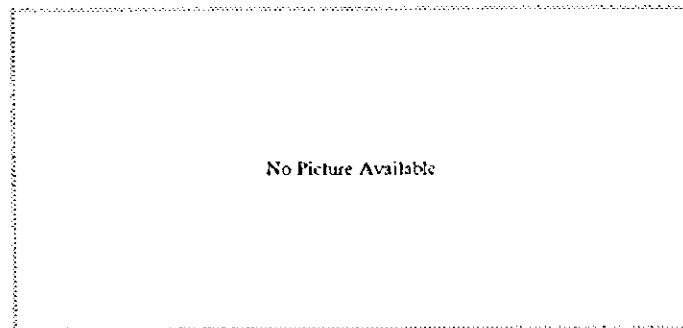


Name of Urban Center	Kapsabet				
District	Nandi		Coordinates		x y
Province	Rift valley		Elevation		35° 08' 0° 13'
Mean Annual Precipitation (mm)	Temperature max & min °C				
	1995	1998	2000	2005	2010
Population Projections	14,604	20,000	25,747	38,277	44,693
Municipal Area (ha)	164				
Population Density (ppha)					
Water Supply	1995	1998	2000	2005	2010
Domestic water demand (m3/d)					5,674
Total water consumption (m3/d)	920				
Area served (estimated net (ha))	100.0		247.0		420.0
Raw water source	Kabutie River				
Sewerage Facilities	1995	1998	2000	2005	2010
Population Served	5,226	4,000	7,724	9,569	11,173
Service coverage ratio %	36%	2%	30%	25%	25%
Area served (estimated net (ha))					
Population Density (ppha)					
Wastewater volumes (m3/d)					
No. of connections	130 to increase to 300 after Phase 3				
Treatment process					
<pre> graph LR A1[A] --> SF1[SF] A2[A] --> SF2[SF] A3[A] --> SF3[SF] A4[A] --> SF4[SF] SF1 --> M1[M] SF2 --> M1 SF3 --> M1 SF4 --> M1 M1 --> M2[M] </pre> <p>A, Anaerobic SF, Secondary facultative M, Maturation</p>					
Description & dimensions	Size (Top of embankment)		Area (Top)	Depth	Volume
Anaerobic pond 1	38.0	33.0	1,254.0	3.00	2070.0
Anaerobic pond 2	38.0	33.0	1,254.0	3.00	2070.0
Anaerobic pond 3	38.0	33.0	1,254.0	3.00	2070.0
Anaerobic pond 4	38.0	33.0	1,254.0	3.00	2070.0
Secondary facultative pond 1	95.0	75.0	7,125.0	1.75	10250.0
Secondary facultative pond 2	95.0	75.0	7,125.0	1.75	10250.0
Secondary facultative pond 3	74.5	50.0	3,725.0	1.70	4870.0
Maturation 1	74.5	50.5	3,762.3	1.50	4300.0
Maturation 2	72.0	51.0	3,672.0	1.50	4100.0
	Design Capacity		Actual flow		
	Dry weather	Population	Min	Max	Avg
Hydraulic loading	1,000				
BOD loading					
	BOD	COD	SS	TN / TP	IC
influent	480	800	140		
effluent	20	220	80	5.2 / 1.2	Nil
receiving water body u's					
receiving water body d's	4		30		
Receiving water body	Chebarbar river- Mokong river				

Aftercare Study on
the National Water Master plan

KAPSABET(2/3)

Sludge Processing	Treatment Method	Disposal
	Drying	Sold as manure
Operation & Maintenance	Treatment Works	
1. New facility, well maintained.		
2		
3		
4		
5		
6		
	Sewers	
1. Sewers are new.		
2		
3		
4		
5		



On-going projects	None

Management

Staffing			
	Skilled	Unskilled	
Sewage works and sewer maintenance	3	5	
Bye-law enforcement	-	-	
Other (watchmen)	-	-	

Resources Available		Comments
1 No. Exhauster lorry		Good condition
1 No. Saloon car		Good condition
1 No. Rodding machine		Good condition
Sewer rods and tools		Good condition

Sources of Revenue	
Sewer charges	
Connection fees	

Annual Cash Flow, Kshs.			
Year	Revenue	Expenditure	Surplus
1995	Billing not	120,000	
1996	Started yet	220,000	
1997		300,000	

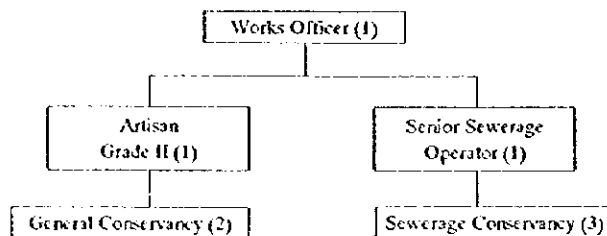
Financial Problems	
Inaccurate billing due to lack of service to meters	
Unmetered water service	

Investment Budget Plan	
Type of activity	Target Year
None	

On - Plot Sanitation

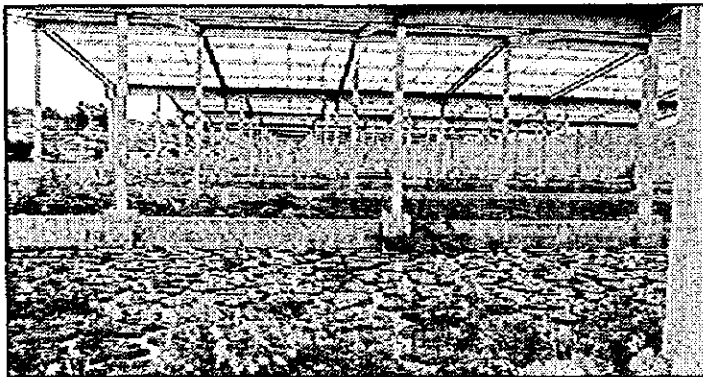
% Population with on-plot sanitation	80%
Method of desludging facility	Municipal Council Exhauster
Estimated Quantity of sludge m ³ /year	300 (approximately 40 trips per year - 8000 litres exhauster)
Location of disposal point	Sewage treatment works

