliminary and a Pre-feasibility phase.

The preliminary study covers review of relevant data and information, diagnostic survey of existing water supply and sanitation facilities, water demand projection, revision of water supply facility plan, cost estimation and evaluation, identification of the laws and regulations of environmental impact assessment, legal and regulatory framework on facility performance. It entails basic data collection, field reconnaissance and field inspection of the utilities to assess the current condition and situation of the water supply and sanitation schemes.

The pre-feasibility study phase covers establishing the socio-economic characteristics of the study area, assessment of surface water and groundwater potential, identification of institutional and legal constrains that affect improvement in operations of water facilities and determination of viable financial and commercial plans that ensure long-term sustainability of the facilities.

The pre-feasibility phase includes review of existing data, evaluation of the technical, socio-economic, institutional and financial aspects, formulation of water supply and sanitation facility rehabilitation plans, and formulation of preliminary technical and institutional development plans on which recommendations will be based.

In addition to the ten towns that constitute the pilot programme, operational experiences have been obtained from the towns which have been undergoing the commercialization approach, promoted by GTZ, i.e. Malindi, Kitale and Nakuru, for comparison purposes. The year 2010 has been chosen as a planning horizon.

1.4 COMPOSITION OF THE FINAL REPORT

The final report comprises of a total of two volumes as follows:

Volume 1: Executive Summary
Volume 2: Main Report

As indicated by their titles, Volume 1 is a summary of the study while Volume 2 is a presentation of the full town report including supporting and back-up data.

2 EXISTING PHYSICAL AND SOCIO-ECONOMIC CONDITIONS

2.1 GEOGRAPHY OF THE STUDY AREA

Location and climate are described hereunder in Section 2.3.2(b).

2.1.1 General

Lamu town is the oldest settlement in Kenya and is situated on the east side of Lamu island. Lamu island along with Pate and Manda islands make up the Lamu Archipelago some 100 km south west of the Kenya/Somalia border and approximately 350 km north east of Mombasa.

Lamu town is the headquarters of Lamu District, one of the 6 administrative divisions of Kenya's Coast Province. Lamu town is important as a regional centre and is a popular tourist destination.

Lamu is famous for its fine examples of Swahili architecture and archaeological remains.

2.2 INFRASTRUCTURE

2.2.1 Roads

Lamu town is a pedestrian area, the streets being too narrow for any form of vehicular traffic, The preferred mode of transport is by bicycle or donkey. There are very few vehicles - the District Commissioner and the District Water Officer have 4 wheel drive vehicles for official purposes. Roads are mostly sand tracks.

2.2.2 Logistics

Lamu town is only accessible from the sea, either by dhow or motor boat ferry. There is an airstrip on Manda island and visitors are ferried across to Lamu.

2.2.3 Health

A district hospital is located in Lamu.

2.2.4 Education

There are a number of Muslim and non-Muslim primary and secondary schools.

2.3 SOCIO-ECONOMIC CONDITIONS

2.3.1 Administration

Lamu is a cosmopolitan town situated on an island in Lamu district in the Coastal province of Kenya It is the administrative headquarters of Lamu district and its Central Business District (CBD) houses offices of the district commissioner, other district departmental heads, county council as well as offices of major parastatals. It lies in Amu division and is divided into four locations and six sub locations. (See appendix H 1-1 in appendices for a map of the town). This forms a major business and economic convergence bloc as rural populations come to seek essential services such as hospitals and administrative matters in the town.

2.3.2 Population structure and distribution

Based on the 1999 housing and population census, the population of Lamu town was 12959[1] people as at 1999. This contrasts with the 1979 and 1989 censuses where the total population in general was placed at 8394 and 8959 respectively representing an inter censal growth rate of 1.08% for 1989-1999 period compared to 0.65 in the 1979-1989 period. The marginal increment in population is attributed to the peripheral positioning of the town within the district map as well as poor communication network. The number of households increased from 2015 in 1989 to 2982 units in 1999 with a mean household size of 5.5. Urban population density (considering the CBD) was 1419 persons per km^2 in 1999. The distribution of the population and number of households on the basis of sub locations and water service area is shown in table 2.1 below.

Table 2.1 Population structure and distribution (1999)

Sub-Location	Number of households	Population in urban council	Population in service area
Mkomani	1367	5724	
Langoni	1615	7235	
Total	**2982**	**12959**	**8752**

Source: District Statistical Office Lamu, 1999 and central Bureau of Statistics,2001

2.3.3 Population projections to the year 2010

The 1989-1999 inter censal growth rate for the town based on the 1999 housing and population census aggregate results was 1.08%. The marginal increment in growth rate is in line with the national trend that shows a general decline in urban population. It is expected that the revamping of the tourism industry may have a positive impact on population growth. However, the final

[1] This excludes non-residential population but includes the special population. Special population in this regard based on the 1999 census enumeration procedures considered to include though not restricted to people in hotels/lodgings, bus stops, police cells, on transit, idlers and street urchins found within the town as at mid-night of the census enumeration day.

analysis of the 1999 population results show a general decline in inter censal growth rates in urban centres. It is expected that the population growth will remain relatively stable over the next ten years. Table 2.2 below gives a comparative trend of the population growth for the next ten years based on the water service area and overall population in the urban council using a growth rate of 1.08%.

Table 2.2 Population projection[2] to the year 2010.

Year	Population under county urban council	Existing water service area
2000	13100	
2001	13200	
2002	13400	
2003	13500	
2004	13700	
2005	13800	
2006	14000	
2007	14100	
2008	14300	
2009	14400	
2010	14600	

2.3.4 Economic and commercial activities

The main land-use patterns within the CBD are limited to business/economic activities, schools, hospitals and other health facilities, institutional offices and other essential social infrastructure such as tourist lodges. The growth of the town is closely linked to the performance of the tourism industry. Wholesale and retail businesses are fairly well established. A walk through Lamu's main street clearly confirms the vibrancy of trade and commerce. There is a notable shift from local to increasingly imported goods, mainly cheap consumer items from the Far East. Manufactured food products, second hand clothing and hardware products relating to agricultural and building activities are predominant. Around 49% of the total wholesale and retail activities in Lamu district are located on Lamu Island. The distribution of commercial activities is as shown in the table 2.3 below.

[2] Projections based on the following formula [$P_{projected} = P_{actual}(1+r)^t$] where r=rate of pop growth and t= year and the base year is the 1999 estimated population rounded off to the nearest 100.

Table 2.3 Commercial activities

Commercial activity	Existing establishment
Major Hotels	10
Retailers	218
Wholesale/Hardware	25
Small Hotels/Cafés	19
Manufacturing (Oil Millers)	1
Carpentry Workshops	26
Petroleum Dealers	5
Hawkers	45
Kiosks	21
Total	**370**

Source: Local Authority Development Plan 1999, Lamu

2.3.5 Social infrastructure

2.3.5.1 Communication

Lamu is an island connected to the mainland by use of water transport. It has motorable tracks useful only to four-wheel trucks. However, the town has an airstrip for light aircraft. Other services include subscriber trunk dialling (STD) telephone services, fax facilities, Internet service bureaux.

2.3.5.2 Social Institutions

The existing structure of social institutions is as shown in tables 2.4 and 2.5 below

Table 2.4 Educational institutions

Institution	Number
Pre primary schools	10
Primary school	12
Secondary schools	2
Youth polytechnic	4
Adult education centre	1
Total	**29**

Source: District Development Office, Lamu

Table 2.5 Other social institutions

Facility	Number
Mission Hospital	1
District Hospital	1
Health Centres	1
Dispensaries	6
Churches	12
Private Clinics	30
Slaughter house	1
Parastatals	6
Social hall	1
Total	**59**

Source: District Development Office, Lamu

2.3.6 Income levels

The distribution of income in the town is quite uneven as it reveals major disparities in household resource endowment. Wages, salaries and profits form a major income source for the urban population. According to the findings of the Welfare Monitoring Survey (WMS) II, the mean monthly household income for the town was estimated to be Kshs. 10321.3 as shown in table 2.6 below. About 61.9% of the urban households mean monthly income is drawn from wages, salaries and profits.

A random sample survey of 80 households carried out by the study team revealed that about 80% of the households interviewed earn an average income of between Kshs 5,000 and Kshs 10,000 per month. This therefore means that though the level of tariff is considered to be high, a major problem affecting consumer payments for water is the level of service. This is based on information received from the DWO.

Table 2.6 Mean monthly household incomes (Kshs).

Income source	Mean
Wages/salaries/profits	6859.1
Other Non-agriculture income	1753.1
Agriculture income	697.3
Crop income	1011.7
Total household income	**10321.3**

Source: Welfare Monitoring Survey II, 1994

2.3.7 Willingness and ability to pay for water services

2.3.7.1 Ability to pay

Ability to pay is a function of level of household incomes, the acceptable share of water/sewerage services in total expenditures, tariffs and the target consumption levels. However, the main consideration in the ability to pay in this study is the household level of income vis-a-vis consumer awareness on the benefits of taking safe and clean drinking water. It has been considered that the ceiling on the budget share of income that may be spent for water and/or sewerage services is usually taken to be 5%. This budget share normally varies from one income group to another. It is generally accepted that households in the lower income bracket spent a higher budget share of their income in real terms to access safe and clean drinking water on water than households in the middle to high-income group who spent approximately 2.2% and 1.4 % of their incomes respectively.

Considering that about 30% of the designated population of the town live in the low income bracket under very poor sanitary conditions, a re-evaluation of their income levels, W/ATA and W/ATP is integral and forms an important component of the perceived water and sanitation improvement plan.

2.3.7.2 Willingness to pay

To get information on willingness to pay[3] the study team carried out a random survey on a sample of 80 households mainly within the service area. Through questionnaire based interviews each household head was asked questions on how much they would be willing to pay for a cubic meter of water assuming improved service delivery. The general conclusion of the survey was that most households were willing to pay more for improved service delivery with the level of tariff increase depending on the perceived problem in a particular area.

The preliminary analysis of information collected indicated that over 80% of the households interviewed were willing to pay up to Kshs. 500 for actual water consumption compared to an average monthly bill of Kshs. 300. A similar survey in the areas not currently serviced established that majority of the households would be willing to pay for water at the current general water tariff of Kshs. 30/m^3. Simulations to establish the threshold tariff beyond which people would not be willing to pay revealed that even with increment of up to 30% in the tariff, people would still be willing to pay

On the basis of the above analysis therefore, willingness and ability to pay for water can be analyzed on the basis of consumer expectations. Though only 78.2% of the respondents were dissatisfied with the level of water supply, all

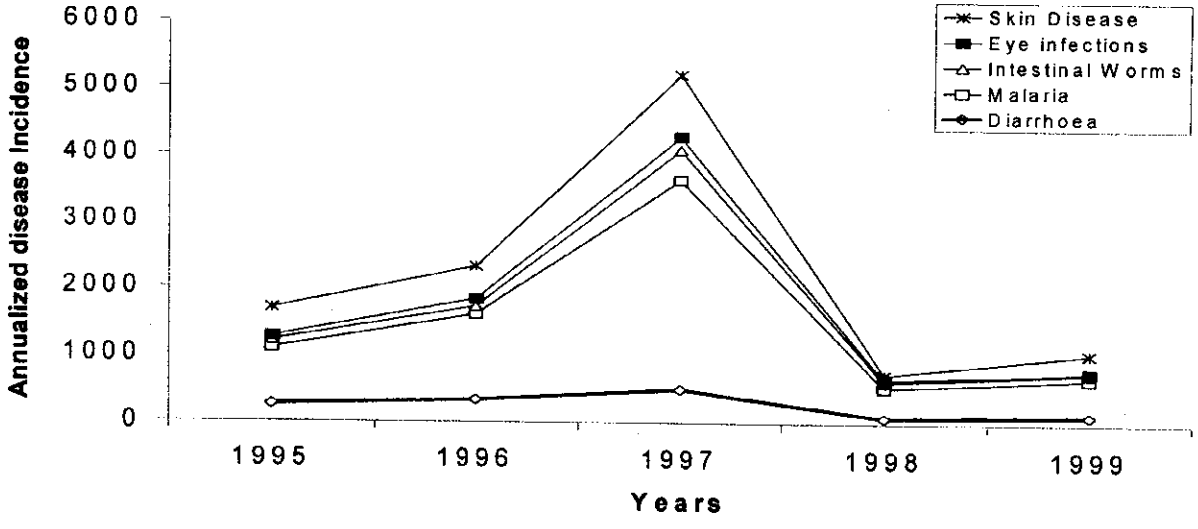
[3] The appropriate methodology in estimating willingness and ability to pay (W/ATP)/ willingness and ability to accept (W/ATA) is to use the contingent valuation (CV) approach. This approach is validated through asking water consumers at the household level hypothetical questions (which are a true reflection of actual water consumption levels) how much they are paying for water as compared to how much they would be WTP if existing water supply externalities are internalized.

(100%) were willing to pay an average of Kshs. 286 for an improved water service. Of this 63.6% were willing to pay more than Kshs. 360. only 3.6% were willing to pay less than Kshs.100. Therefore from this analysis, if farmers expectations are met, payment for clean water doesn't seem to be a problem.

2.3.8 Health and sanitation situation

The general health and sanitation conditions were analyzed and information on disease situation and use of sanitary facilities collected. Though Lamu has no conventional sewage system, dry pit latrines are the traditional form of sewage disposal. Filled pits are emptied by digging new pits along the alleys and emptying the sludge from the latrines to these alley-pits. Open drains carry rainwater and wastewater down to the harbour. There is no formal garbage collection and disposal system in place, rubbish accumulates in the drains whereby wastewater stagnates, thus breeding disease. Access to health services in Lamu is poor. Though this may be defined on the basis of both the high cost of medication and inaccessibility (due to poor roads and the unreliability of sea transport on which majority of the residents rely to seek medical attention), it may also be attributed to people's health seeking behaviour, which is drastically changing. Access to clean water is limited due to poor sanitation and high levels of water salinity. In general, the pattern of water borne and water related diseases is shown in chart I below.

Chart 1: Incidence of water Related diseases in Lamu Town



Source: Health Information Unit, Ministry of health and PHO, Lamu 2001

2.3.9 Types of settlements

Lamu town is divided, though not physically, into three main parts: the old stone town (Mkomani), the new town (Langoni) and the mud and thatch section (Gardeni). These sections are themselves divided into smaller units called "mitaa" or wards. The town has a current population of around 14,000 of

which 50% reside in new expansion areas out with the original stone town. The average population density in the town is around 350 people per hectare rising to over 600 p/h in the more overcrowded areas such as Langoni. A lack of available developable land has driven the population to increasingly marginalized sites on the boundaries of the original town. In these newer areas such as Langoni, Gardeni and Kashmiri, planning is non-existent. This is compounded by the fact that most of these parcels are on private land, and the Government has not demanded the planning of such land.