Staff Organization Chart

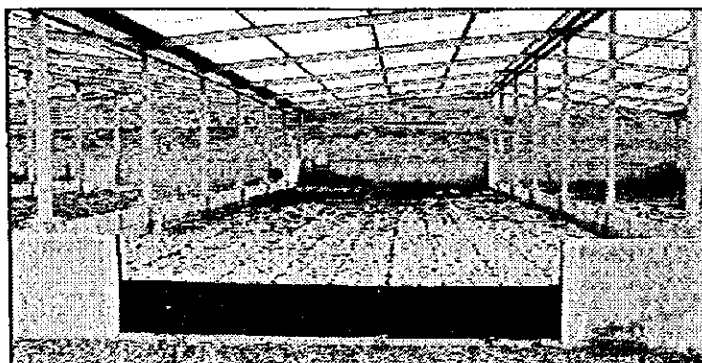


Name of Urban Center	Kericho		X	Y	
District	Kericho		Coordinates	35° 16'	0° 20'
Province	Rift valley		Elevation		
Mean Annual Precipitation (mm)	Temperature max & min °C				
	1995	1998	2000	2005	2010
Population Projections	55,108	80,000	91,601	132,237	152,522
Municipal Area (ha)	117	6,600.0			
Population Density (ppha)	479.6	12.1			
Water Supply	1995	1998	2000	2005	2010
Domestic water demand (m ³ /d)					20,663
Total water consumption (m ³ /d)	424	5,246			
Area served (estimated net (ha))	308.0	6,600.0	662.0		1,083.0
Raw water source	River				
Sewerage Facilities	1995	1998	2000	2005	2010
Population Served	4,647	41,600	18,320	39,671	61,009
Service coverage ratio %	8%	6%	20%	30%	40%
Area served (estimated net (ha))		396.0			
Population Density (ppha)		105.1			
Wastewater volumes (m ³ /d)		2,600			
No. of connections		236			
Treatment process					
<pre> graph LR PS1[PS] --> TF1[TF] TF1 --> SS1[SS] SS1 --> SF1[SF] SF1 --> SF2[SF] PS2[PS] --> TF2[TF] TF2 --> SS2[SS] SS2 --> SF3[SF] SF3 --> SF4[SF] SF2 --> M[M] SF4 --> M </pre> <p>PS, Primary sedimentation TF, Trickling filter SS, Secondary sedimentation SF, Secondary facultative M, Maturation</p>					
Primary clarifier	d=11				
Primary clarifier	d=11				
Primary clarifier	d=9.5				
Trickling filter 1	d=27.5				
Trickling filter 2	d=27.5				
Secondary clarifier 1	d=12				
Secondary clarifier 2	d=10				
Facultative pond 1					
Facultative pond 2					
Facultative pond 3					
Maturation pond 1					
Maturation pond 2					
	Design Capacity		Actual flow		
	Dry weather	Population	Min	Max	Avg
Hydraulic loading	1,500		300	500	400
BOD loading					
	BOD	COD	SS	TN/ TP	TC
influent	450	1950	250		
effluent	25	120	60	31.8 / 11.2	20
receiving water body u's					
receiving water body d's					
Receiving water body	Dionsoyet river				

	Treatment Method	Disposal
Sludge Processing	Digesters and sludge drying beds	Municipal garbage dump site
Operation & Maintenance		
Treatment Works		
1. Connecting pipe from first facultative ponds to second secondary facultative pond leaking since construction. Maturation pond does not fill to capacity due to the leak.		
2. High stormwater flow goes directly to first facultative ponds without any pre-treatment		
3. Treatment works well maintained.		
4		
5		
6		
Sewers		
1. Approximately 300 blockages per year		
2. 1000m of 100mm dia pipes require changing to 150mm dia pipes due to capacity restrictions.		
3		
4		
5		



Sludge Drying Beds: note simple structure to keep rain off drying beds



Sludge Drying Beds: note concrete slabs allow drainage into filter media and easy removal of dried sludge

On-going projects	None

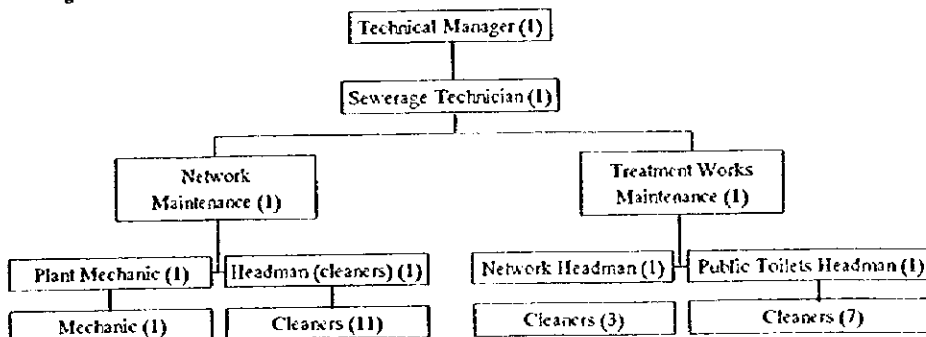
Management

Staffing			
	Skilled	Unskilled	
Sewage works and sewer maintenance	5	25	
Bye-law enforcement	-	-	
Other (watchmen)	-	-	
Resources Available		Comments	
1 No. Exhauster lorry		Good condition	
1 No. Pick-up		Good condition	
1 No. flushing machine		Good condition	
Sewer rods		Good condition	
Tools		Good condition	
Sources of Revenue			
Sewer charges			
Connection fees			
Annual Cash Flow, Kshs.			
Year	Revenue	Expenditure	Surplus
1995/1994	No records available		
1996/1995	5,820,254	103,600	5,716,654
1997/1996	5,983,861	24,158,368	(18,174,507)
Financial Problems			
Inaccurate billing due to lack of service to meters			
Consumer failure to pay bills			
Investment Budget Plan			
Type of activity	Target Year		
Rehabilitation and expansion of sewer system	1998		

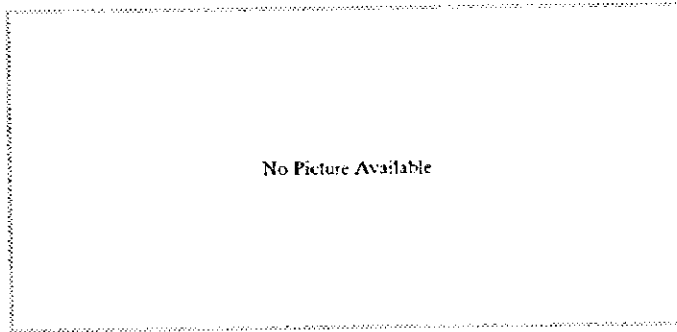
On - Plot Sanitation

% Population with on plot sanitation	48%
Method of desludging facility	Municipal Council Exhauster
Estimated Quantity of sludge m ³ /year	7000
Location of disposal point	Sewage treatment works

Staff Organization Chart



Sludge Processing	Treatment Method Drying Bed	Disposal In farmlands
Operation & Maintenance		
<p style="text-align: center;">Treatment Works</p> <p>1. The system is properly maintained</p> <p>2. Access bridge to the rotors is a temporary timber structure which is risky for use during maintenance</p> <p>3. The scum from the clarifier is removed manually</p> <p>4. The screw pump is in good working condition, however there is no standby generator in case of power failure</p> <p>5. There is provision of increasing the capacity of the ditch by installing the second rotor. The concrete works in the second clarifier to be used in future was completed under phase I project.</p>		
Sewers		
<p>1. The sewers are in good working order with few reported blockages (about 130 per year)</p> <p>2.</p> <p>3.</p> <p>4.</p> <p>5.</p>		



On-going projects	None

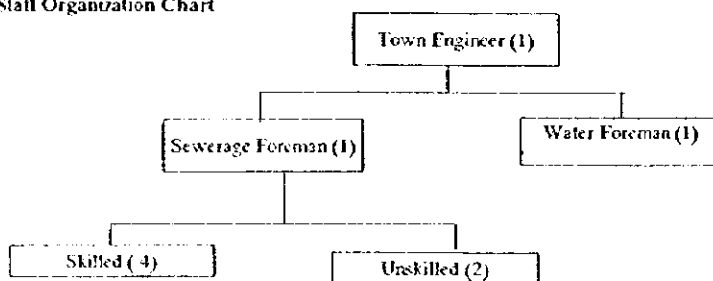
Management

Staffing				
	<i>Skilled</i>	<i>Unskilled</i>		
<i>Sewage works</i>	2	1		
<i>Sewer maintenance</i>	3	1		
<i>Bye-law enforcement</i>				
<i>Other</i>	-			
Resources Available		Comments		
		Sewer rods		
		Wheelbarrow/Jembes etc.		
Sources of Revenue		Sewer charges		
		Connection fees		
		Water charges		
Annual Cash Flow, kshs.				
	<i>Year</i>	<i>Revenue</i>	<i>Expenditure</i>	<i>Surplus</i>
	1995	-	-	-
	1996	-	-	-
	1997	4,476,654	204,527	4,272,127
Financial Problems		None		
Investment Budget Plan				
	<i>Type of activity</i>		<i>Target Year</i>	
	None			

On - Plot Sanitation

% Population with on plot sanitation	70%
Method of desludging facility	Exhauster hired from Ruiru County Council and Nairobi City Council
Quantity of sludge m ³ /year	not known
Location of disposal point	In manholes

Staff Organization Chart

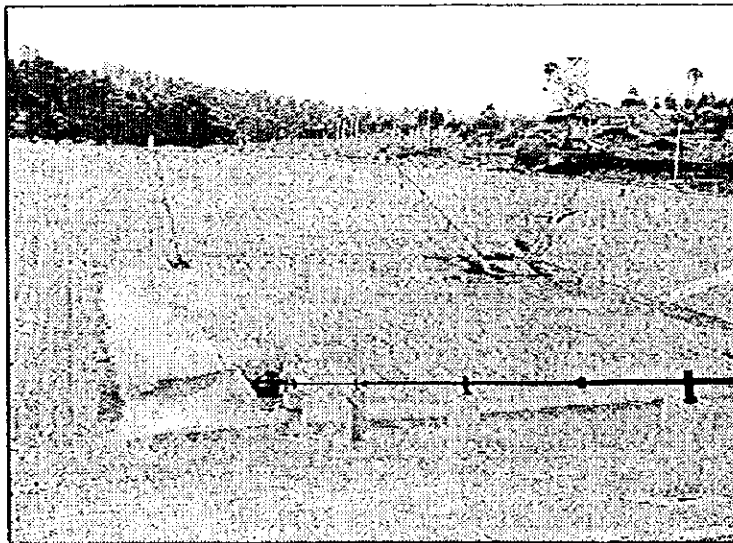


Aftercare Study on
the National Water Master plan

KISII (1/3)

Name of Urban Center	Kisii		x	y	
District	Kisii		Coordinates 34° 48' 0 ^s 39'		
Province	Nyanza		Elevation		
Mean Annual Precipitation (mm)	Temperature max & min °C				
	1995	1998	2000	2005	2010
Population Projections	50,604	65,000	77,666	107,666	120,615
Municipal Area (ha)	264	2,900.0			
Population Density (ppha)	191.7	22.4			
Water Supply	1995	1998	2000	2005	2010
Domestic water demand (m ³ /d)					16,320
Total water consumption (m ³ /d)	3,562	4,600			
Area served (estimated net (ha))	342.0		680.0		1,034.0
Raw water source	Nyakobisaro				
Sewerage Facilities	1995	1998	2000	2005	2010
Population Served		13,000	15,533	32,158	48,246
Service coverage ratio %	0%	5%	20%	30%	40%
Area served (estimated net (ha))		145.0			
Population Density (ppha)		89.7			
Wastewater volumes (m ³ /d)					
No. of connections		500			
Treatment process					
<p>A, Anaerobic SF, Secondary facultative M, Maturation</p>					
Description & dimensions	Retention Time (days)		Area	Depth	Volume
Anaerobic pond 1			2,300.0	4.00	5750.0
Anaerobic pond 2			2,300.0	4.00	5750.0
Anaerobic pond 3			2,300.0	4.00	5750.0
Anaerobic pond 4			2,300.0	4.00	5750.0
Secondary Facultative Pond		7.0	14,550.0	1.20	16700.0
Maturation Pond		7.0	9,100.0	3.00	24800.0
	Design Capacity		Actual flow		
	Dry weather	Population	Min	Max	Avg
Hydraulic loading					
BOD loading					
	BOD	COD	SS	TN/IP	FC
Influent	500	2000	40		
Effluent					
Receiving water body u/s	4	40	100		
Receiving water body d/s	6.5	45	275		
Receiving water body					

	Treatment Method	Disposal
Sludge Processing	Drying	Sold as manure
Operation & Maintenance		
Treatment Works		
1. Still to be commissioned treatment works has started operating and ponds are still filling up.		
2. Construction complete apart from landscaping.		
3.		
4.		
5.		
6.		
Sewers		
1. Old sewer lines have been connected to the new network.		
2. New sewer lines have been constructed and are undergoing testing.		
3. Due to the unavailability of 400mm dia pipes, 375mm dia were laid.		
4. Illegal stormwater entry into sewer lines is common.		
5. Individual consumer connections still pending.		



Anaerobic Pond: under construction

On-going projects

New treatment works will be commissioned by the end of 1998

Management

Staffing			
	Skilled	Unskilled	
Sewage works and sewer maintenance	1	6	
Bye-law enforcement	-	-	
Other	-	-	

Resources Available	Comments
1 No. Council pick-up	Good condition
Sewer rods	Good condition
Tools	Good condition
Sewerage department to receive 4 No. vehicles from contractor	

Sources of Revenue	
Sewer charges	
Connection fees	

Annual Cash Flow, Kshs.	Year	Revenue	Expenditure	Surplus
	1995	No records for revenue or expenditure yet due to consumers not connected		
	1996			
	1997			

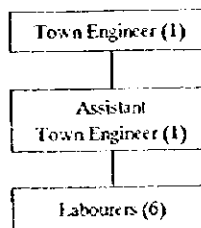
Financial Problems	

Investment Budget Plan	Type of activity	Target Year
	None	

On - Plot Sanitation

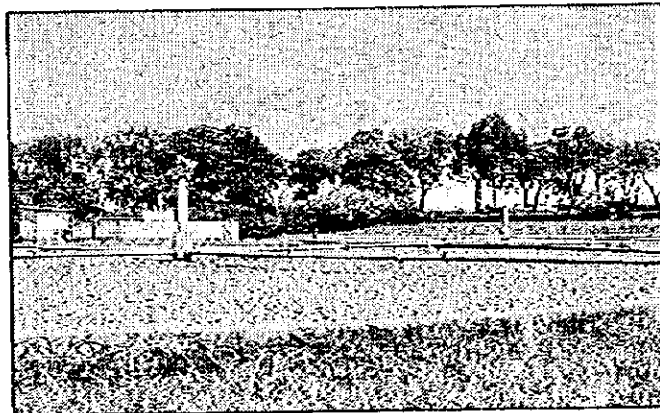
% Population with on-plot sanitation	80%
Method of desludging facility	Ministry of Public works Exhauster
Estimated Quantity of sludge m ³ /year	20 (3 trips per year)
Location of disposal point	Sewage treatment works