Table 2.7 Distribution of income based on broad income categories

Income category	Number	Percentage
High income	649	5
Middle income	8423	65
Low income	3887	30
Total	**12959**	**100**

2.3.10 Situation of women in society

Women make up a disproportionately large share of the poor and very poor in urban areas as they are particularly vulnerable to many factors that create and perpetuate poverty. Most families whether poor or not may not be able to survive without the help of female family members. However, for the urban population of Lamu town, water collection remains a preserve of women and only forms one of their major social roles among many other economic activities within the household. Therefore, women in Lamu town like other parts of Kenya are traditionally responsible for collecting water for domestic use in the household. They are conceivably one of the most abused groups with regard to water collection habits making them a major vulnerable group in society. Just like poverty, collecting water is a circumstance women find themselves in and which does not necessarily define them. Collecting water for the household can therefore have negative repercussions on the length and hardship of an average poor woman's working day. Despite the government pre commitment that by the year 2010, all households should have access to water within a radius of 2 kilometres, this situation is yet to be realized especially within the peri-urban areas. This therefore means that the rehabilitation exercise planned for the towns must meet societal expectations in order to ease the excess burden on the woman and an average woman's workload should be a key monitoring indicator. Other than situations where hand cats, bicycles and donkeys are used, the burden for carrying water requires women to have a substantial amount of energy. This condition is energy sapping and causes considerable stress especially to pregnant women leading to multiple complications at childbirth. Other causes of stress include headaches, backaches, sometimes and deformation of the spine. Accidents do occur and these include slipped discs, paralysis, injury to children carried on the back to extreme cases such as strangulation by the head strap. Improved water supply conditions would change all these and ease the burden on women, releasing time and energy for other development activities necessary in nation building.

2.4 EXISTING WATER RESOURCES, MANAGEMENT AND UTILISATION

2.4.1 Hydrology

There are no surface water resources available in Lamu. The source of water for the town is ground water studied here below.

2.4.2 Hydrogeology (groundwater resources)

(a) Geology

Lamu lies on Quaternary marine sediments that can be as much as 50 metres thick. Limestone deposits lie intercalated in these sediments, and may be between 20 – 30 metres thick. The sediments comprise grey or yellow-grey sand and clayey sand. Limestone deposits mainly comprise coral reefs embedded in the sedimentary deposits.

The limestones vary in permeability, from very porous coral deposits, to poor porosity in the limestone intercalated in clayey sand deposits. Dune sands are the single units with the highest permeability.

(b) Climate

Lamu Town is located at 40° 54' E, 2° 16' S at an elevation of 20 metres above sea level (masl). The town is situated on Lamu Island on the Kenyan coast and is relatively flat.

The climate in Lamu can be described as "coastal equatorial". Humidity is high, rainy seasons are pronounced, evaporation is high and monsoon winds blow. The annual rainfall is varies from 1100 mm at the coast, to 550 mm per annum inland. Temperatures peak at 36.4°C and are minimum at 19.5°C. However, the temperature window is generally between 24 and 30°C most of the year. Lamu Island has a mean annual evaporation of 2327 mm. The aridity ratio for Lamu (rainfall divided by evaporation) is 0.47, which makes it a humid area.

(c) Hydrogeological units

The most important hydrogeological unit in Lamu is the Shela Dunes. These are beach dunes of fine to coarse sand with high permeability. The second significant unit is the coral limestone beds in the Quaternary marine deposits. This section briefly considers the range of aquifer types in the area, and summarises the highest potential units. Groundwater resources constitute the most viable bulk water source for public water supply purposes in Lamu.

(i) Dune sand deposits

These as already mentioned, occur in the Shela Beach area. The dune belt is some 10 km long, extending the whole length of Lamu Bay. These deposits have the highest potential aquifers due to their high permeability. Geophysical

surveys (WRAP, 1988) have indicated that the current wellfield can be extended further along the dune-field. Yields of up to 60 m3/hr have been reported from wells sunk in this unit. Located at the shoreline as it were, the threat of saltwater intrusion limits the rate of abstraction from wells because pumping water levels should not be too high as to allow the saltwater/freshwater interface to rise, leading to pumping of brackish water.

The recharge regime still needs to be studied further, so that the maximum allowable annual abstraction from the Shela aquifer can be established.

(ii) Quaternary marine sediments

These comprise the sands with embedded coral reefs. Where the coral limestone occurs near the surface, sinkholes occur. Due to differences in porosity of the various intercalated sediments, the depth to water varies. Further, lower porosity leads to concentration of salts; the quality of water from this unit is thus poorer than from the Shela Dunes.

The sinkholes serve as recharge conduits for aquifers both in the marine sediments and the Shela dunes.

The following is a summary of the hydrogeological conditions in Lamu.

- Depth range to the main aquifer: 2 – 20 m.
- Depth range of water rest level: 5 – 20m.
- Discharge range: 1 – 60 m^3/hr.
- Water quality: fresh, alkaline calcium bicarbonate waters to brackish or saline sodium chloride waters. Salinity is occasioned by saltwater intrusion due to over-pumping. Brackish water is also found in areas with less permeable aquifers, mainly inland. The ionic concentrations of chloride, total dissolved solids and possibly iron are likely to be high.

Aquifers are unconfined, and comprise sandy sediments, and coral limestone. Recharge to the aquifers occurs by lateral underflow from recharge features such as sinkholes that occur in the area as waterholes. Local underflow from the sea also contributes to recharge if aquifers are over-pumped.

(d) Status of existing groundwater supply facilities

The town depends on shallow wells for its water supply. There are 30 no. such wells located in a single wellfield at the Shela Dunes. The wells are operated and maintained by the Water Department in Lamu Town. Of these wells, 20 no. were recently rehabilitated under the El Niño Emergency Project.

(e) Potential for groundwater development

Groundwater supply will continue to play an important role in the water supply requirements for Lamu Municipality. There is potential for expanding the area of the existing wellfield on the Shela Dunes.

3 EXISTING WATER SUPPLY CONDITIONS

Chapter 3 is a detailed assessment and diagnostic evaluation of the existing water supply system.

Chapter 4 recommends a rehabilitation plan in accordance with the terms of reference of the study.

The main features of Lamu water supply are shown schematically in Figure 3.1.

3.1 SOURCES AND INTAKES

3.1.1 Medium deep wells

Lamu is supplied with fresh water from a well field located in the sand dunes of Shela Beach some 3 km south west from the town.

The aquifer of fresh water rests on top of the lower level sea water.

There are 30 no. medium deep wells in the well field which extends for some 5 km and is approximately 5 km^2 in area.

The wells are 3 m in diameter and are between 15 and 25 m deep.

3.1.2 Low lift (raw water) pumping

Each well is equipped with a pump rated at 6 m^3/hour against a head of 25 m. The motor is 1.5 kw.

The pump is dry mounted and sits on a ledge inside the well liner some 10 m below cover level. Discharge is through a DN50 galvanised pipe into a DN100 manifold which in turn discharges into 2 no. 50 m^3 collector tanks at the main pumping station.

The pump control is pole mounted adjacent to the well and has an automatic low level cut-out to prevent over-pumping of the well which would result in the production of saline water.

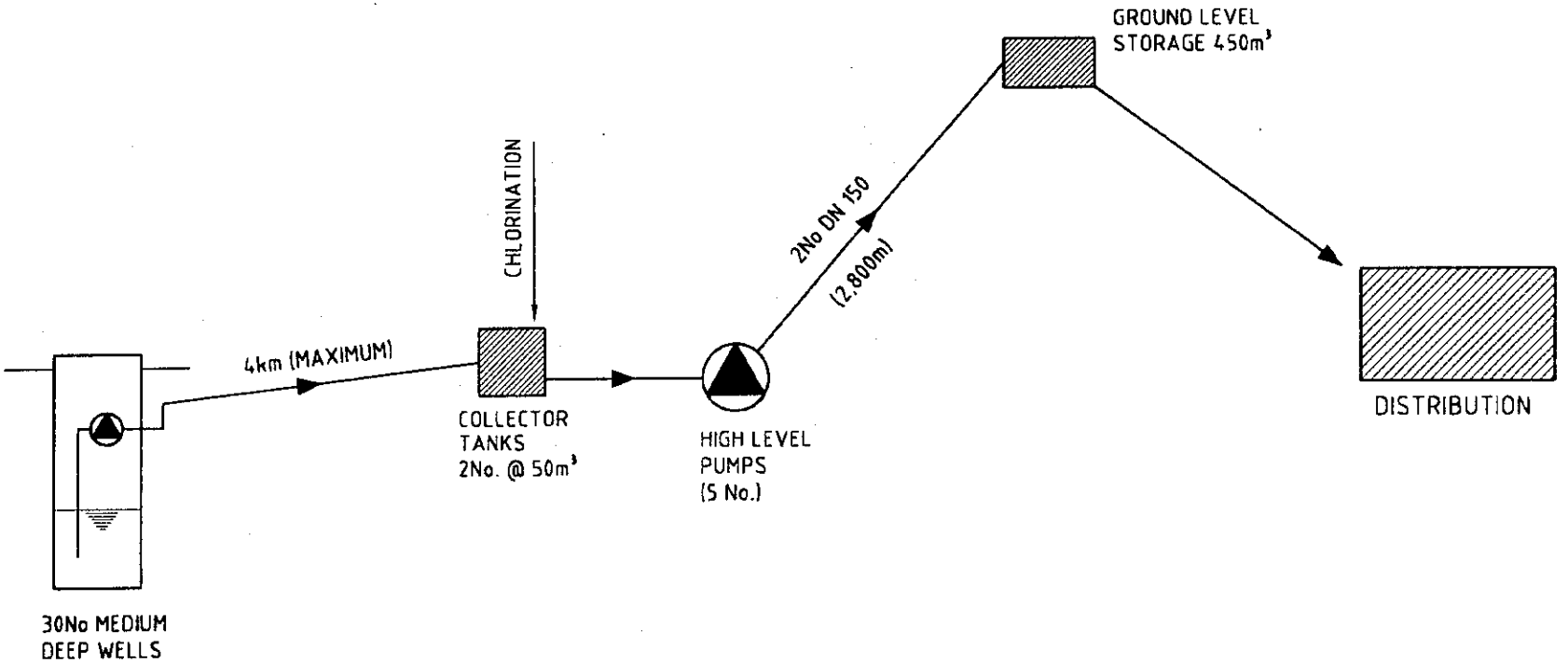
3.2 TREATMENT

3.2.1 Chemical dosing

The well water is disinfected in the 2 no. 50 m^3 collector tanks adjacent to the pumping station using sodium hypochlorite dispensed through gravity dosers.

3.2.2 High lift (treated water) pumping

Chlorinated well water is transferred by pumping to the main storage tank (capacity 450 m^3) in Lamu through 2 no. DN150 uPVC rising mains. Each of the pumping mains has a functioning bulk flow meter.



Client
JAPAN INTERNATIONAL CO-OPERATION AGENCY

GIBB Eastern Africa
LAWGIBB Group Member

Project Title
TEN TOWNS WATER SUPPLY & SANITATION STUDY

Drawing Title
LAMU WATER
EXISTING POSITION
SHEMATIC

Date
JAN 2001

Fig. No.
3.1

The storage tank is situated in the District Water Office compound.

There are 5 no. high lift pumps, 4 no. vertical centrifugal pumps in the pump hall and 1 no. submersible pump in one of the collector tanks.

- 2 no. Johnson vertical centrifugal 50 m^3/hour v 60m 40hp
- 2 no. Grundfos vertical centrifugal 20 m^3/hour v 60m 11kw
- 1 no. Grundfos submersible 20 m^3/hour v 60m 11kw

There is a pumping constraint in that the existing electrical transformer is rated 50 KVA and thus a maximum of 3 no. pumps can be run simultaneously. This restriction limits the amount of water transferred to between 1,600 and 2,000 m^3/day maximum.

3.3 DISTRIBUTION

Most of the distribution pipes in the town were laid in 1956 and are galvanised mild steel. Additions to the network have been made in AC and recently, under the El Nino Rehabilitation Project, some 5,000m of small diameter uPVC pipes have been laid.

Figure 3.2 shows a plan of Lamu indicating the position of the existing 450m^3 ground level tank. The plan also indicates the complex nature of the street system, with many streets being less than 1m wide.

Unaccounted for water is of the order of 50% of supply.

The reticulation network is now undersized and the situation will continue to worsen as demand increases. Therefore a detailed survey and network analysis of the pipe layout is needed. The results of the analysis will identify lengths of pipelines which are causing restrictions in flow and which should be replaced or augmented.

3.4 STORAGE

The main storage, as mentioned above, is a 450 m^3 masonry tank situated in the compound of the District Water Office on top of the ridge running north/south through the town.

There is a functioning bulk flow meter on the outlet pipe to distribution.

The majority of houses have small storage tanks for domestic use.

3.5 EXISTING O&M

The Lamu water supply is managed by the District Water Officer (a hydrologist), and 3 no. superintendents - water, electrical and mechanical.

There is an antiquated Landrover for transport.

There is no store and no spare parts. Purchasing of spare parts is through the Ministry of Environment and Natural Resources in Nairobi.

Water meters have long since ceased to function.

3.6 ON-GOING OR PLANNED EL NINO WORKS

3.6.1 El Nino Emergency Programme (ENEP)

Rehabilitation works have recently been completed and include :

- Rehabilitation of 30 no. shallow wells.
- Equipping wells with pumps and pump controls.
- Laying a DN100 manifold pipe .
- Construction of a 50 m^3 collector tank.
- Installation of 2 no. gravity dosers for chlorination using calcium hypochlorite.
- Rehabilitation of the high lift pumping station.
- Installation of 3 no. high lift pumps.
- Laying 1no DN150 rising main to the storage tank in the town.
- Laying approximately 5,000 m of distribution pipelines.

The value of the rehabilitation contract is Kshs 25 million.

3.7 OTHER WORKS AND PROJECTS

None.

3.8 LEVELS OF SERVICE

3.8.1 Population served

According to the District Water Officer there are currently 837 connections in Lamu, of which 706 are active.

The 1999 population of Lamu is given as 11,831 (11,800), in 2,707 households, an average household size of 4.37.

The population of Lamu living inside the water supply service area is estimated to be 8,752 or 74% of the population.

The number of people with active connections is 706 x 4.37 = 3,085 or 35% of the people within the serviced area.

3.8.2 Per capita supplies

The total daily water production is 1,600 m^3 or 49,000 m^3/month. Water consumption is estimated to be 32,500 m^3/month, indicating considerable quantities of unaccounted for water.

The per capita consumption for the estimated 'connected population is 350 lcd, or an average of 124 lcd for the population living within the serviced area.

3.9 SUMMARY OF SHORTCOMINGS AND PRELIMINARY RECOMMENDATION FOR REHABILITATION

3.9.1 General

The pumped supply from the well field to the storage tank is limited by the size of the existing pole mounted transformer, the average daily volume of water pumped is 1,600 m^3.

This study seeks to identify and rehabilitate elements of the existing facilities without expansion. Recommendations are prioritised and listed below :

- Supply and install a 100 KVA transformer.
- Install bulk and domestic meters.
- Identify sections of the distribution system where pipes are leaking and/or diameters are too small and replace or reinforce.
- Construct 500 m^3 ground level storage tank..

4 PROPOSED STRATEGY FOR WATER SUPPLY REHABILITATION

4.1 DEMAND/CONSUMPTION PROJECTIONS TO 2010

4.1.1 Population

The population of Lamu according to the 1999 census is 11,831 in 2,707 households. The annual population growth rate is 1.08%.

Yearly population projections to 2010 (rounded to the nearest '00) are shown in Table 4.1

Table 4.1 Population projections to 2010

Year	Population
1999	11,800
2000	12,000
2001	12,100
2002	12,200
2003	12,400
2004	12,500
2005	12,600
2006	12,800
2007	12,900
2008	13,000
2009	13,200
2010	13,300

4.1.2 Water demand projection

Demand rates are taken from the Ministry of Water Development Design Manual (1986) and are included in Appendix H2.

Table 4.2 shows estimated daily demand from 2000 to 2010 compared with the current capacities of the various system components.

Demand has been calculated using the following percentages for different level income brackets of consumers, ascertained from data collected in the field.

Category	**Proportion (%)**	**Population (1999)**	**Rate (lcd)**	**Demand (m^3/day)**
High income	5	590	250	148
Middle income	65	7,670	150	1,151
Low income	30	3,540	75	266
Total domestic demand				**1,565**

The following institutional demands have been included in addition :

Table 4.2
Lamu Water Supply Projected Water Demands and Current System Capacities

Year	Population	Income brackets		Population	Demand rate lcd	Demand m^3/day	Institutional demand m^3/d	Total demand m^3/day	Production capacity m^3/day	Transmission capacity m^3/d	Storage capacity m^3
		Status	%								
1999	11,800	High	5	590	250	148					
		Middle	65	7,670	150	1,151	200	**1,764**	3,500	1,600	460
		Low	30	3,540	75	266					
2000	12,000	High	5	600	250	150					
		Middle	65	7,800	150	1,170	200	**1,790**	3,500	1,600	450
		Low	30	3,600	75	270					
2001	12,100	High	5	605	250	151					
		Middle	65	7,865	150	1,180	200	**1,803**	3,500	1,600	450
		Low	30	3,630	75	272					
2002	12,200	High	5	610	250	153					
		Middle	65	7,930	150	1,190	200	**1,817**	3,500	1,600	450
		Low	30	3,660	75	275					
2003	12,400	High	5	620	250	155					
		Middle	65	8,060	150	1,209	200	**1,843**	3,500	1,600	450
		Low	30	3,720	75	279					
2004	12,500	High	5	625	250	156					
		Middle	65	8,125	150	1,219	200	**1,856**	3,500	1,600	450
		Low	30	3,750	75	281					
2005	12,600	High	5	630	250	158					
		Middle	65	8,190	150	1,229	200	**1,870**	3,500	1,600	450
		Low	30	3,780	75	284					
2006	12,800	High	5	640	250	160					
		Middle	65	8,320	150	1,248	200	**1,896**	3,500	1,600	450
		Low	30	3,840	75	288					
2007	12,900	High	5	645	250	161					
		Middle	65	8,385	150	1,258	200	**1,909**	3,500	1,600	450
		Low	30	3,870	75	290					
2008	13,000	High	5	650	250	163					
		Middle	65	8,450	150	1,268	200	**1,923**	3,500	1,600	450
		Low	30	3,900	75	293					
2009	13,200	High	5	660	250	165					
		Middle	65	8,580	150	1,287	200	**1,949**	3,500	1,600	450
		Low	30	3,960	75	297					
2010	13,300	High	5	665	250	166					
		Middle	65	8,645	150	1,297	200	**1,962**	3,500	1,600	450
		Low	30	3,990	75	299					

Sub-district hospital (50 beds)	500l/50 beds	25 m^3/day
12 no. health centres/dispensaries	5,000l/day	60 m^3/day
40 no. schools	2,600/25l/day	65 m^3/day
Adult education centre	120/25l/day	3 m^3/day
20 no. hotels and guest houses	20/10/2/300l/day	120 m^3/day
Total institutional demand		**273 m^3/day**
	Say	**300 m^3/day**

Commercial activity is of a level such that domestic water usage rates can be applied.

There are no major industries in Lamu.

4.2 PRELIMINARY DESIGN OF RECOMMENDED REHABILITATION OPTIONS

The principal design criteria for water engineering design are presented in Appendix H2.

The following sections summarise the main focus of the proposed rehabilitation plan for Lamu water supply.

Table 4.3 shows the summary schedule of the proposed rehabilitation works.

4.2.1 High priority rehabilitation works

The recommended works comprise :

- Installation of a 100 KVA transformer.
- Installation of bulk and domestic meters.
- Reinforcement of the distribution system.
- Provision of 500 m^3 additional storage.

4.2.2 Transformer

100 KVA transformer will be supplied and installed by KP&LC Ltd.

4.2.3 Meters

Metering of supplies will greatly assist in the reduction of unaccounted for water (UFW) and improve the efficiency of the undertaking.

4.2.4 Distribution system

A detailed survey and network analysis of the distribution system using a population and housing distribution plan will indicate pipe sizes in the system. Decisions can then be made on replacement, augmentation, etc.

Principal design criteria :

- Minimum head at consumer connections to be 10m.

- Maximum head generally not greater than 60m.

4.2.5 500m^3 ground level storage tank

A network analysis of the distribution system will indicate the optimum position for the tank.

Section 11.3.1 of the MENR Design Manual requires balancing storage for a pumped scheme to be 75% of the average daily demand. The average daily demand in 2010 is calculated to be 2,062 m^3, giving a storage requirement of 1,550 m^3. Existing storage is 450 m^3 thus leaving a shortfall of approximately 1,100 m^3.

500 m^3 will be provided under the identified rehabilitation works, and the remaining 500 m^3 in future expansion works.

4.3 COSTING OF RECOMMENDED REHABILITATION PLAN

An indicative budget for rehabilitating the existing Lamu water supply system is Kshs 130 million as shown in Table 4.4.

4.4 EXPANSION OF WATER SUPPLY FACILITIES

4.4.1 General

Groundwater is the only source of water on the island of Lamu and the precious resource must be carefully managed. There is an adequate supply of fresh water to cater for demand to the design horizon year of 2010 and beyond.

There are two main areas of concern - over-pumping of the aquifer, and pollution of the aquifer.

(a) Over-pumping

There is a danger that in abstracting fresh water from a particular well the natural interface between the fresh and salt water will be upset and salt water will rise in the well resulting in brackish water being produced.

A comprehensive monitoring programme of water quality must be maintained.

Brackish water can be purified using the reverse osmosis process. The process equipment is expensive to install and maintain and is not considered to be appropriate technology.

Similarly, desalination of sea water is a possible source of drinking water, but again the cost of a major installation is prohibitive, at least in the short term.

Table 4.3
LAMU WATER SUPPLY
SCHEDULE OF REHABILITATION WORKS

Item	Unit	Ref	Component	Condition	Proposed action	Comments	Implementation
1.	Shallow wells	1.1	30 no medium deep wells DN3,000, av depth 10m	Good	None	Rehabilitated under ENEP	
		1.2	30 well pumps & controls	Good	None	Rehabilitated under ENEP	
2.	Rising mains	2.1	DN100 and DN50 pipelines from wells to collector tanks at pstn	Good	None	Rehabilitated under ENEP	
3.	Collector tanks	3.1	2 no 50m^3 tanks	Good	None	Rehabilitated under ENEP	
4.	High lift pumping stn	4.1	Building	Good	None	Rehabilitated under ENEP	
		4.2	5 no high lift pumps & controls	Good	None	Rehabilitated under ENEP	
		4.3	2 no gravity chemical dosers (Cl_2)	Good	None	Rehabilitated under ENEP	
5.	Rising mains	5.1	2 no DN150 uPVC rising mains	Good	None	Rehabilitated under ENEP	
6.	Storage	6.1	450m^3 GL masonry tank	Fair	Install access ladders and covers, level indicator		Rehabilitation
		6.2	Additional storage		Construct additional 500m^3 GL tank	Existing storage too small	Rehabilitation
7.	Distribution	7.1	Existing pipes =/>On100	In use	Rehabilitate, replace		Rehabilitation
		7.2	New distribution		Construct new system, uPVC & steel pipes DN75 min		Rehabilitation
		7.3	Meters		Install bulk, zonal & domestic meters as necessary	Existing meters non-functioning	Rehabilitation
8.	Transformer	8.1	Existing 50 KVA transformer	Too small	Replace with 100KVA	Restricts quantity of water pumped	Rehabilitation
9.	Generator	9.1			Install stand-by generator		Future project
10.1	Logistical facilities and equipment	10.1	Rehabilitate existing office buildings			Improve working conditions of staff	Rehabilitation
		10.2	4WD twin-cab pick-up			Improve working conditions of staff	Rehabilitation
		10.3	Motor boat			Improve working conditions of staff	Rehabilitation
		10.4	Motorcycles			Improve working conditions of staff	Rehabilitation
		10.5	Computers			Improve working conditions of staff	Rehabilitation
		10.6	Printers			Improve working conditions of staff	Rehabilitation
		10.7	Computer software			Improve working conditions of staff	Rehabilitation
		10.8	Office equipment & furniture			Improve working conditions of staff	Rehabilitation

Table 4.4 : Cost estimates of rehabilitation works for Lamu water supply

Ref	Description	Unit	Quantity	Rate (Kshs)	Amount (Kshs)
1.	**Water meters**				
1.1	Bulk meters (various diameters)	no.	4	250,000	1,000,000
1.2	Domestic meters	no.	1,000	6,000	6,000,000
2.	**Storage**				
2.1	Rehabilitate exsiting 450m^3 ground level tank	sum		1,000,000	1,000,000
2.2	500m^3 ground level tank	sum		6,000,000	6,000,000
3.	**Pipes**				
3.1	Distribution uPVC DN 50 - 100	km	25	2,000	50,000,000
4.	**Transformer**				
4.1	100 KVA transformer	no.	1	4,000,000	4,000,000
5.	**Logistical facilities and equipment**				
5.1	Rehabilitate existing office buildings	sum		3,000,000	3,000,000
5.2	4WD twin-cab pick-ups	no.	1	2,500,000	2,500,000
5.3	Motor boat	no.	1	1,500,000	1,500,000
5.4	Motorcycles	no.	3	250,000	750,000
5.5	Computers	no.	1	200,000	200,000
5.6	Printers	no.	1	100,000	100,000
5.7	Computer software	sum		200,000	200,000
5.8	Office equipment & furniture	sum		1,000,000	1,000,000
		Total of works			**77,250,000**
Add	20% preliminaries and general items				15,450,000
		Sub-total			92,700,000
	15% contingencies				13,905,000
		Sub-total			106,605,000
	20% consultancy fee				21,321,000
		GRAND TOTAL			**127,926,000**
				say	**130 million**

(b) Pollution

The wellfield is located some distance from the population concentration in Lamu town and the possibility of pollution on the aquifer from on-plot sanitation is remote. Nevertheless, constant monitoring of groundwater quality is essential.

4.4.2 Alternative power sources

Lamu's water supply is double pumped and consequently in order to make the supply of water economically viable, tariffs must be comparatively high. KenGen has a diesel power station situated to the south of the town and power supplies are regular.
At some later stage of the water supply development, consideration should be given to the use of wind power to drive the small pumps located inside the wells.

Wind power is not suitable to drive the high lift/high volume treated water pumps.

4.4.3 Existing water supply system components and expansion

(a) Groundwater

There is sufficient groundwater to meet the 2010 demand.

(b) Treated water pumping

There is sufficient installed pump capacity to meet the 2010 demand.

(c) Pumping mains

The 2 no. existing DN150 rising mains can pump over 3,500m^3/day.

(d) Storage

After rehabilitation available useable storage is 950m^3.

(e) Distribution

Although some 25 km of distribution pipework will have been replaced under the rehabilitation works further expansion of the reticulation network will be necessary.

A provisional length of 25 km of pipelines between Dn200 and DN50 is proposed for expansion works, with a proportional number of domestic meters.

Cost estimates for expansion works are shown in Table 4.5.

Table 4.5 : Cost estimates of expansion works for Lamu water supply

Ref	Description	Unit	Quantity	Rate (Kshs)	Amount (Kshs)
1.	**Water meters**				
1.1	Bulk meters (various diameters)	no.	4	250,000	1,000,000
1.2	Domestic meters	no.	1,000	6,000	6,000,000
2.	**Pipes**				
2.1	Distribution uPVC DN 50 - 200	km	25	2,000	50,000,000
		Total of works			**57,000,000**
Add	20% preliminaries and general items				11,400,000
		Sub-total			68,400,000
	15% contingencies				10,260,000
		Sub-total			78,660,000
	20% consultancy fee				15,732,000
		GRAND TOTAL			**94,392,000**
				say	**95 million**

4.5 O&M COSTS AFTER REHABILITATION

Cost estimates for O&M costs are shown in Table 4.6.