Staff Organization Chart

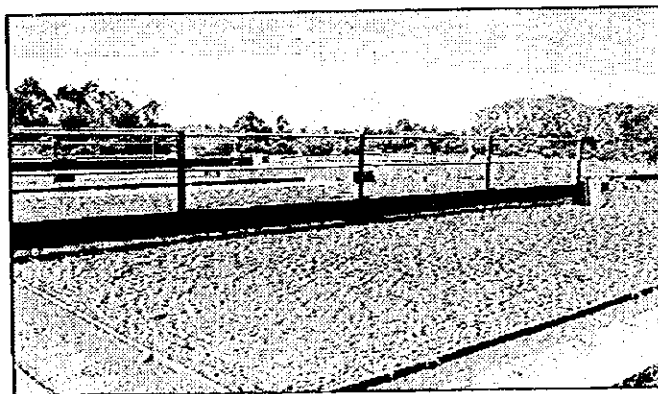


Name of Urban Center	Kitale		x	y	
District	Trans nzoia		Coordinates		
			35° 01'	01° 01'	
Province	Rift valley		Elevation		
Mean Annual Precipitation (mm)	Temperature max & min °C				
	1995	1998	2000	2005	2010
Population Projections	73,956	75,000	128,530	193,913	229,328
Municipal Area (ha)	420				
Population Density (ppha)	176.1				
Water Supply	1995	1998	2000	2005	2010
Domestic water demand (m3/d)					57,332
Total water consumption (m3/d)	5,610	9,000			
Area served (estimated net (ha))	421.0		1,063.0		1,861.0
Raw water source	Kabutie River				
Sewerage Facilities	1995	1998	2000	2005	2010
Population Served	5,968	37,500	19,279	38,783	57,332
Service coverage ratio %	8%		15%	20%	25%
Area served (estimated net (ha))					
Population Density (ppha)					
Wastewater volumes (m3/d)					
No. of sewer connections		1500			
Treatment process					
<pre> graph LR In(()) --> ST1[ST] In --> ST2[ST] ST1 --> TF1[TF] ST2 --> TF2[TF] TF1 --> SC1[SC] TF2 --> SC2[SC] SC1 --> M1[M] SC2 --> M1 M1 --> M2[M] M2 --> M3[M] M3 --> Out(()) </pre> <p>ST, Setling Tank TF, Trickling Filters SC, Secondary clarifier M, Maturation Pond</p>					
Description & dimensions	Size		Area	Depth	Volume
Primary settling tank 1	8.8	8.8	77.4	6.80	210.0
Primary settling tank 2	8.8	8.8	77.4	6.80	190.0
Trickling filter 1	Dia =	27.3	583.2	1.86	1085.0
Trickling filter 2	Dia =	27.3	583.2	1.86	1085.0
Humus tank 1	6.8	6.8	210.0	5.90	104.0
Humus tank 2	6.9	6.9	210.0	5.90	107.0
Maturation pond					
Maturation pond					
Maturation pond					
Sludge drying beds - 12 No.					
	Design Capacity		Actual flow		
	Dry weather	Population	Min	Max	Avg
Hydraulic loading	1,830		950	1,110	1,030
BOD loading					
	BOD	COD	SS	N/P	FC
influent	550	3520	700		
effluent	100	120	40	10.4/2.9	Nil
receiving water body u/s	9.5	90	25		
receiving water body d/s	12.5	85	167		
Receiving water body	Frison Ravine				

Sludge Processing	Treatment Method	Disposal
	Sludge drying beds	Sold as manure
Operation & Maintenance		Treatment Works
1. The system is not operational due to the breakdown of all mechanical components and most of the units are blocked		
2. All pumps for this site have been out of order.		
3. The mechanical components for the inlet works are out of operation making it to be manually operated		
4. Access to maturation ponds is not possible and the site needs to be fenced		
5. Distribution system for one filter is out of order.		
6. The digester requires rehabilitation		
7. Due to acute prolonged water shortage in the town the system is receiving negligible wastewater		
Sewers		
1. Due to the current water shortage and small size sewers (65% are 150mm) there are frequent blockages About 2 blockages per day have been reported		
2. Some of the sewers laid in 1957 requires replacement		
3. The pumping station to the conventional works has been out of order and the effluent is diverted into the ravine		
4		



Trickling filter: note that the filter is not operating because hydraulic head is insufficient as a result of low flows; therefore there is no secondary treatment.



Primary Clarifier: note heavy accumulation of scum and sediment indicating effective primary treatment.

On-going projects	None

Management

Staffing			
	Skilled	Unskilled	
Sewage works	1	2	
Sewer maintenance	1	5	
Bye-law enforcement	-		
Other	-		

Resources Available	Comments
1 Pickup	grounded
1 set of sewer rods	In good condition
Jembes/ pangas/slathers etc.	In good condition

Sources of Revenue	
Sewer charges	
Connection fees	
water charges	

Annual Cash Flow, Kshs.	(Revenue and expenditure figures same for both systems)			
	Year	Revenue	Expenditure	Surplus
	1995	26,472,000	-	-
	1996	26,472,000	-	-
	1997	26,472,000	-	-

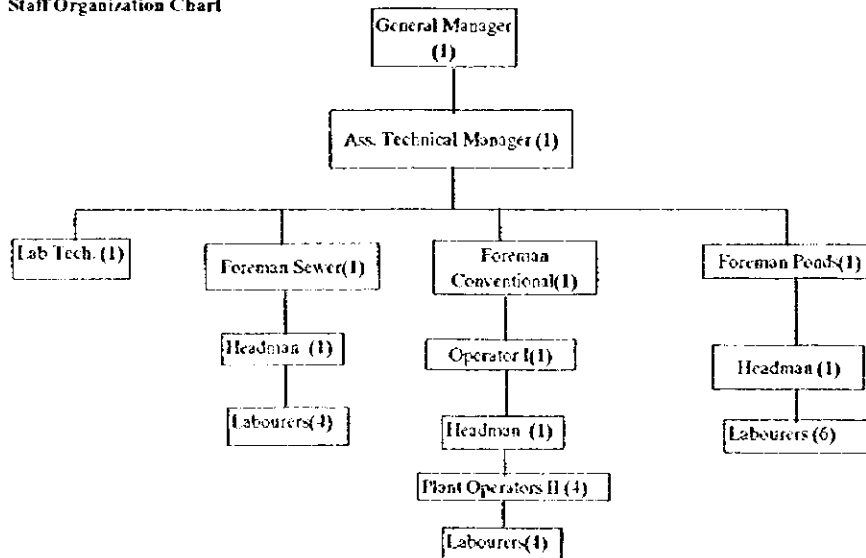
Financial Problems	
Inaccurate billing system	
Consumer failure to pay bills	
High cost of pumping water to the distribution reservoirs	

Investment Budget Plan	Type of activity	Target Year
	None	

On - Plot Sanitation

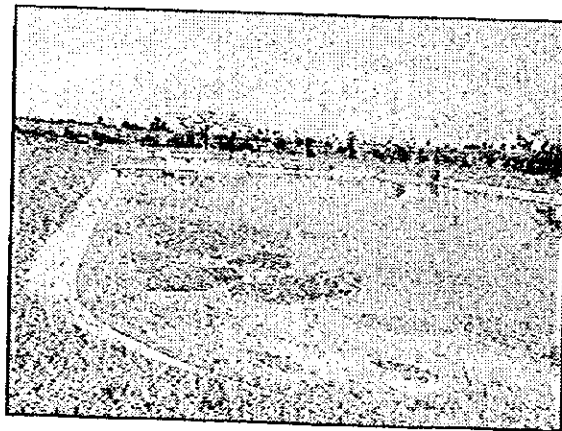
% Population with on-plot sanitation	
Method of desludging facility	Council exhauster from Public Health Dept.
Quantity of sludge m ³ /year	not known
Location of disposal point	At Conventional Sewage Works site