Table 4.6 : Cost estimates of O&M activities for Lamu water supply

Ref	Description	Unit	Amount (Kshs)
1.	**Capital costs**		
1.1	Management consultancy (2 years)	sum	25,000,000
1.2	Vehicles, office equipment, etc.	sum	10,000,000
	Sub-total		**35,000,000**
2.	**Recurrent costs (monthly)**		
2.1	Salaries and allowances	sum	1,500,000
2.2	Electricity charges	sum	500,000
2.3	Chemical charges	sum	120,000
2.4	Vehicle running costs & maintenance	sum	150,000
2.5	Office running costs	sum	100,000
2.6	Housing maintenance	sum	100,000
	Sub-total		**2,470,000**
3.	**Spare parts (for 1 year)**		
3.1	Pipes	sum	1,000,000
3.2	Fittings	sum	200,000
3.3	Valves	sum	250,000
3.4	Meters		
3.4.1	bulk	sum	500,000
3.4.2	domestic	sum	2,000,000
3.5	Pumps		
3.5.1	impellers	sum	1,000,000
3.5.2	seals	sum	100,000
3.5.3	packing	sum	100,000
3.6	Electric motors, re-winding	sum	250,000
3.7	Pump controls, relays, MCBs, etc.	sum	250,000
3.8	Dosing equipment, spares	sum	200,000
	Sub-total		**5,850,000**

5 EXISTING WASTE WATER DISPOSAL & SANITATION CONDITIONS

5.1 SANITATION SYSTEM

There is no waterborne sewerage system in Lamu. Open drains built in 1956 and running west to east carry rainwater and grey water to the sea. The drains are frequently blocked by rubbish with the consequent accumulation of stagnant water, an excellent breeding ground for mosquitoes. Waste disposal is by means of septic tanks and traditional pit latrines. Shallow wells in many private homes cannot now be used due to pollution of the shallow underlying aquifer by effluent/seepage from on-site disposal facilities.

With the improvement and expansion of water supply facilities, there will be a corresponding increase in per capita consumption, resulting in an increase in quantities of grey and black water. Existing traditional methods of waste disposal will become overloaded and non-sustainable. The problem must be addressed, as failure to do so will lead to unhygienic conditions, a rise in the number of cases of waterborne diseases and a reduction in the quality of life of the population. Alternative solutions must be found for waste disposal.

Given the unique layout of the town with its many narrow winding streets, the provision of a conventional sewerage system will be difficult and expensive to construct. There is no defined central business district in Lamu and therefore consideration should be given perhaps to the construction of communal septic tanks and corresponding small-bore sewerage system.

5.2 SEWERAGE SYSTEM (O&M)

Not applicable.

5.3 SEWAGE TREATMENT WORKS (O&M)

Not applicable.

5.4 OTHER DISPOSAL FACILITIES

5.4.1 Solid waste disposal

Rubbish in the narrow streets of Lamu is one of the towns most unpleasant aspects. Lamu County Council has a tractor and trailer for removing most of the rubbish to the main dumping area at the north end of the town.

A more efficient landfill management programme is urgently needed.

5.5 ON-GOING OR PLANNED EL NINO WORKS

None.

5.6 OTHER WORKS AND PROJECTS

None.

5.7 SUMMARY OF SHORTCOMINGS AND PRELIMINARY RECOMMENDATIONS FOR REHABILITATION

Not applicable.

6 PROPOSED STRATEGY FOR WASTEWATER DISPOSAL AND SANITATION REHABILITATION

6.1 DEMAND FOR SANITATION SERVICES

Current waste disposal methods in Lamu are on-site by means of septic tanks, cess pits and pit latrines. However, with the increased use of flush toilets and showers, the existing on-plot disposal systems are being overloaded with an impact on the groundwater quality. It is therefore becoming increasingly necessary to provide an alternatative form of sanitation.

Given the unique layout of the town with its many narrow twisting streets, the installation of a waterborne sewerage system will present a difficult challenge to the designer and would be equally difficult and expensive to construct.

A community based small-bore system with communal septic tanks will probably be the best solution.

6.2 DEMAND FOR WASTEWATER DISPOSAL SERVICES

There is no waterborne sewerage in the town, however, as stated in Section 6.1, it is becoming increasingly necessary.

6.3 CONFIRMATION OF REHABILITATION OPTIONS

Construction of a waterborne sewerage system is outside the scope of this study and no other rehabilitation of the sanitation system is proposed.

6.4 PRELIMINARY DESIGN OF RECOMMENDED OPTION

This is not applicable as rehabilitation or new sewerage works are not proposed under this study.

6.5 COSTING OF RECOMMENDED REHABILITATION PLAN

This is not applicable as rehabilitation or new sewerage works are not proposed under this study.

7.0 LAWS AND REGULATIONS OF ENVIRONMENTAL IMPACT ASSESSMENT

7.1 GENERAL

The current Government of Kenya policy requirement stipulates that before any major development project is undertaken in the public or private sector, there is need to carry out Environmental Impact Assessment (EIA) on the project in order to ensure that each component conforms to good environmental management. This study involves mainly the identification of laws and regulations that govern the environmental impact assessment of water supply and sanitation projects.

7.2 LEGISLATION/REGULATIONS GOVERNING ENVIRONMENTAL IMPACT ASSESSMENT

7.2.1 General

A large number of Acts and organizations deal with issues of pollution, environmental degradation and conservation. These include among others:

- Constitution of Kenya (especially Section 71)
- Water Act (Cap 372)
- Agriculture Act (Cap 318)
- Irrigation Act (Cap 347)
- Forests Act (Cap 385)
- Lakes and Rivers Act (Cap 409)
- Maritime Zone Act (Cap 371)
- River Basin Development Authorities Act (e.g. Cap 443)
- Land Tenure and Land Use Legislation
- Wildlife (Conservation and Management) Act (1976 and 1989 Amendment)
- Public Health Act (Cap 242)
- Local Government Act (Cap 265)
- Environmental Management and Co-ordination Act (1999)

Effectiveness in enforcement has not been commensurate with the many acts and regulations; in some instances there have been contradictions when an institution has evoked its act at the expense of proper operation of facilities belonging to another institution. The reason for the foregoing situation is that each sector utilizing water, apart from the water authority, has different objectives; their primary focus is not water development. The need to harmonize the application of the various Acts and Regulations, for effective protection of the environment, has been felt and expressed for a long time; hence the birth of the Environmental Management and Co-ordination Act of 1999.

7.2.2 Environmental Management and Co-ordination Act (1999)

The most significant Act that specifically addresses environmental impact is the newly enacted Environmental Management and Co-ordination Act, 1999. Among the specific issues related to EIA procedures are stipulated in the Act as follows:

- Establishment of Environmental Management Authority (NEMA) to administer the Act.
- Submission of an EIA Report to NEMA by developers before undertaking any new project specified in the Act.
- Issue of an Environmental Impact License by NEMA if it is satisfied with the EIA Report.
- Environmental Impact Assessment to be conducted in accordance with the EIA guidelines and procedures provided in the 4th schedule of the Act.

7.2.3 Laws Relating Specifically to Water Supply and Sanitation

Within the Environmental Management and coordination Act, a number of sections dealing specifically with water and sanitation can be identified as follows:

- Part V Section 42 dealing with protection of rivers, lakes and wetlands,
- Part VIII Section 72 dealing with water pollution prohibition,
- Part VIII Section 74 dealing with effluents to be discharged into the sewerage system,
- Part VIII Section 86 dealing with standards for waste,
- Part VIII Section 87 dealing with prohibition against dangerous handling and disposal of wastes,
- Part VIII Sections 88 and 89 dealing with waste licenses and licensing of waste disposal sites,
- Part VIII Sections 91 – 93 dealing with hazardous wastes and their disposal,
- Part XIII dealing with environmental offences and related penalties.

In order to minimize the conflicts in enforcement (due to the many different Acts and Regulations) as mentioned before, the Environmental Management and Coordination Act stipulates that where the provisions of any existing law conflicts with the provisions of this Act, then the provisions of this Act shall prevail. The foregoing proviso, in conjunction with the multi-disciplinary or composition of the Environmental Committees will hopefully enhance the effectiveness of administration and enforcement of the Act.

7.2.4 Environmental Impact Assessment (Guidelines and Administrative Procedures)

The format of the EIA Report has been set out in the guidelines and should include the following sections:

- Introduction
- Title of the Project
- Project Initiator
- Statement of Need
- Project Description
- Project Options
- Description of Existing Environment
- Results of Preliminary Assessment
- Detailed Examination of Impacts
- Suggested Mitigation and Abatement measures
- Residual Impacts
- Project Evaluation
- Summary Conclusions

In addition, the EIA guidelines and procedures describe procedures to be used in environmental planning and management in Kenya. It also gives a checklist of sectors, which can provide guidance to the public and private sector agencies involved in initiating development projects.

7.2.5 Objectives of Environmental Impact Assessment

The objectives of Environmental Impact Assessment Study for this project are identified as follows:

- To identify the existing environmental concerns which need to be taken into account in the proposals for rehabilitation of water supply and sanitation system.

- To evaluate the environmental impacts of the proposed rehabilitation works.

- To propose the counter measures to mitigate the impacts.

- To make recommendations for environmental conservation.

7.3 INITIAL ENVIRONMENTAL EXAMINATION

7.3.1 Water Quality of Existing Supplies

Lamu town gazetted water scheme obtains its water from a well field located on sand dunes next to the coastline. The fresh water sits on top of seawater separated by a delicate front, which can be easily broken by over-pumping and hence possible contamination of the aquifer by saltwater. Pumping must therefore be carefully controlled and monitored to maintain freshwater production.

The programme for monitoring water quality both at source and within the distribution systems is in place at the town, however, implementation is generally poor because of lack of appropriate and adequate laboratory equipment and reagents. Water quality analysis results were not available except pH and residual chlorine. The well field exploited at Lamu is an ecologically sensitive area that should be carefully protected and preserved.

7.3.2 Existing Sanitation Situation

Lamu town depends on on-site sanitation systems comprising mainly Swahili type pit latrines and cess-pits. There are a few septic tanks serving the DC's residence and some hotel resorts, while in the town centre, there is no space to accommodate septic tanks. Information obtained on site indicated that some of the latrines date back to the17th Century when the Portuguese and Arabs settled in the town. In some cases modern water closets have been connected to the latrines and yet the latrines have not filled up.

An interview with one of the technicians who has been involved with the installation and maintenance of these latrines revealed that there is a way by which the latrines get evacuated into the sea during the process of rising and ebbing of the tide. Alternatively filled up pits are emptied manually into fresh pits because there is no possibility of access by exhauster vehicle.

However, the general sanitation situation in the town is deteriorating because of lack proper disposal of sullage; wastewater flows freely in the storm water drains and into the streets. Floating human feaces and donkey droppings could be seen in the storm drains leading into the harbour.

7.3.3 Screening and Scoping for Environmental Impact Assessment

Many guidelines have been used in Kenya for EIA but especially those of the World Bank. Often, the sponsor of a development has stipulated the standards to be met, because in the past Kenya did not have specific guidelines. However, as mentioned before, the Environmental Management and Coordination Act (1999) has set out the guidelines for EIA in its 4th Schedule. The guidelines propose the checklist method for screening and scoping for EIA.

The general environmental concerns in the town and a checklist of items of general environmental concern have been provided herein. A comprehensive EIA will be undertaken at the feasibility stage, however, it is envisaged that almost all the project components will be of such small scale that their impacts will not be serious. Issues that require further careful study have been identified given the unique and important position Lamu occupies in the economy of the country.

7.4 EXPERIENCES IN APPLICATION OF EXISTING LEGISLATION AND REGULATIONS IN WATER AND ENVIRONMENTAL MANAGEMENT IN LAMU TOWN

Interviews conducted with the personnel involved in management of water Resources and pollution control revealed the following experiences:

(i) The personnel are aware and well versed with the relevant section of the Water Act Cap 372 (1972) dealing with

- Enforcement of regulations – section 146
- Prevention of pollution – section 145
- Protection of water catchment areas – section 150

(ii) Apart from making provision for pollution prevention and protection of catchment areas the Water Act does not specifically deal with environmental impacts or environmental protection.

(iii) Although the new Environmental Management and Coordination Act (1999) took effect on 14th January, 1999 the personnel were not conversant with it.

(iv) The personnel observed the following difficulties with execution of the existing laws and regulations:

- Fines for offenders are very low and not punitive enough to deter prevalence of default or spur compliance.
- The process and procedure of effecting protection of water resources is unnecessarily long.
- Issuance of Water Permits takes a very long process.
- Section 158 of the Water act, which deals with Water Pollution, does not give the Water Department clear powers to protect water resources.
- The Water Bailiff's who are well versed with the Water act do not have powers to prosecute cases related to water matters.
- There is a conflict between the Water Department and the Public Health Department on water and environmental matters because of fragmentation of authority.

- The implementation of the Environmental Management and Coordination Act has not been effected in Lamu.

7.5 ENVIRONMENTAL CONCERNS IN LAMU TOWN

Discussions regarding environmental, public health general developmental issues in Lamu were held with the district officers in charge of Environment, Public Health, Planning, and Social Development. The following is a summary of the environmental concerns expressed and observed.

1. How the water catchment area can be protected to stop any possibility of land grabbing; there are indications that the catchment is already staked out by private developers. The dunes are the life-line of Lamu.

2. The need to draw up an integrated plan to conserve the area involving Water, Agriculture, Survey and Forest Departments, which are the main stakeholders. Also Hindi, Mpeketoni and Sheila islands should be considered in the same context.

3. Survey of the area should be undertaken (a PDP has already been drawn up) and title given to the MENR or any subsequent water undertaker to deter any prospective grabbers.

4. Breaking the pavements for repair and placement of old pipes has caused a deterioration of the pavements because of difficulty to reinstate the pavement to its original mix. New pavements seem to wear out faster.

5. Use of Jambias as water catchment creates other problems e.g. mosquitoes and waterborne diseases if the environment is not sanitary.

6. Bursting of pipes as a result of the additional water brought about by improvement of the El Nino Project.

7. Water pipes follow the waste canals or cross them and possibility of contamination is high, especially considering the fact that the pipes are very old and corroded.

8. Sewerage development has been one of the priority projects for the County Council for a long time but this has not been implemented (since 1994). Wastewater now flows freely into the sea without treatment.

9. There are 5 main drainage canals in Lamu which discharge raw sewage into the sea. Long ago there was a way of storing the waste temporarily before discharging to the sea, but no one knows now how the system worked.

10. Obtaining land for alternative garbage disposal site is underway and 3 sites have been identified, but not yet acquired.

11. There is a youth project which buys plastic bags at 5/= per kilogramme and burning them. This project should be encouraged and replicated in other islands, as part of a clean up project for the town.

12. Lamu has a problem of controlling donkey droppings that litter the streets. There are plans to look for appropriate designs for napkins for donkeys from places like Kwalalumpur and Malasia, to alleviate the problem since donkeys form a vital means of taxi transport in the town.

13. The open drainage system in Lamu was initially meant for storm water only but currently people are discharging sullage and even human faeces could be seen in some drains.

14. Maintenance of the open drains is poor causing ponding of water and general nuisance.

15. Most residents use Swahili pit latrines as the main sanitation system since the town plan does not allow for use of septic tanks.