Staff Organization Chart

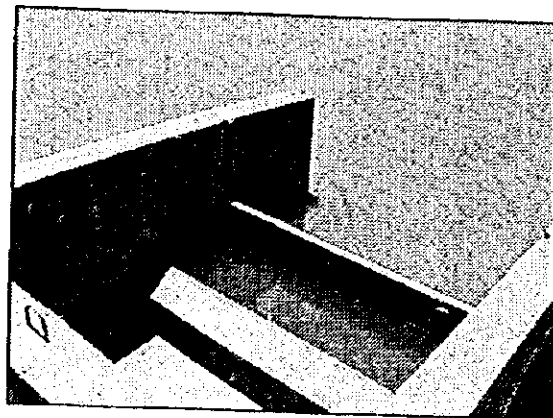


Name of Urban Center	Kitale		X	Y	
District	Transzoia		Coordinates		
Province	Rift valley		35 01	01	01
Mean Annual Precipitation (mm)	Elevation				
	Temperature max & min °C				
	1995	1998	2000	2005	2010
Population Projections	73,956	75,000	128,530	193,913	229,328
Municipal area (ha)	420				
Population Density (ppha)	176.1				
Water Supply	1995		2000	2005	2010
Domestic water demand (m3/d)					31,091
Total water consumption (m3/d)	5,610	9,000			
Area served (estimated net (ha))	421.0		1,063.0		1,861.0
Raw water source	Koitobos River				
Sewerage Facilities	1995		2000	2005	2010
Population Served	5,968	37,500	25,706	58,174	91,731
Service coverage ratio %	8%		20%	30%	40%
Area served (estimated net (ha))					
Population Density (ppha)					
Wastewater volumes (m3/d)					
No. of sewer Connections		1500			
Treatment process					
Description & dimensions	Size		Area	Depth	Volume
Anaerobic pond 1	Bottom Area =		317.0		
Anaerobic pond 2	Bottom Area =		317.0		
Anaerobic pond 3	Bottom Area =		317.0		
Anaerobic pond 4	Bottom Area =		317.0		
Secondary Facultative Pond 1	Bottom Area =		9,881.5		
Secondary Facultative Pond 2	Bottom Area =		2,701.0		
Maturation Pond 1	Bottom Area =		4,331.0		
Maturation Pond 2	Bottom Area =		4,331.0		
	Design Capacity		Actual flow		
	Dry weather	Population	Min	Max	Avg
Hydraulic loading	2,930		1,500	2,500	2,000
	BOD	COD	SS	N.P	FC
influent	550	63500	11700		
effluent	105	180	700	17.71	600
receiving water body u/s	-	-	-		
receiving water body d/s	-	-	-		
Receiving water body	Marsh-Sabwani river				

	Treatment Method	Disposal
Sludge Processing	No treatment	
Operation & Maintenance	Treatment Works	
1.	The site is well maintained but there are no grit removal facilities	
2.	High level overflow from storms discharges into a nearby drainage ditch	
3.	Receives flows mostly from KCC Dairy, fats and grease which form scum over the anaerobic ponds	
4.	Organically overloaded due to industrial waste	
5.		
6.		
	Sewers	
1.	Main trunk sewer is clogged by grease	
2.		
3.		
4.		
5.		



Anaerobic Pond: note proper maintenance of grass embankment and convenient overflow spillway at end of pond



Final effluent weir: note that the effluent channel is dry indicating there is no outflow.

On-going projects	None

Aftercare Study on
the National water Master plan

KITALE (3/3)

Management

Staffing			
	Skilled	Unskilled	
Sewage works	1	2	
Sewer maintenance	1	5	
Bye-law enforcement	-	-	
Other	-	-	

Resources Available	Comments
1 Pickup	grounded
1 set of sewer rods	In good condition
Jembes/ pangas/slashers etc.	In good condition

Sources of Revenue	
Sewer charges	
Connection fees	
water charges	

Annual Cash Flow, kshs.	(Revenue and expenditure figures same for both systems)			
	Year	Revenue	Expenditure	Surplus
	1995	26,472,000	-	-
	1996	26,472,000	-	-
	1997	26,472,000	-	-

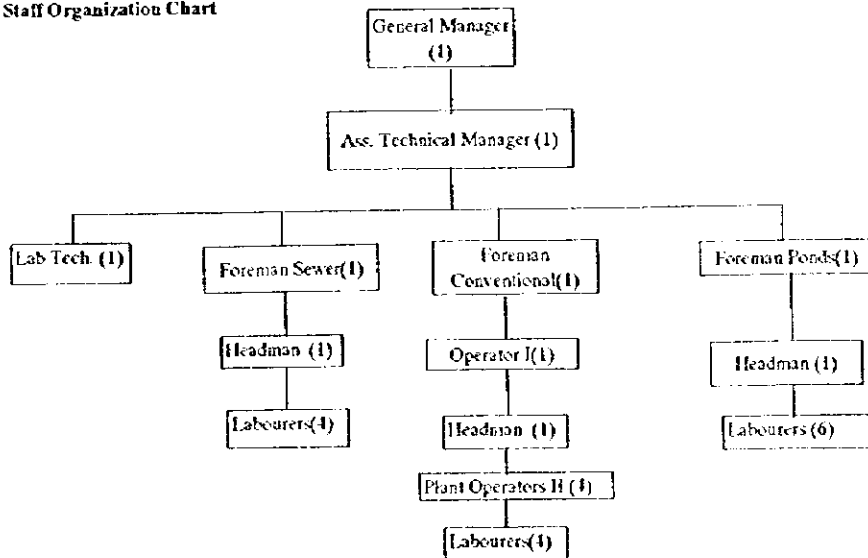
Financial Problems	
Inaccurate billing system	
Consumer failure to pay bills	
High cost of pumping water to the distribution reservoirs	

Investment Budget Plan	Type of activity	Target Year
	None	

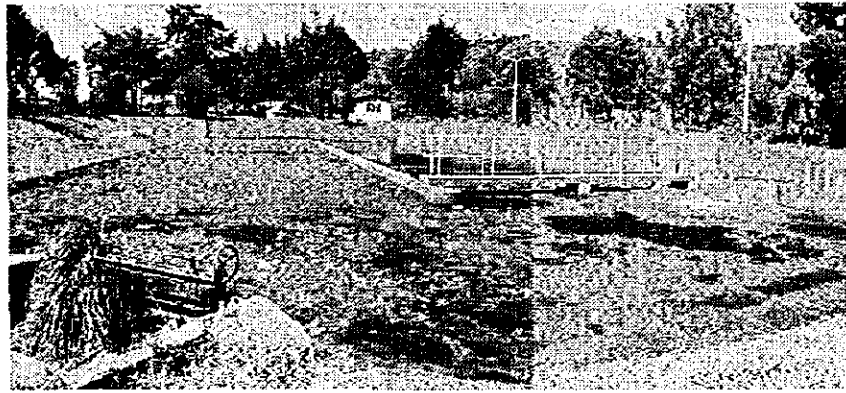
On - Plot Sanitation

% Population with on-plot sanitation	
Method of desludging facility	Council exhauster from Public Health Dept.
Quantity of sludge m ³ /year	not known
Location of disposal point	At Conventional Sewage Works site

Staff Organization Chart



	Treatment Method	Disposal
Sludge Processing	No treatment	Municipal garbage dump
Operation & Maintenance		Treatment Works
1. Managed by MI RRWD		
2. Most of the mechanical components do not operate		
3. Maturation pond receiving even effluent from Bata factory needs to be cleared of the vegetation		
4. Sludge drying beds require clearing of vegetation and reinstatement of filter media		
5. Channel to the maturation pond needs to be cleared of the vegetation		
6		
		Sewers
1. The sewers are all uPVC and are in good working condition with few blockages (about 20 blockages /year are reported)		
2		
3		
4		
5		



Oxidation Ditch: note heavy accumulation of scum and anaerobic conditions. Treatment works is completely inoperative.



Maturation Pond: note accumulation of weeds and natural vegetation.

On-going projects	None

Management

Staffing			
	Skilled	Unskilled	
Sewage works	2	2	
Sewer maintenance	2	-	
Bye-law enforcement	-	-	
Other	-	-	

Resources Available	Comments
	Wheelbarrows/Jembes/slashers etc. Note : Unblocking equipment for sewers is hired from Nairobi

Sources of Revenue	
	Water charges Connection fees Sewer charges - 50% of water charges

Annual Cash Flow, kshs.			
Year	Revenue	Expenditure	Surplus
1995	-	-	-
1996	3,800,000	-	-
1997	3,900,000	-	-

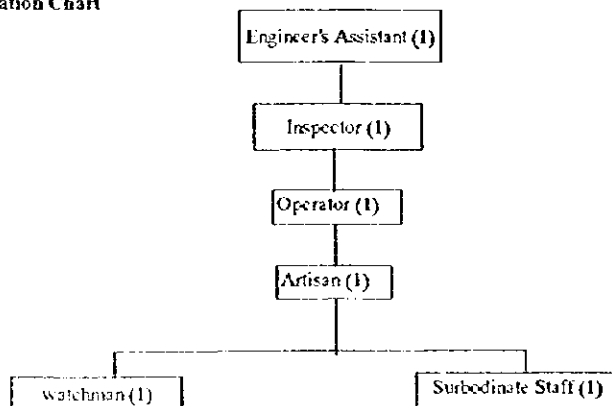
Financial Problems	
	The scheme is owned and operated by NWCPC. The sewer charges collected are taken to the NWCPC head office and are not used to run the scheme. The distribution of the collected revenue by the NWCPC is on a priority basis and only 64% is returned to the district.

Investment Budget Plan	Type of activity	Target Year
	None	

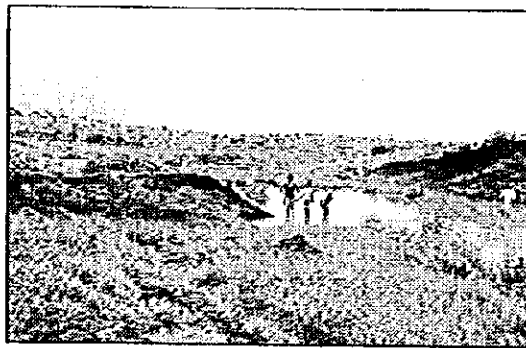
On - Plot Sanitation

% Population with on-plot sanitation	30%
Method of desludging facility	Not carried out for the pit latrines because they are on large plot
Quantity of sludge m ³ /year	Not applicable
Location of disposal point	Not applicable

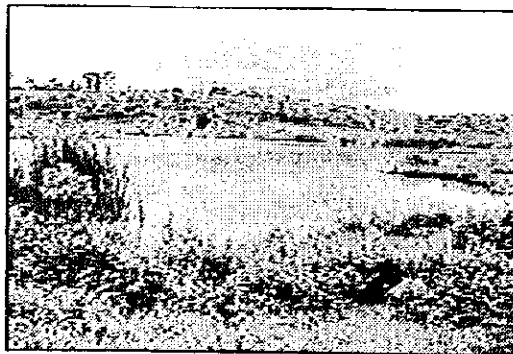
Staff Organization Chart



	Treatment Method	Disposal
Sludge Processing	Drying on the ground	Dumping ground near treatment works
Operation & Maintenance Treatment Works		
1. Hydraulically and organically overloaded		
2. Maturation pond was added downstream of original treatment works; stream is used to carry partially treated effluent to a maturation pond approximately 1.5km downstream. The stream is used by residents but not protected.		
3. Maturation pond is formed by a dam across the stream, with spillway. Pond is overgrown with weeds and looks more like a natural wetland		
4. Inlet has no grit removal facility, the distribution of flow is uneven, the facultative pond receives more flow than the anaerobic		
5. Facultative pond was desludged in 1995 and sludge dumped on nearby plots. Anaerobic pond requires desludging.		
6. Site is generally tidy although there is no fence or gate and staff houses and offices have been vandalised.		
7. There is no access road to the treatment works . Access to the anaerobic pond is only across the river.		
Sewers		
1. Pumping station is frequently out of order due to power failures and mechanical breaks and spares are not easily available.		
2. Overflow of raw sewage from the pumping station is directed to a small retention pond. The pond has an outlet to a nearby stream.		
3. Only one pump is working from the two.		
4. Sewer lines on steep gradient require replacing.		



Overflow from maturation pond: note erosion of embankment and children playing in the water



Maturation pond: note that this pond is a wet land area formed by impounding the river; the effluent from the primary facultative pond is discharged into the river approximately 2 km upstream.

On-going projects

A master plan has been prepared and new treatment sites identified but no funding is available.

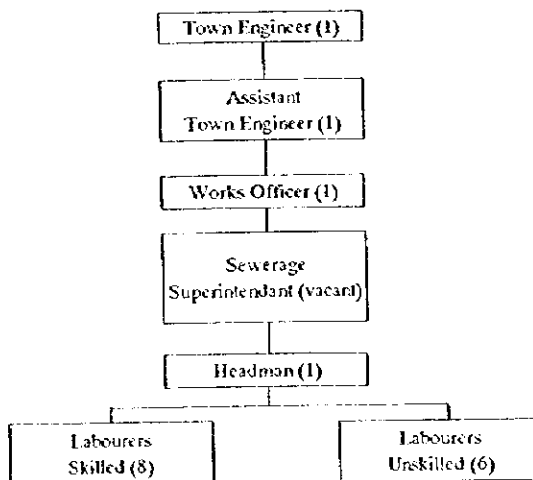
Management

Staffing		Skilled	Unskilled
Sewage works and sewer maintenance		12	6
Bye-law enforcement		-	-
Other (watchmen)		-	-
Resources Available		<i>Comments</i>	
	1 No. Exhauster lorry	Good condition	
	1 No. Land Rover	Good condition	
	Sewer rods	Good condition	
	Tools	Good condition	
Sources of Revenue			
	Sewer charges		
	Connection fees		
Annual Cash Flow, Kshs.			
	<i>Year</i>	<i>Revenue</i>	<i>Expenditure</i>
	1995	800,100	2,746,254
	1996	686,232	2,775,472
	1997	924,078	3,363,821
			<i>Surplus</i>
			(1,946,154)
			(2,089,240)
			(2,439,743)
Financial Problems		Insufficient funding for rehabilitation and maintenance needs Consumer failure to pay bills Failure of water undertakers to submit revenue for sewerage	
Investment Budget Plan			
	<i>Type of activity</i>	<i>Target Year</i>	
	None		

On - Plot Sanitation

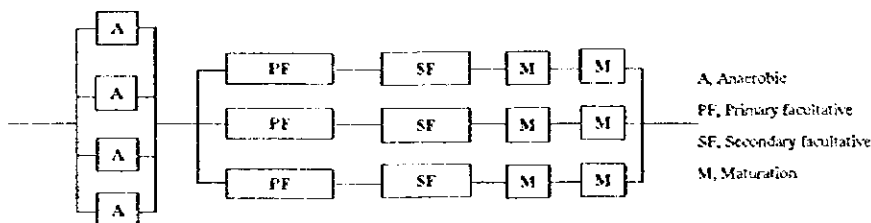
% Population with on-plot sanitation	90%
Method of desludging facility	Municipal Council Exhauster
Estimated Quantity of sludge m ³ /year	800 (Exhauster makes on average 3 trips per day)
Location of disposal point	Sewage treatment works