16. There is no access to the pit latrines for emptying by exhauster, so manual emptying is practiced in cases where the pits get filled up. This practice may not be sustainable in the future due to congestion of plots.

17. Inadequate solid waste management leads to accumulation of wastes in the open drains and contributes to general nuisance.

18. The planning of the town does not allow proper access to the waste generation points. Any accumulating wastes have to be carried to the sea front where access by tractor is possible.

19. The existing dumping point for waste is at the sea front where the tide reaches it and sweeps it into the harbour. Floating garbage is common in the harbour where children can be seen swimming.

20. The water supply is not adequate and many people still depend on shallow wells, which are also located next to pit latrines, and are liable to contamination. There was a serious outbreak of Cholera after the El Nino in 1998,which was traced to contamination of shallow wells. People are now generally sensitized to boil water for drinking and occasionally the Public Health Department provides chlorine for the wells.

21. The slaughterhouse wastes flow freely into the sea, and is an eyesore next to the KANU office.

22. Malaria is quite prevalent as a water-related disease because of mosquito breeding in wastewater ponding in open drains.

7.6 RESULTS OF INITIAL ENVIRONMENTAL EXAMINATION

Lamu is an old town built by the Portuguese since the 14th century. The water supply comes from a collection of 30 wells located in a well-field along the western coast of the island. The supply is inadequate therefore, a sizeable proportion of the town population depends on shallow wells located in individual plots. The town has very narrow, non-motorized streets along which run the storm water drains. Summaries of initial environmental examination are presented in tables 7.1 and 7.2

Table 7.1 IEE Checklist - Water Supply Component

ITEM	EVALUATION	COMMENT
1. Human Settlement	4	No negative impact expected
2. Economic Activities	5	Positive impact expected from improved water supply
3. Transport	5	No negative impact expected
4. Water and Common Rights	3	The well field is an environmentally sensitive area that needs protection
5. Sanitation	4	Improved water supply should lead to better sanitation
6. Waste	4	May need attention during construction
7. Hazards/Dangers	5	May need attention during construction
8. Topography and Geology	5	No impact expected
9. Soil Erosion	5	No impact expected
10. Groundwater	1	Well field needs protection
11. River and Wetlands	5	No impact expected
12. Coastline and Sea	5	No impact expected
13. Flora and Fauna	4	No impact expected
14. Weather	5	No impact expected
15. View	5	No impact expected
16. Air Pollution	4	No impact expected

17. Water Pollution	5	No impact expected
18. Soil Contamination	5	No impact expected
19. Noise and Vibration	4	No impact expected
20. Ground Subsidence	4	No impact expected
21. Noxious Odours	5	No impact expected
22. Cultural and Archeological Assets	3	No impact expected
23. Conflict with community Aspirations	5	No impact expected

KEY:

1. Serious impact expected
2. Minor impact expected
3. Uncertain (investigation needed to clarify)
4. Almost no impact expected if proper construction procedures are used
5. Almost no impact expected (no need for EIA)

Table 7.2 IEE Checklist - Sanitation Component

ITEM	EVALUATION	COMMENT
1. Human Settlement	5	No negative impact expected
2. Economic Activities	4	No negative impact expected
3. Transport	4	No negative impact expected
4. Water and Common Rights	5	No negative impact expected
5. Sanitation	1	Aim of project is to improve sanitation
6. Waste	1	Sludge from pit latrines is manually emptied causing risk to human health
7. Hazards / Dangers	4	No impact expected
8. Topography and Geology	5	No impact expected
9. Soil Erosion	5	No impact expected
10. Groundwater	1	On-site sanitation increases risk of groundwater contamination
11. River and Wetlands	5	No impact expected

12. Coastline and Sea	1	Disposal of waste in the sea is blighting the harbour and coastline
13. Flora and Fauna	4	No impact expected
14. Weather	5	No impact expected
15. View	5	No impact expected
16. Air Pollution	3	No impact expected
17. Water Pollution	1	Emptying of latrine sludges into the sea reduces the aesthetic value of the harbour
18. Soil Contamination	4	No impact expected
19. Noise and Vibration	4	No impact expected
20. Ground Subsidence	4	No impact expected
21. Noxious Odours	3	Odours bound to be nuisance during emptying of latrine sludges
22. Cultural and Archeological Assets	3	No impact expected
23. Conflict with community Aspirations	4	No impact expected

KEY

1. Serious impact expected
2. Minor impact expected
3. Uncertain (investigation may clarify)
4. Almost no impact expected if construction is undertaken properly
5. Almost no impact expected (no need for EIA)

7.7 INITIAL ENVIRONMENTAL IMPACT ASSESSMENT

By and large, the proposed rehabilitation project will have positive impacts by providing improved water service, reducing incidence of disease, and general improvement of the environment. However, from the results of IEE, four main items of potential impacts of the proposed rehabilitation works are be identified for study as listed below:

(i) Impacts resulting from abstraction of water from river or groundwater sources during operation.

(ii) Impacts arising from the increase in wastewater generation that would result from the improved water supply.

(iii) Impacts resulting from the operation of wastewater management and sanitation facilities.

(iv) Impacts resulting from construction activities during implementation of rehabilitation works.

7.7.1 Impacts Resulting from Water Abstraction

Hydrogeological investigations of the catchment area reveals that with proper management the sand dunes comprising the main freshwater aquifer may satisfactorily supply the water needs of Lamu town in the short term. The impact of prolonged increased abstraction at the existing intake is not clear. However, the raw water quality may quickly deteriorate in case of over-pumping or interference with the catchment area.

7.7.2 Impacts from Increased Wastewater Generation

Improved water service to be wrought by the rehabilitation will definitely make more water available to the consumers. The resulting increased wastewater flow will present disposal problems by putting pressure on the capacity of the existing on-site sanitation systems.

The hydrogeology of the area shows that the groundwater table is quite high for example in the town and people draw water from shallow wells. The risk of groundwater contamination by on-site sanitation systems in these areas is therefore real. Installation of a sewerage system, coupled with intensified public education on proper waste management is needed for protection of the environment.

7.7.3 Impacts from Operation of Sanitation Facilities

Current operation of the existing sewerage system is polluting the environment since the wastes are discharged freely into the harbour, which is the gateway into the town and a recreational area for the young people. On-site sanitation facilities pose danger to groundwater and increased wastewater flow will aggravate the situation.

7.7.4 Impacts from Construction

At the rehabilitation stage construction will consist mainly of additional water storage and replacement of old corroded pipes in the distribution system. These constructions will not be of any large scale but could adversely affect human settlements because of the unique layout of the town with its narrow and winding streets. Excavations for pipelines may cause deterioration of street pavements as observed during the El Nino improvements in the town. There will also be serious interruption of human traffic flow although this will be on a temporary scale. Careful planning of construction activities will be needed to minimize inconveniences.

However, development of sewerage systems and treatment facilities will necessitate major disturbance of human settlements if the current town plans have not set aside land for the purpose. This will need further clarification at the feasibility stage. Moreover, a conventional sewerage system may not be appropriate for the town, instead the small-bore sewer system should be considered.

Disturbance of the soil during construction may also give rise to soil erosion but this will be minimal because no large-scale earthworks are anticipated in the rehabilitation phase. The noise and vibrations are common features of most construction works and there are no unusual works that need special attention with respect to noise and vibration.

7.8 ISSUES FOR FURTHER INVESTIGATION

1. The impact of prolonged pumping from the shallow aquifer provided by the sand dunes should be studied. The feasibility of an alternative water source development e.g. desalination of seawater should be studied given the advances in technology in this area.

2. The study of an appropriate sewerage system especially its impact on the receiving water body given the rising and ebbing of the tides that tend to spread the wastes far and wide.

3. Since a substantial section of the population is not served by the current water supply scheme and therefore draws water from traditional sources, the full impact of continued use of on-site sanitation systems on the degradation of water quality in such sources needs to be studied.

8. PROPOSED UTILITY MANAGEMENT PLAN

The 10 study towns visited can be grouped into three different institutional categories or groups under the Ministry of Environment and Natural Resources. District water offices: Narok, Meru, Muranga, Wundanyi, Migori and Lamu report to the Ministry directly, Division water offices: Makindu, Webuye and Mumias are included in the respective District reporting, and Kabarnet Sub Area office reports to the Regional area office, which falls under the jurisdiction of the National Water Conservation & Pipeline Corporation, which again operates as a State Corporation under the same Parent Ministry, the Ministry of Environment and Natural Resources.

8.0. GENERAL APPROACH

The approach for the analysis of the 10 towns was to work with a comprehensive base questionnaire that covers the commercial, financial and technical aspects of a water utility system. Interviews and discussions were held with those staff members that are either in charge or responsible for certain aspects of the day to day operation.
For the commercialised systems in Kenya, three sample towns were chosen: Malindi which is operated under a management contract for the NWC&PC, and Nyeri and Kitale Water Company, which are operated on the basis of an agency agreement for and on behalf of the respective municipal councils. Different questionnaires were used in order to obtain information about the problems that they have experienced since commencement of their operation.

The current system of Government reporting and record keeping has made it very difficult to obtain reliable and meaningful data within the given timeframe. The prevailing situation in all systems is that details are available, but neither instantly ready, nor summed up. Consequently numerous figures had to be compiled and abstracted from various ledgers and folders, in order to draw a picture of the current situation. At system level, the consumer ledger was found to be the most resourceful book of information concerning number of accounts, their condition (metered, non-metered, active, in-active), monthly consumption, arrears and payments received. It was therefore decided to use the consumer ledger information and take a snapshot picture of the situation for the month of June 2000. Where annual figures and records were available, those were absorbed for the Financial Year 99/00 in order to calculate monthly averages for comparison with the snapshot month June 2000. To substantiate procedures in place, it was considered essential, to question the figures and details that are routinely forwarded to the Head Quarter.

As procedures do continue at Head Quarter level it was as well attempted to find out, what procedures have to be undergone and is the information that is provided from Divisional or District Offices analysed in order to make planning assignments possible.

The details and procedures representing the NWC&PC area office in Kabarnet have been analysed upto the Regional Office level only. Operational decision making, funding and most personnel related issues are vested in the powers of

the Regional Manager. Instructions and procedural requirements, retained by the Head Office or vested in the State Corporation Act , are however considered for the analysis.

8.1. EXISTING WATER SUPPLY& SANITATION SYSTEMS

8.1.0. Overview Of All Systems Visited

All records and details abstracted in or compiled for the ten towns visited, are compiled in Appendices: A3 for Narok Town, B3 for Meru Town, C3 for Muranga Town, D3 for Kabarnet Town, E3 for Makindu Town, F3 for Wundanyi Town, G3 for Migori Town, H3 for Lamu Town, I3 for Webuye Town and J3 for Mumias Town. System situation description has been prepared for every town visited. Appendix K 3 holds questionnaires used for the commercialised systems and all summary statistics. Summary Table ST 8.2. contains the verified statistics for all 10 towns, using the month of June 2000 as the month for which verification could be done, based on the information abstracted from the various consumer ledgers. Comparisons between the towns are drawn from the same overview called "verified statistics summary" on details considered most relevant.

8.1.0.1.Utility Systems Organisation

8.1.0.1.1. Staffing:
All systems have a high number of unskilled Subordinate Staff being employed with different responsibilities. The O&M department integrates not only the source, treatment and distribution aspect of the water systems, but it is also responsible for billing and revenue collection. Within the billing and revenue collection department, majority of all staff have a technical background. Training, if offered, is within the technical field, financial or commercial training is not really considered. The staff assigned to the distribution system do as well undertake meter reading for which no schedules are available. Control over staff activities and where abouts becomes very difficult. The number of consumer accounts per staff ranges from 23 in Migori to 110 in Mumias. Organisation Charts have been drawn for all 10 towns, based on the information collected and are to be found under the Appendix of the respective town.

The managers responsible for the various systems have no commercial or managerial, but technical background. There is no training offered to prepare officers into their managerial responsibilities, even though the assignment described in The "Schedule of Duties for the Ministry of Water Resources" – January 1999, issued by the Permanent Secretary, describes the duties of every District Water Officer as:

Representative of the MWR in the District and responsible to the PWO/Central for the following duties and responsibilities:

- Overall planning, control and management of all water related matters in the District, including financial management thereof
- Any other duties as may be assigned

8.1.0.1.2. Office Set-up, Facilities and Transport:
While some District offices have adequate space, Division offices visited are in dire need of a decent working- and consumer-receiving-environment. Hard funishing can be termed as basic, but storage facilities for keeping and archiving documents reflect additional requirements in all places visited. Shortage of stationary or calculators is common everywhere.
The new NWC&PC office in Kabarnet has been taken over from the contractor just recently and basic requirements are still in very good condition.
The transport situation of all systems visited is below requirement. Water systems that are shared with the District water operation do have the advantage that transport can at least be shared in case of an emergency. All other systems do depend on well wishers, public transport or they walk.

8.1.0.1.3. Consumer and Meter Information:
The existing level of information concerning the status of the meters, dis-connection/ re-connection or new connection statistics or their operationality, must be termed as low. In a number of towns, the available though estimated figures are not diverting too much from the snapshot situation taken for the month of June 2000, but others are completely "off-track" and reflect that the value of information has to be more emphasized.

Ad hoc information was difficult to obtain anywhere. The statement that everything is available somewhere, somehow, but not in a comprehensive and meaningful format, easy to analyse, applies to all systems. As an example can be taken that the cost for maintaining a vehicle cannot be abstracted from one ledger card, but different kind of items are reflected on different ledger cards for certain expenditure categories. This means, that the cost determination could only be made by going through a number of ledger cards and then compiling the same information.

8.1.0.1.4. Production and Consumption:
For a number of systems, neither production nor consumption figures can be determined with certainty.

Where master meters were either not working or simply lacking, pumping hours were used to calculate the production; where gravity flow does not provide meter information, the situation was reflected, based on the assessment offered by the staff of the respective water system and then compared with the engineer's information. All systems operate well below their capacity, which can be related to:

- Limited use of power, because more pumping cannot be justified with equally increasing billed consumption
- Weak distribution systems, which cannot take the increased pressure and result in higher UfW
- Faulty pumps
- Reduced source capacity

To confirm consumption details is even more difficult, as the majority of consumer meters are not operational. The number of estimated accounts range from 31% in Wundanyi to 99% in Mumias. The verification of consumption details was only

possible for the month of June 2000, by abstracting consumer ledger information in a uniform format for all systems. While the information still reflects a number of discrepancies, it was considered the closest one can get, within the scopes and limited timeframe of the study.

While Migori, Webuye and Mumias have a very high estimated number of accounts (88% - 99%), the consumption abstracted exceeds the production considerably or is almost the same and raises the question of: what is the assessment tool for estimating accounts, or better their consumption?