Staff Organization Chart



Name of Urban Center	Athi River		x	y	
District	Machakos	Coordinates	37 02	01	31
Province	Eastern	Elevation			
Mean Annual Precipitation (mm)	Temperature max & min °C				
	1995	1998	2000	2005	2010
Population Projections	18,304	50,000	28,602	41,713	48,441
Municipal Area (ha)					
Population Density (ppba)					
Water Supply	1995	1998	2000	2005	2010
Domestic water demand (m3/d)					
Total water consumption (m3/d)	6,400	2,000			
Area served (estimated net (ha))	187.0	441.0		733.0	
Raw water source	Nel-turesh p.l				
Sewerage Facilities	1995	1998	2000	2005	2010
Population Served	1,310	12,500	4,290	8,343	12,110
Service coverage ratio %	7%		15%	20%	25%
Area served (estimated net (ha))					
Population Density (ppba)					
Wastewater volumes (m3/d)					
No. of connections	370				

Treatment process



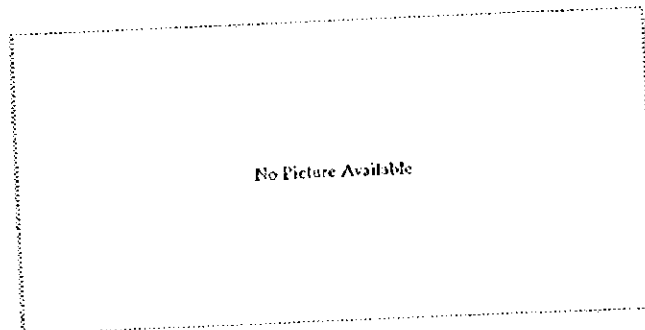
Description & dimensions	Size (Top of Embankment)	Area (TWL)	Depth	Volume	
Anaerobic pond 1	63.0	33.0	1,800.0	3.00	3255.0
Anaerobic pond 2	63.0	33.0	1,800.0	3.00	3255.0
Anaerobic pond 3	63.0	33.0	1,800.0	3.00	3255.0
Anaerobic pond 4	63.0	33.0	1,800.0	3.00	3255.0
Primary Facultative pond 1	379.0	128.0	47,113.0	1.75	77895.0
Primary Facultative pond 2	379.0	128.0	47,113.0	1.75	77895.0
Primary Facultative pond 3	379.0	128.0	47,113.0	1.75	77895.0
Secondary Facultative Pond 1	140.0	52.0	6,700.0	1.75	10072.0
Secondary Facultative Pond 2	140.0	52.0	6,700.0	1.75	10072.0
Secondary Facultative Pond 3	140.0	52.0	6,700.0	1.75	10072.0
First Maturation Pond 1	115.0	52.0	5,500.0	1.50	7197.0
First Maturation Pond 2	115.0	52.0	5,500.0	1.50	7197.0
First Maturation Pond 3	115.0	52.0	5,500.0	1.50	7197.0
Second Maturation Pond 1	115.0	52.0	5,500.0	1.50	7197.0
Second Maturation Pond 2	115.0	52.0	5,500.0	1.50	7197.0
Second Maturation Pond 3	115.0	52.0	5,500.0	1.50	7197.0

	Design Capacity		Actual flow		
	Dry weather	Population	Min	Max	Avg
Hydraulic loading	12,960	85,007	1,000		
BOD loading	10,321	85,007			
influent	BOD	COD	SS	N	FC
effluent					
receiving water body u/s					
receiving water body d/s					
Receiving water body	Athi River				

Aftercare Study on
the National Water Master plan

ATHI RIVER (2/3)

	Treatment Method	Disposal
Sludge Processing	To date no disposal has been effected	
Operation & Maintenance		
Treatment Works		
1. New facility built in 1994. Low flows and ponds are still filling.		
2. Treatment works is not well maintained		
3		
4		
5		
6		
Sewers		
1. Ingrown roots in concrete pipes		
2. No cleaning operations		
3. Pump station not being used currently due to the sewer line being destroyed recently. Area served by the pump station discharges into a temporary retention pond.		
4		



On-going projects	None

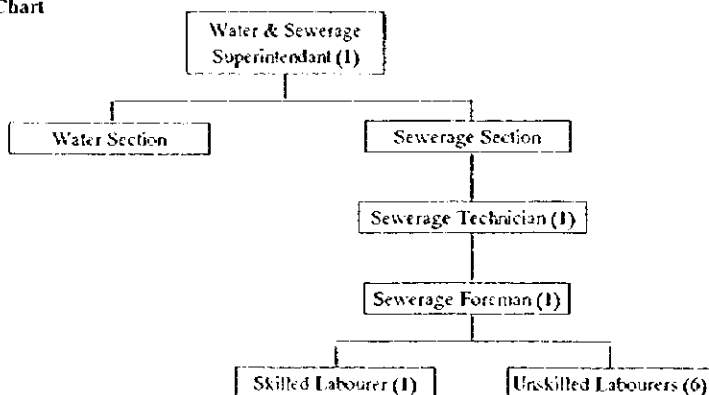
Management

Staffing				
	<i>Skilled</i>	<i>Unskilled</i>		
<i>Sewage works</i>	-	-		
<i>Sewer maintenance</i>	4	6		
<i>Bye-law enforcement</i>	-	-		
<i>Other</i>	-	-		
Resources Available				
	<i>1 No. pump</i>	<i>Comments</i>		
	<i>Sewer rods</i>	<i>Good condition</i>		
	<i>Tools</i>	<i>Good condition</i>		
Sources of Revenue				
	<i>Sewer charges</i>			
	<i>Connection fees</i>			
	<i>Billing penalties</i>			
	<i>Water charges</i>			
Annual Cash Flow, Kshs.				
	<i>Year</i>	<i>Revenue</i>	<i>Expenditure</i>	<i>Surplus</i>
	1995	2,418,480	3,319,280	(900,800)
	1996	9,716,900	3,817,180	5,899,720
	1997	9,503,180	7,639,120	1,864,060
Financial Problems				
Investment Budget Plan				
	<i>Type of activity</i>	<i>Target Year</i>		
	<i>None</i>			

On - Plot Sanitation

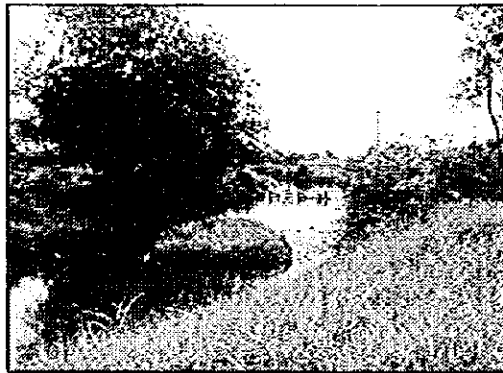
% Population with on-plot sanitation	75%
Method of desludging facility	Exhauster hired from Nairobi or Machakos
Estimated Quantity of sludge m ³ /year	No records
Location of disposal point	Sewage treatment works