8.1.0.1.5. Un-accounted for Water (UfW):
Where production and consumption details are not very reliable, the determination of UfW is difficult and equally unreliable. While most systems do fill monthly returns with arithmetical calculations on the UfW, the verified information reflects differences. Where a calculation of UfW was possible, the percentages range from 1% for Webuye town to 77% for Kabarnet town (excluding Mumias and Migori towns which reflect a higher consumption than production).

The overall calculated loss, expressed in Kenya Shillings is considerable. The verified month of June 2000 calculates for 8 out of the 10 towns, for which UfW calculation was done, a total of approximately Kshs 6,374 million per month, or extrapolated: Kshs 76,492 million per calendar year.

As the calculation is based on water lost and the average tariff calculated for every town, this calculation should serve as a guiding figure only, as the figures used for the calculation are based on the month of June 2000 information and might vary, when a deeper analysis is carried out. The loss furthermore does not yet capture the full cost of the loss, because the current tariff is considered as not cost covering.

The determination of cost represents one of the most basic problems again applying to all systems, which starts by trying to establish the actual expenditure. With the current level of information cost can only be assessed but not established.

8.1.0.1.6. Billing and Revenue Collection:
Many monthly billing records and returns were found to be estimated. Various explanations were offered, but all centered around the fact, that the information has to be monthly and manually abstracted from all consumer ledgers after the billing has been completed. The time available between completion of billing and submission of the monthly return is considered too short to complete the time consuming exercise. As monthly returns do not seem to be returned by the Head Quarter, the estimation is seen as an accepted practice. While the practice of estimation could be accepted for the given reason, the reconciliation at the end of the FY is missing, and annual details for the Head Quarter are simply wrong. Only Muranga town and possibly Makindu seem to be reporting actual monthly records. The tariff increment effective November 1999 could not be seen in many of the estimated billing figures for most systems, neither was it apparent for some of the revenue officers, that delayed implementation of the tariff increment should be captured with a retro-active adjustment.

The issue of estimation of monthly billing returns was not applicable for Kabarnet, as the water system only obtains meter readings and the Regional Office prepares computer generated bills. Monthly information about what was billed to the consumer should be correct.

For the verification exercise of June 2000 bills, the consultant filtered out consumers with the same actual consumption and noted, that different billing amounts seem to be calculated for the same consumption. As the majority of the billing officers do not have a calculator, this can be seen as a possible explanation for the variations. Appendix K 3 – ST 1.1. shows the analysis and reflects the situation for a few sample towns. The same bill variation seems to be the case for Kabarnet however limited in number, explanation for which should relate to the billing program.

Revenue collection records and returns are based on records obtained from the District Commissioner's office. Only minor discrepancies were noted, which can be explained by the fact, that report preparation does not necessarily fall together with calendar end month.

The attempt, to verify consumer payments against reported revenue collection, failed. The payment situation abstracted from the consumer ledgers for the month of June, 2000 was explained to reflect the situation as at 30.06.00. Unfortunately ALL the 9 water systems (excluding Kabarnet) involved in the exercise, misunderstood the information requested for and reflected last payments up to December,2000.

The billing efficiency for the various towns ranges between 22% in Kabarnet town and 64% in Narok town, while the collection efficiency ranges between 22% and 87% for Muranga. It should be noted that Migori and Mumias have not been considered for this comparison, as their billing efficiency is exceeding 100 % and unrealistic, as consumption should not be higher than the production.
The combined billing and collection efficiency ranges between 15% and 49% and is suggested to be used as one of the criteria for selecting priority projects.

Muranga is the only town where consumers voluntarily come to the DC's office to ask for the amount due for payment, which they then pay, without even having received the bill. Bills are only issued for GOK institutions, schools or companies on request. While Lamu operates in a similar way, it must be noted that Muranga merges this fact with a high billing and collection efficiency.

8.1.0.1.7. Average Tariff:
The average tariff had not been calculated in any of the towns visited, because it is not required for any of the GOK returns, hence not a commonly used term. The calculation of the average tariff, where possible, was prepared for the month of June 2000. It ranges between 16.57 Kshs for Migori and 42.31 Kshs for Wundanyi.

The June 2000 average tariff read in conjunction with the percentage of consumers billed on 10 cbm minimum charge, indicates which towns have a substantial base of minimum consumers. The minimum charged consumers

range from 12.37 % in Webuye to 78.14 % in Lamu. An analysis for the number of consumers falling into the various consumption brackets is commented on in the report for the various systems and gives an indication of the revenue base and the consumer portfolio.

8.1.0.1.8. Debt Situation:
The monthly debt situation is reported to the Head Quarter, whereby brought forward balances are increased by the monthly ("averaged or estimated") billed revenue less revenue collected. For all towns it was therefore found, that balances abstracted from the consumer ledgers did not correspond with the reported information. Discrepancies reflected are substantial in some cases. It can however not be established where or when those differences slipped into the system. An analysis was undertaken to split between GOK, major and minor consumers where possible. The one consumer taking the biggest share of unpaid bills in District towns, is the Government of Kenya. While the debt situation increases on a monthly basis, no effective measures seem to be in place to improve on the prevailing situation. Collection targets are set for the WS systems, but collection of GOK debt must be termed as very difficult and the possibility of involving the MENR Head Quarter should be considered after verification and substantiation of existing GOK debts.

Verified debt , as abstracted from the consumer ledgers, for all the towns visited amounts to: Kshs 61,899 million as at the end of May, 2000 and Kshs 64,678 million as at the end of the Financial Year 99/00. This can be interpreted such that the debt outstanding, increases by approximately 3 million per month for all the ten towns. Even though this information has been abstracted from the respective consumer ledgers, it must be pointed out, that a much more intensive analysis will have to be done, to confirm the collectable debt, as it includes disputed bills relating to wrong billing calculation, wrong meter reading or no water situations. The abstracted figure can however be used as an indicator. When comparing the total outstanding at the end of the Financial Year with the value of the annual water loss of approximately Kshs 64,8 million, the need for intervention concerning UfW, becomes even more apparent. Remedial efforts should concentrate and start with the attempt to reduce this aspect of water lost.

8.1.0.1.9. Funding:
Salaries, power and chemical expenses are paid through MENR Head Quarter. All other expenses at District level are funded through A.I.E. (Authority to Incur Expenses).

The A.I.E. earned during the FY is not automatically the A.I.E received. Any application, pending approval at the end of the FY, is not returned for resubmission in the new year, but null and void. It appears, that the 10 towns have earned a total of Kshs 17,930 million in A.I.E., but only received and incurred expenditure amounting to Kshs. 17,182 million. When a comparison is drawn between A.I.E. earned and A.I.E. received on a town by town basis, it shows that some towns managed to receive more A.I.E. then they have actually earned while others received considerably less. It could not be established with certainty how the procedure of "receiving more" operates.

8.1.0.2. Utility System Procedures

Existing procedures were analysed against the facts, figures and details obtained. Statements were questioned against the background of facts established.

8.1.0.2.1. Administration:

8.1.0.2.1.1. Staff:
No personnel management, training or recruitment procedures are in place and the approach of utilising staff where and when needed, results in a situation of no control over staff movements. Moving the technical staff into billing and revenue, instead of recruiting qualified and trained staff for the commercial aspect of the utility operation reflects on the system efficiency. The staff morale is equally affected and the low salary structure and delayed promotions attribute to the often understandable "not really concerned" situation. Sanctioning within the civil service structure has not been very effective in the past. The worst to happen was a transfer with no financial repercussions. At the same time positive efforts are not appreciated which often leads to the above indifference.

The recent retrenchment exercise has however changed the prevailing opinion concerning job security. The criteria for the recent retrenchment has not been understood by the staff, as in a number of systems, important and knowledged staff members were removed.

8.1.0.2.1.2. Consumer Accounts:
Clear guidelines on new connection, dis-connection, re-connection and any other routine procedure, are not in place. Especially for cases of recently gazetted changes, the gazette notice seems not sufficiently explained with the consequence, that every system handles the issue differently. Concerning new meters, deposit levels or delayed tariff implementation, wrong implementation of the gazetted notice translates into loss of revenue. If for example the tariff adjustment information and implementation instruction reaches the systems with a certain delay, the gap between gazettment and implementation should be closed. Some systems did so, others did not.
The maintenance of consumer and connection records must be considered as vital for any utility system. All systems lack however clear guidelines and control at system level. The ever prevailing shortage of stationary or operating material is the excuse and/or explanation for messy filing or files and books not found or records not kept. Clear guidelines on consumer record keeping were not found and the recording varies from application form to meter reading book to consumer ledger, depending on the WS system.

8.1.0.2.1.3. Meter Reading, Billing and Revenue Collection:
Meter reading schedules and procedures are not in place and there is no control over the process, neither the staff entrusted the exercise. Wrong or no meter reading affects the billing efficiency and eventually revenue collection, as consumers dispute by simply not paying. When wrong or over estimated bills go along with no supply and service, the payment morale drops and illegal activities increase. While all District water offices have water bailiffs on their staff list, they

are not used to handle cases of illegal water consumption, but only deal with water rights and granting permits for water abstraction.
All systems operated by the MENR issue manual bills and varying bill formats are used. Formats of the system have not been improved for years and some reflect for example consumption stated in gallons, while almost all consumer meters are read in cbm. This increases the risk of error calculations. Majority of consumer bills are hand delivered or collected from the water office, as no funds are available for mailing.
Systematic dis-connection and control procedures were not found to be in place. Explanations given relate always to shortage of funds and/or lacking plugging material, no transport or shortage of staff. Once an account is dis-connected, the consumer retains this status, unless he comes forward to regularise his/her account. Routine checks on long dis-connected accounts, are not practiced or not really possible, because the transport or staff necessary, is not available. This fact bears a high risk of undetected illegal re-connections and contributes into the high UfW.

8.1.0.2.1.4. A.I.E. and Procurements:
An A.I.E. is calculated based on the monthly revenue collection and a certain A.I.E. percentage, determined by MENR, and varying from town to town. In the case of the towns visited, the percentage ranges between 60 % and 90 %. The basis for the different percentages could not be established.
The receipt of an A.I.E. is affected by many factors and in all cases causing delays for procurements and the day to day operation. Appendix K 3 – Figure 8.2. illustrates the 17 steps between revenue collected at the DC's office and the approved authority to spend. The approved A.I.E. can only be used for procurement, if the Local Purchase Order (L.P.O.) processing procedure has been complied with. Suppliers often reject to supply against an L.P.O., because the payment processing procedure is another lengthy procedure to follow. Appendix K 3 – Figure 8.3. illustrates the path a pro-forma invoice has to take, before a cheque can be issued. Supplies are limited to listed suppliers within the District and the District Tender Board has to approve such suppliers.
The issuance of a cheque to a supplier is furthermore dependant on District Office liquidity and priorities set by the District Administration. As the District Administration is not only responsible for A.I.E. of the water department, but all the other GOK departments represented within the District, priorities might be given to other departments, depending on the situation. Collection efforts from the water department can be frustrated by such factors, which are beyond their control.
As long as quotations are obtained as required, and vouchers are signed by the respective signatories, expenditure seems the responsibility of the respective District Water Officer. It must only be ensured that it can be booked against votes that have been budgeted for. Finally, the District Administration has to account for the expenditure incurred, while the Ministry concerned is no longer involved. The complicated and lengthy procedures do not seem to relate to Financial Control at the end of the process.

Transport and staff related expenditure absorb a relatively high percentage of the approved and received A.I.E., while stationary or other inexpensive items are said to be lacking. It could not be established based on which criteria approved A.I.E. are spent and whether quotations obtained, reflect a realistic market price, when

compared. The process shows that Water department requirements are not only at the discretion of the water department through its representative the District Water Officer, but mainly depend on the District Administration, which is answerable to the Office of the President and the Treasury/Ministry of Finance.

Divisional Offices are affected by the same procedure, but their requirements have to undergo an additional step in order to be incorporated into the District requirements.

The Kabarnet area office submits all its requirements through the Regional Office, which in turn still has to follow the same or similar GOK procurement procedures.

8.1.0.2.2. Operation & Maintenance:
No preventive maintenance is in place, neither are technical manuals available. There is no guidance on standards and no procedure control over quality of water. Consumer meter servicing is neither scheduled, nor controlled or guided. Master meter preventive or routine maintenance is not covered by any procedure, and servicing lacks skill and the necessary tools. While some provincial water offices do have the necessary equipment, they lack spares. The reason for all shortcomings is said to be the lack of funding.

Chronically empty stores are explained by the same lack of funding. Only Lamu town had stock balance records available, which could relate to its location and island status. In most cases it was explained that procurements mainly relate to a technical problem that has to be attended to and parts are used as soon as they are available.

The WS Operators Handbook was found in the Webuye WS system, but the available version seemed very old (without any printing date) and not reflecting any system specific information or guidance.

8.1.8. Lamu Water Supply & Sanitation System

Lamu is the District Water Office falling under the Provincial Water Office Mombasa (Coast Province), and at the same time provides the urban water supply for Lamu island and town, currently serving a population of approximately 12,000.
While Lamu oversees 7 Divisions, only 3 Divisions are manned by a Divisional Water Officer and only one Division collects revenue.
The water demand for Lamu could be met by the just recently and partly rehabilitated source, comprising of 30 wells. 10 wells were rehabilitated under the El-Nino project, while 5 wells were at the time of visit non-operational due to electrical problems.
Discussions have been held with residents of the prestigious Shella area, where exquisite hotels and holiday homes of many Kenyan and foreign "famous" are situated. They currently operate their own wells and would like to connect to the main supply.
The distribution network only reaches certain areas of the town and is seemingly badly corroded. The pipe network of Lamu is to a great extent located under the old town buildings and streets and leak detection is very difficult. Contributing to the complicated situation is the fact that the town has numerous wells, located in-between the old houses, serving some houses with piped and pumped supply as well as those, that provide free bucket supply, where the need arises. During the site visit the consultant walked along the network and came across a number of criss-crossing lines of which not even the meter reader was sure whether they carry the main supply or the "free well" supply.
Power rationing is not an issue for Lamu, as the KenGen generator depends on the Water Department's water for cooling their system. Both suppliers depend on the service of the other.
Even though the supply situation has improved since the ElNino rehabilitation, consumers visited still complain of getting no water, while being charged average on those accounts that have non-working meters. Rationing consumers is done but since the rehabilitation it is said to be done such, that everyone gets some water daily.

8.1.8.1. Utility System Organisation:

8.1.8.1.1. Staffing:

The total number of staff is 17, of which 6 staff members, including the District Water Officer, are shared between District and Lamu Water Supply activities. Refer to Appendix H Figure 8.1.8. – Organisation Chart. A clear delineation between District and Lamu WS staff has been difficult and is reflected in the organisation chart to the best of the understanding of the consultant.
The Head of O&M is responsible for Source, Treatment, Distribution, Billing and Revenue Collection and Accounts. The Accounts section only processes A.I.E. and forwards procurements, which is partly covered by the stores and the DWO directly. At the time of the visit, it was understood that the executive Officer / Accounts had been retrenched and the store man was attending college, while an SS was holding office for him.
The background of all Billing and Revenue staff is technical. Meter reading is done by one meter reader, as the second meter reader had been just retrenched. Training

opportunities have not been forthcoming for the last 6 years, even though applications are forwarded every year.

The index of number of accounts per staff member is:

Staff	Consumer Accounts	Accounts/Staff
17	837	49.24

8.1.8.1.2. Office Set-up, Facilities and Transport:

The office is located in a large compound with the 450 m^3 main reservoir and several small stone buildings, shared between District and Lamu WS staff. Six small offices and a corner for the secretary operate within the compound and 1 office and 2 stores (apart from 2 staff houses) are situated at the pump site. Basic hard furnishings are provided including tables, chairs and cabinets, but all need repair. Due to its coastal climate and no breeze from the Indian Ocean, the offices are infested by mosquitos and air conditioning is considered as a basic requirement. The secretary has one manual typewriter, but no calculators are available for the Billing office. One working telephone line with 6 extensions is available.
One Landrover 110 pick-up and one Yamaha motor-bike, however grounded for lack of spare parts are shared with the District. Lamu does not have high requirements concerning transport due to the fact that cars are not permitted on the island and transport in Lamu is done with the help of donkey carts.

8.1.8.1.3. Consumer and Meter Information:

All information is somewhere, but not in a compiled or summarised format, and possibly not readily available.
The decision was therefore made to obtain as much information as possible for June 2000 from the consumer ledgers, and use that "Base Verification Month" as a representative snapshot. This information was then related to figures and returns that are normally sent to the Provincial Water Officer (PWO) and MENR Head Quarters.
An abstract of the comparison between information available or provided, with the verified information, is shown here below. Complete information is available in Appendix H3 Table 8.1.8.:

Detail	Provided from NAROK	Verified for June 2000
Registered Consumers:	Approx. 900	837
Metered:	Not readily available	800
Working:	90	104,but 95 actual bills
Not-Working:	810	697, but 608 estimate bills
Un-metered:	Not readily available	35
Disconnected:	Not readily available	95
Major Consumers	Not readily available	2*
Minor Consumers:	Not readily available	701

- * Consumer ledger information Table 8.1.8. did NOT include the hospital account, but has been said to be a major consumer. Supplied directly from the 6" raising main, hence supply is guaranteed.

There is one operational Kiosks in town, but hardly records any consumption. The kiosk sells predominantly during the dry season and mainly for residents of other islands.

The distinction between Major and Minor consumers was based on the June 2000 consumption exceeding 100 m^3 for Major consumers only.

8.1.8.1.4. Production and Consumption:

Production:

Production figures as used for the monthly O & M Monitoring returns, are based on master meter readings. 2 master meters are located at the pumpstation and 1 master meter is at the reservoir. All are operational. Appendix H3 Table 8.2.8. as abstracted from the site records, reflects the following picture:

Detail	Average 1-6/00 as provided	June 2000 as provided
Design Capacity / Month	90,000 m^3	90,000 m^3
Production / Month	16,699 m^3	22,833 m^3
Production / Day	557 m^3	761 m^3

By September 2000 the ElNino rehabilitation had already reflected considerably in the production and records were obtained to reflect the production improvement by that time. While the **Production Efficiency for June 2000** was **25.37 %,** the same had improved to 55,44% by September 2000 and is expected to have produced even more by the end of October, when the ElNino works were completed.

Consumption:

Consumption records are available in Appendix H3 Table 8.2.8. and compared with the verified details from Appendix H3 Table 8.1.8.:

Detail	%	June 2000 as provided	%	Average 1-6/00 as provided	%	June 2000 as verified
Actual Consumption	45	9,292 m^3	28	4,232 m^3	17	1.294 m^3
Estimate & Flat Rate	55	11,141 m^3	72	10,729 m^3	83	6,510 m^3
Kiosks		10 m^3		10 m^3		Included in above
TOTAL:	100	20.443 m^3	100	14,971 m^3	100	7.804 m^3

On a monthly basis, consumption records can only be compiled by summation from the consumer ledgers. This exercise is, however, not done on a monthly basis in Lamu, but the information required for the monthly returns to the Provincial and Head Office is assumed to be estimated. This conclusion is drawn, when comparing June 2000 records with the verified records, which shows a very big difference.
As these returns do not appear to be commented on, or returned back to the Lamu office, the practice of approximation seems to be accepted. No reconciliation seems to be done at the end of the FY.
The June 2000 consumer portfolio as analysed here below shows that Lamu has the absolute majority of consumers, consuming up to 10 m^3 per month and this consumer group represents 92.75% of all billed connections.

It should be pointed out that future tariff adjustments towards a cost covering tariff structure will become very sensitive for towns like Lamu, where the highest contribution into the earned revenue comes from the lowest consumption group. A social tariff, shifting cost to the consumers or institutions on higher consumption, is from the picture reflected below almost impossible. The discussions concerning the

possibility of including Shella into the supply area and further investigation concerning hotel demand and consumption within Lamu old town, might however change the picture.

Consumption Steps	Number of Bills		Revenue Earned (June 2000)	
	Actual	Estimate	Actual Kshs	Estimate Kshs
0 to 10 m^3	56	596	16,080.00	167,480.00
11 to 20 m^3	27	7	10,733.00	2,835.00
21 to 40 m^3	8	2	6,280.00	1,690.00
41 to 60 m^3	2		3,050.00	
61 to 100 m^3	1	2	2,695.00	6,375.00
> 100 m^{3*}	1	1	4,285.00	4,040.00
TOTAL:	**95**	**608**	**43,123.00**	**182,420.00**

- It is to be noted, that the June bill for the Ministry of Health (District Hospital) reflects Kshs 58,635.00, but no consumption is reflected, hence the bill and consumption is NOT reflected in the above analysis. It was however mentioned that the Hospital has a very high consumption.
- The remaining balance of Kshs. 8,202.00 to the revenue earned is explained with another 10 bills reflected without any consumption records.

8.1.8.1.5. Unaccounted for Water (UfW):

Lamu's main problem relates to the weakness in the distribution system.
Lamu WS reflects its monthly losses in the O&M Monitoring Report. Refer to Appendix H3 Table 8.2.8. for the months January – June 2000. The reported average loss over those 6 months is calculated as 10.34 % per month.
Using the production of 22,833 m^3 and the verified consumption of 7,804 m^3, for the month of June 2000 translates into a loss of 65.82 % or 15,029 m^3. Lamu reported for the month of June a loss of 2,390 m^3, equivalent to 10.46%.
The value of UfW, calculated for June 2000, using the average tariff of Kshs 37.47, is therefore Kshs 563,136.63. When the monthly loss is compared with the collected revenue, it almost accounts for 6 months collection.

8.1.8.1.6. Billing and Revenue Collection:

Billing:

The Billed and collected revenue is reflected in Appendix H3 Table 8.3.8 and abstracted from monthly returns to the PWO and MENR. The billed revenue only varies minimally from month to month and is believed to be estimated, especially when considering that 87% of all bills are estimated or averaged. The month of June, being the last month of the Financial Year does not seem to reconcile the picture.
It is noted that the tariff adjustment took place with the February 2000 bill, as the billed revenue almost doubled. Adjustments for the months of December and January cannot be seen in the months thereafter.
The approach of the Consultant was to verify using Appendix H3 Table 8.1.8, which contains the information abstracted from the consumer ledgers for the month of June 2000. This exercise indicated the amount of Kshs 292,380.00 as the billed revenue, whilst the monthly return to PWO and MENR abstracted from Appendix H3 Table 8.3.8 states the June figure as Kshs 339,122.00. The difference can not be explained and would require further reconfirmation on site.

Based on the production for June 2000 of 22,833 m^3 and Appendix H3 Table 8.1.8 records, a billed consumption of 7,804 m^3., would result in a verified
Billing Efficiency for June 2000 at **34.18%**
The Consultant visited a number of consumer connections to try and compare records with field information and the following was observed:

- Where new meters had been installed just recently, the consumption reflected within a week was more then the amount used as the monthly estimated average in the past.
- Where connections receive water, neighbours seem to share and give each other "hose-piped" assistance, which means that it will be eventually very difficult to do realistic consumption assessments, when trying to reconcile old accounts that have been on estimated average for a long time.

Revenue Collection:
The revenue collected is reflected in Appendix H3 Table 8.3.8 as provided through the Lamu WS office return and the District Treasury. This amounts for the whole FY to Kshs 1,295,717.00, resulting in an average of Kshs 107,976.40 per month.

Detail	June 2000 as provided	Average FY 99/00 As provided	June 2000 Verified
Billed Revenue:	338,122.00	239,625.60	292,380.00
Collected Revenue:	100,935.00	107,976.40	100,935.00

The attempt to verify payments with the information contained in Appendix H3 Table 8.1.8. must be termed as futile because the officers abstracting the information from the consumer ledgers, not only did consider payments up to 30.06.00, but also any payment that was in their records up to 21st September 2000.
The amount used for calculating the Billing efficiency is the collected revenue, verified with the District Treasury.
The verified **Collection Efficiency for June 2000** stands at **34.52 %**
The District Hospital, being one of the very few major consumers affects the collection efficiency considerably, as it was noted that the Hospital has a debt balance of 1,192,285.00 Kshs and the last payment is recorded on 12th January 2000.

8.1.8.1.7. Average Tariff:
As no reliable summarised consumption or billing details are available, the average tariff is calculated for June 2000, based on records from Appendix H3 Table 8.1.8. Billed Revenue Kshs 292,380.00 / billed consumption of 7.804 cbm and results in a verified **Average Tariff for June 2000 of Kshs 37.47 per m^3**

8.1.8.1.8. Debt Situation:
The debt arrears situation as provided by Lamu is the computed total, forwarded on a monthly basis in the format of Appendix H3 Table 8.3.8. The Lamu basis of calculation shows two main problems:
a. Monthly bills are estimated, and
b. The outstanding balance from the last FY incorporates the same problem.
As the estimated billed revenue is not reconciled at the end of the FY, no correction ever takes place.

Using and analysing the information from Appendix H3 Table 8.1.8., the situation **prior to the June 2000 bill** is:

Detail	Lamu Debtors as provided	No. of accounts	Verified Debtors	No. of accounts
Total Debtors	2,436,479.00	Approx. 900	3,137,731.00	828
Major Consumers				
10,001 to 20,000	Not available		147,830.00	11
20,001 to 30,000	Not available		29,301.00	1
Above 30,000	Not available		1,308,051.00 *	3
Total Major			**1,485,182.00**	**15**
Minor Consumers				
0 to 10,000	Not available		1,652,549.00	813
Total Minor			**1,652,549.00**	**813**

* Kshs. 1,192,285.00 relates to District Hospital

As Lamu residents are fortunate enough to have a substitute well supply in most areas of town, disconnection efforts do only have limited success. It was however mentioned that Lamu WS system does not experience illegal connection problems, as the island is as well seen as a religious island and "haram" (something prohibited or forbidden) is feared by the consumers. Lamu residents only have a problem where they receive a bill, but they do not receive the expected supply and explains the high balance of minor consumer outstanding.

8.1.8.1.9. Funding:

Based on the collected revenue and an A.I.E. (Authority to Incur Expenditure) of 90% , funds are sent from Treasury to the District Treasury. The process involves the MENR Head Office and is explained under Chapter 8.4. of the main report. The A.I.E. percentage is determined by the MENR Head Office and in the case of Lamu very high, which is likely to relate to its island status. Appendix H3 Table 8.5.8. reflects that the A.I.E. earned is not necessarily A.I.E. received.

A.I.E. Earned FY 99/00	A.I.E. Received FY 99/00
1,166,145.30*	1,269,860.00

- * Calculated as the 90% of the collected revenue

The A.I.E. received is to be utilised by all Water Divisions within the District. A separation between Lamu WS and the other Divisions was not readily available. It can only be stated, that the actual expenditure reflects as below:

Details:	Expenditure FY 99/00
A.I.E used for O&M	1,264,846.10

8.1.8.2. Utility System Procedures:

All current procedures, as far as the office and field operations are concerned, are covered in the Appendix H3 Questionnaire 8.1.8. It was the approach of the consultant to verify as many as possible technical, financial and commercial details to substantiate procedures with the facts obtained.

Procedures that continue at Head Office level, and apply to all towns analysed, are investigated separately and covered under Chapter 8.4. of the Main Report.

8.1.8.2.1. Administration:

8.1.8.2.1.1. Staffing:

Staff members are transferred and/or promoted based on decisions made at HQ or Provincial level. The processing of transferrals and promotions in Nairobi seems to be extremely protracted. Staff have not seen any promotions or training opportunities and assume that up-grading has stopped. Expected salary adjustments commensurate with promotion are equally slow in arriving.

While there is provision for annual forms to be completed by staff members requesting promotion and training, staff members believe, that officers entrusted the promotion processing at the Head Quarter have been fazed out.

Salary levels are considered as being much too low.

Staff working in the Billing and Revenue Department have a technical background, and have been placed in positions that bear no relation to the job category for which they were trained, employed and are paid for. When placed into these non-technical positions, staff do not get training, but are expected to learn from the others on the job.

The recent retrenchment exercise affected Lamu considerably, as 17% of the staff members were removed from operation.

8.1.8.2.1.2. Consumer Accounts:

Consumer information is held in the **application** form and the consumer ledger, which is up-dated with the monthly meter reading, calculated bill and payment received.

Form F 101 is available to **close a consumer account**, but Kshs 200.00 have to be paid, upon which the final meter reading is taken, the bill is prepared and pending bills have to be cleared before the account is closed in the consumer ledger.

The **transfer of an account** to another consumer is only recorded in the consumer ledger after the outstanding has been cleared. The account number does not indicate the transfer, as the new consumer simply takes over the old number. **Change of address** is not considered in Lamu, as all consumer bills are either hand delivered or collected, and no information is ever mailed.

8.1.8.2.1.3. Meter Reading, Billing & Revenue Collection:

Meter Reading

After the retrenchment exercise, Lamu is left with only one meter reader, who goes with the meter books from the 17th of every month. He reads for approximately 2 weeks. Back in the office, he transfers the information into the consumer ledger. Books are organised such that they correspond with the zones.

Billing:

The Bills are calculated when the consumer comes to the office. If the consumer does not come for the bill for some time, the bill is prepared together with the dis-connection list.

The billing includes a monthly charge of 30.00 Kshs on behalf of the Council. The charge covers litter collection charges which are applicable for all consumers.

Disconnection:

The Officer in Charge prepares the disconnection list with information abstracted from the consumer ledger. Three people make up the disconnection team. They go with the bills prepared and tell the consumer to pay or get disconnected. With Lamu

being a small island, where everybody knows everybody, consumers then come and pay, if they have said they will they come.
Disconnection and reconnection details are reflected in the O&M monitoring report and reflect an average of 16 disconnections and 3.33 re-connections per month.

New Connection:

Upon a consumer request for a new connection, a site visit/survey is carried out by either the Divisional Water Extension Officer or the Officer In Charge of O & M. If the connection is possible, the application form is filled at the office, and approved by the DWO.
After forms are filled and the survey confirms the availability of water, material has to be provided by the consumer, and the deposit and labour has to be paid for. Before the connection is installed, the information has to be entered into the meter book and consumer ledger. New consumers are advised to bring their own, new meter. The new account number indicates the zone (currently 8 zones) and account number. Account numbers do therefore relate to the area in which the connection is located.

Revenue Collection:

Since September, 2000 all revenue is collected at the District Water Office. The explanation given is the retrenchment of the former revenue collection officer and an attempt to centralise the issuance of bills and payment of the same. Consumers are otherwise forced to move twice between the District Water and District Commissioner's office. Cheques and cash collected are then surrendered to the DC's treasury by filling in a collection control sheet with receipt numbers and amounts collected. Voucher F 017 is then issued to confirm the amount received and the same is attached by the DWO to A.I.E. applications. The collection information is then immediately transferred into the consumer ledgers.

8.1.8.2.1.4. AIE and Procurements:

Authority to Incur Expenditure (A.I.E.)
Monthly revenue returns are prepared to the Head Office and supported by form F.O.17 prepared at the D.C.'s Office, reconfirming the total amount of revenue collected. With this information, the DWO forwards a request to Headquarters to approve the same.

Procurement:

Chemical requests are made through the HO, but no records were readily available. Appendix H3 Table 8.7.8 has details of the total stock balance as at end of June 2000.
Due to its island status, Lamu had higher stock balances then any of the other systems visited.

8.1.8.2.2. Operation & Maintenance:

Intake
No procedure laid down, staff attend to problem when there is a problem

Treatment
No procedure laid down and available.

Lines and Appurtenances
No routine or preventive maintenance procedures are in place.

Master Meters
All master meters, located at the point of production are operational, but no service or maintenance schedule is in place.

Consumer Meters:
No procedures or records of field activities are in place. Normally servicing is not done, only sometimes meters are flushed.

Stock
Stock records were made available (Refer to appendix H table 8.7.8). The supplies officer was not available, as currently in college. His position is temporarily covered by an SS.

Operation Manuals:
Only for the pumps said to be available.
No manuals for technical procedures.

8.1.8.3. Community Projects:

The consultant did not obtain any information about community projects within the Lamu Water Supply area.

8.1.8.4. El-Nino Project:

No information was obtained concerning any on-going El-Nino activity.

8.1.8.5. Recommended Priority Measures:

ElNino has rehabilitated 10 boreholes, which has improved the production/supply to Lamu town considerably. Even though ratios were calculated for June 2000, the production had more than doubled by September 2000. The consequence of increased production, while the distribution system remains principally unchanged, will reflect in UfW . The June 2000 UfW was 66% and should even increase with the considerable increase in production.
The weakness is in the distribution system and the uniqueness of the network, coupled with 86% of all meters being estimated. As Lamu has numerous alternative water sources within the town area, assessment of consumption becomes very difficult. At the same time Lamu has a portfolio of 93% minimum consumers. The aspect of water theft is no issue in Lamu. The reduction of UfW must be given the overall priority.
Unaccounted for Water is made up of:

- Physical losses in the transmission and distribution system
- Wrong meter reading and billing.

The collection efficiency in Lamu seems very low with 35%, mainly relating to GOK and bodies like the District Hospital, which is on flat rate and they last paid in January 2000.
To reduce the water losses, it is recommended to give the following priorities:

1. **Full rehabilitation of the existing distribution system, including standardised meter connections,**
2. **Replacement or repair of all faulty and flat rate consumer meters,**
3. **Setting up of a consumer data base and a reliable billing program, and**
4. **Management and staff Training for the relevant staff members.**

All other recommended activities under the Utility Management Plan under Chapter 8.10., are given second priority. These second priorities are however to be considered as equally important and recommended to be implemented.
The very high number of non-functioning consumer meters is seen as the major contributor into the low billing efficiency of 34%.

8.1.8.6 Recommended Project Implementation Plan:
Based on the Action Plan Activity Phases as reflected in Appendix K3 Summary Table ST 8.4., the following Project Implementation Plan for Lamu is outlined here below for the 3 different Phases mentioned.
The overall assumption under which the proposed activities will reflect in the expected results, is, that major players and stakeholders ensure that recommended reforms in the Water Sector are implemented.
Other assumptions under which the proposed activities will reflect in the expected results are:

Assumption 1:

- Funds for approx. 700 consumer meters are available
- Funds for setting up temporary office with computer hardware (3), printers (2), billing software, additional transport (2 motorbikes (1 line patrol, 1 repairs)) and basic office equipment are available,
- Funds for remuneration of the proposed staffing organisation is available,
- Funds for 6 months interim operation, while cash collection is re-organised such that funds remain available at system level, and
- Funds for the involvement of the Management Consultant

All funds must be available or planned for at the beginning of the Management Consultant's involvement. Refer to Table 4.4.: Cost Estimate for Rehabilitation Works for the Lamu Water Supply.

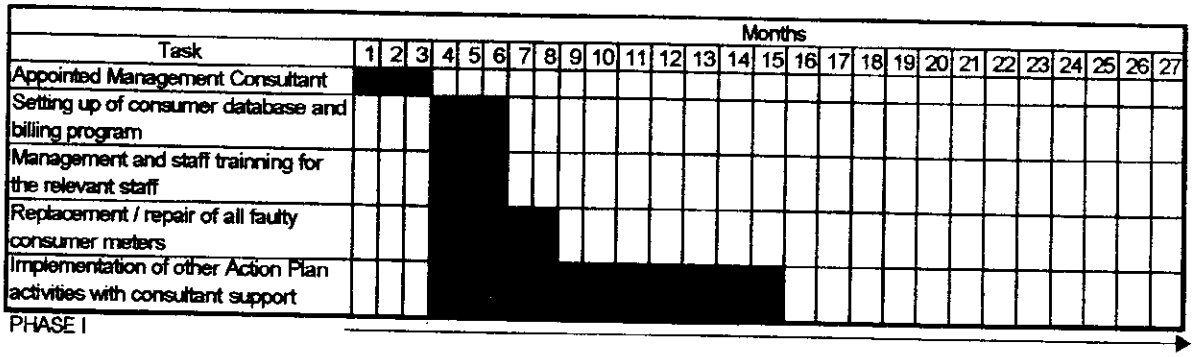
Assumption 2:

Staffing re-organisation, training and selection of staff as recommended by the Management Consultant receives the necessary support from MENR.

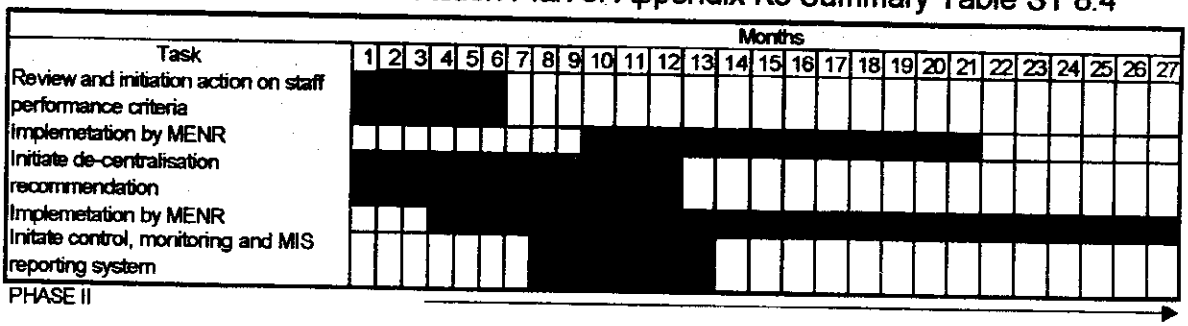
Assumption 3:

The reduction of UfW is expected as an immediate result of the meter replacement, billing improvement and management / training-on-the- job-support. The high number of meters to be replaced will require a period of 5 months, during which time approx. 140 meters are replaced in a standardised manner and on a monthly basis by the Lamu WS staff.

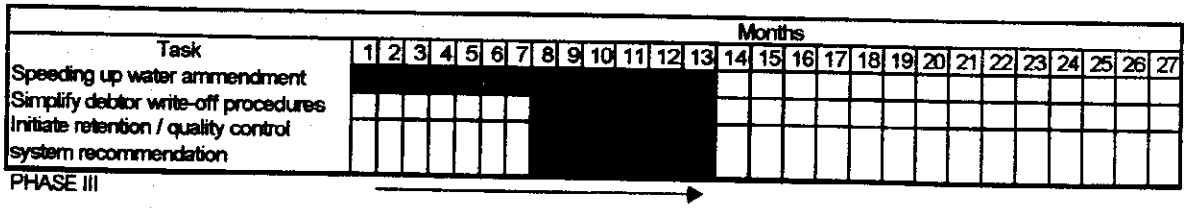
The minimum time involvement of an intensive Management Consultant support is taken as 12 months.



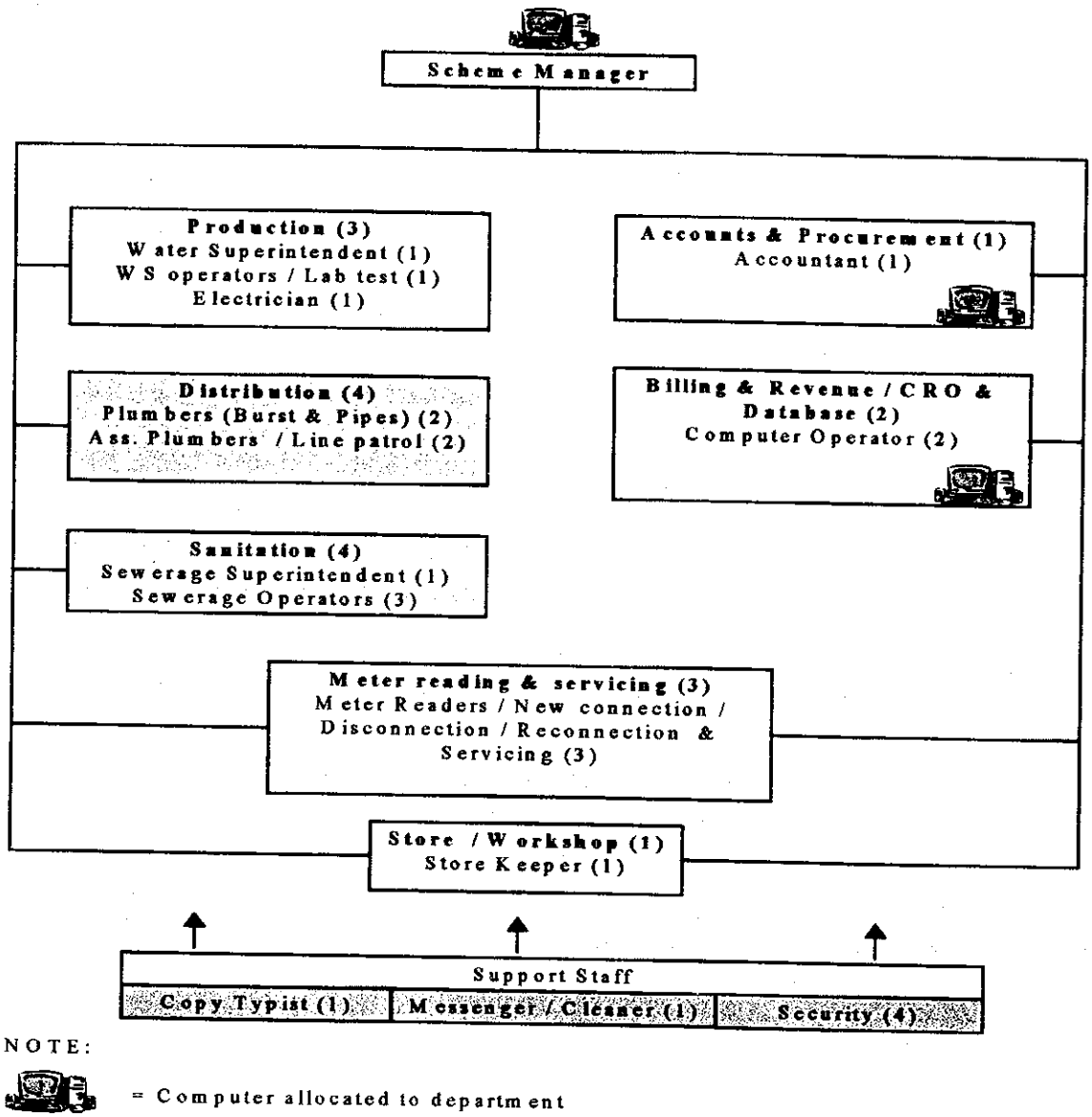
Phase 2 concentrates on de-centralisation changes, for which the more detailed activities are described in the Action Plan of Appendix K3 Summary Table ST 8.4



Phase 3 relates to legal changes recommended for which the more detailed explanations are listed and described in the Action Plan of Appendix K3 Summary Table ST 8.4



8.1.8.7 Recommended Lamu Organisation Chart:



Total recommended number of staff = 21 (additional 4 for sanitation)

NOTE:

- Currently no sanitation, therefore only provisionally noted in the chart

The possibility of out-sourcing security services, master meter and pump maintenance should be surveyed and assessed during the management consultancy contract. Implementation should be considered during the preparation of the rehabilitation works. In connection with the supply of master meters, it is assumed the supply of an adequate number will make a service contract, conditioned to the supply, possible.

Casual labour to support trenching or cleaning of blocked sewers will be sourced from the labour market whenever the need arises.

It is further recommended that consumer payments be received through existing Financial Institutions.