Staff Organization Chart

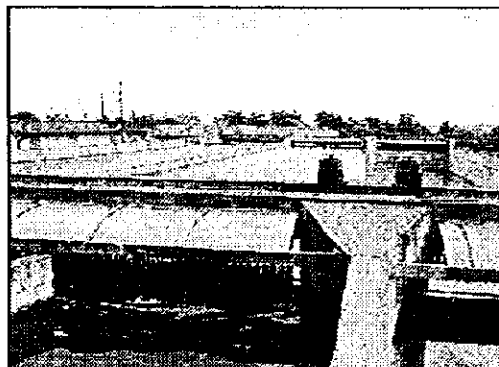


Name of Urban Center	Mombasa		x	y	
District	Mombasa		Coordinates		
Province	Coast		Elevation		
Mean Annual Precipitation (mm)	Temperature max & min °C				
	1995	1998	2000	2005	2010
Population Projections		580,000			
Municipal Area (ha)		28,200.0			
Population Density (ppha)		20.6			
Water Supply	1995	1998	2000	2005	2010
Domestic water demand (m ³ /d)					
Total water consumption (m ³ /d)		18,200			
Area served (estimated net (ha))		1,200.0			
Sewerage Facilities	1995	1998	2000	2005	2010
Population Served		69,600			
Service coverage ratio %					
Area served (estimated net (ha))					
Population Density (ppha)					
Wastewater volumes (m ³ /d)		1,450			
No. of connections					
Treatment Process	<p>Facility: Changamwe Treatment works</p> <p>AT, Aeration Tanks ST, Sedimentation Tanks PF, Primary facultative SF, Secondary facultative M, Maturation TF, Trickling filter OD, Oxidation ditch</p>				
Description & dimensions	Size		Area	Depth	Volume
Aeration Tank 1	90.0	21.0	1,890.0	3.50	6615.0
Aeration Tank 2	90.0	21.0	1,890.0	3.50	6615.0
Aeration Tank 3	90.0	21.0	1,890.0	3.50	6615.0
Aeration Tank 4	90.0	21.0	1,890.0	3.50	6615.0
Sedimentation Tank 1	Dia =	22.9	411.9	4.75	1956.4
Sedimentation Tank 2	Dia =	22.9	411.9	4.75	1956.4
Sedimentation Tank 3	Dia =	22.9	411.9	4.75	1956.4
Sedimentation Tank 4	Dia =	22.9	411.9	4.75	1956.4
Sludge thickening tank 1	Dia =	16.6	216.4	5.40	1168.7
Sludge thickening tank 2	Dia =	16.6	216.4	5.40	1168.7
	Design Capacity		Actual flow		
	Dry weather	Population	Min	Max	Avg
Hydraulic loading	17,100	196,000		2,900	1,450
BOD loading	BOD	COD	SS	TN / TP	FC
Influent					
Effluent					
Receiving body	Indian Ocean				

	Treatment Method	Disposal
Sludge Processing	Drying	Municipal garbage dump
Operation & Maintenance		
Treatment Works		
1. New works to be commissioned.		
2. Old treatment works at the same site to be abandoned.		
3		
4		
5		
6		
Sewers		
1. No cleaning or inspection		
2		
3		
4		
5		

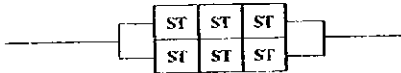


Oxydation Ditch : Note overgrowth and Sludge.

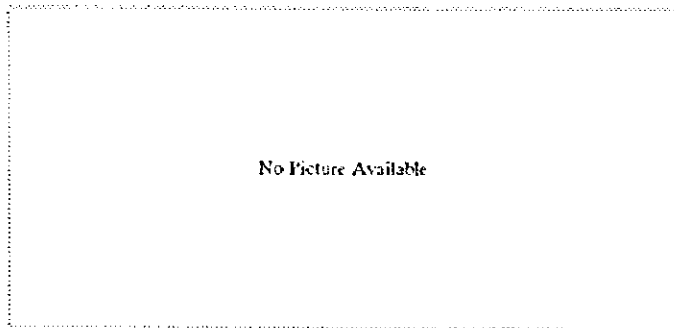


New extended Aeration Plant.

On-going projects	Completion of construction at new treatment works (Electrical cabling, roads, and landscaping)

Name of Urban Center	Mombasa				x	y
District	Mombasa				Coordinates	
Province	Coast				Elevation	
Mean Annual Precipitation (mm)	Temperature max & min °C					
	1995	1996	2000	2005	2010	
Population Projections		580,000				
Municipal Area (ha)		28,200.0				
Population Density (ppha)		20.6				
Water Supply	1995	1996	2000	2005	2010	
Domestic water demand (m ³ /d)						
Total water consumption (m ³ /d)		18,200				
Area served (estimated net (ha))		1,200.0				
Sewerage Facilities	1995	1996	2000	2005	2010	
Population Served		69,600				
Service coverage ratio %						
Area served (estimated net (ha))						
Population Density (ppha)						
Wastewater volumes (m ³ /d)		3,140				
No. of connections						
Treatment process	 <p>ST, Sedimentation tanks AL, Aerated lagoon PF, Primary facultative SF, Secondary facultative M, Maturation TF, Tricking filter OD, Oxidation ditch</p> <p>Facility: Mombasa Island Treatment works (Ras serani)</p>					
Description & dimensions	Size		Area	Depth	Volume	
Sedimentation tank 1	4.8	4.6	21.7	4.90	68.0	
Sedimentation tank 2	4.8	4.6	21.7	4.90	68.0	
Sedimentation tank 3	4.8	4.6	21.7	4.90	68.0	
Sedimentation tank 4	4.8	4.6	21.7	4.90	68.0	
Sedimentation tank 5	4.8	4.6	21.7	4.90	68.0	
Sedimentation tank 6	4.8	4.6	21.7	4.90	68.0	
	Design Capacity		Actual flow			
	Dry weather	Population	Min	Max	Avg	
Hydraulic loading	32,500	33,000				
BOD loading	BOD	COD	SS	IN / IP	FC	
Influent						
Effluent						
Receiving						
Receiving water body	Indian Ocean					

	Treatment Method	Disposal
Sludge Processing	No treatment	To sea at high tide
Operation & Maintenance		
Treatment Works		
1. Treatment works has not worked for the last 10 years and sewage passes untreated to the sea		
2. All mechanical and electrical components require replacing		
3. No space for expansion		
4		
5		
6		
Sewers		
1. No cleaning or inspection		
2		
3		
4		
5		



On-going projects	Proposed Island and North Mainland sewage to be disposed by new long sea outfall - Gibbs, East Africa

Name of Urban Center	Muranga		X	Y	
District	Muranga		Coordinates		
Province	Central		37 07	00 43	
Mean Annual Precipitation (mm)	Temperature max & min °C				
	1995	1998	2000	2005	2010
Population Projections	26,376	30,000	39,680	55,613	62,635
Municipal Area (ha)	525	2500			
Population Density (ppha)	50.2	12.0			
Water Supply	1995	1998	2000	2005	2010
Domestic water demand (m ³ /d)					8,494
Total water consumption (m ³ /d)	3,000	2,000			
Area served (estimated net (ha))	162.0		338.0		524.0
Raw water source	River				
Sewerage Facilities	1995	1998	2000	2005	2010
Population Served	6,940	10,500	6,940	11,123	15,659
Service coverage ratio %	26%	15%	17%	20%	25%
Area served (estimated net (ha))		315.0			
Population Density (ppha)		28.0			
Wastewater volumes (m ³ /d)		870			
No. of connections		500			
Treatment process					
			<p>A, Anaerobic PF, Primary facultative SF, Secondary facultative M, Maturation</p>		
Description & dimensions	Retention time (days)		Area	Depth	Volume
Anaerobic pond 1	4.5		2,848.0	2.50	7120.0
Anaerobic pond 2	4.5		2,835.0	2.50	7058.0
Primary facultative pond 1	17.5		7,813.0	1.75	13673.0
Primary facultative pond 2	17.5		7,813.0	1.75	13673.0
Secondary facultative pond 1	5.3		2,375.0	1.75	4156.0
Secondary facultative pond 2	5.3		2,375.0	1.75	4156.0
Maturation pond 1	3.5		2,731.0	1.00	2731.0
Maturation pond 2	3.8		2,948.0	1.00	2948.0
	Design Capacity		Actual flow		
	Dry weather	Population	Min	Max	Avg
Hydraulic loading	1,564			1,037	864
BOD loading	BOD	COD	SS	IN / IP	IC
influent	568	1600	800		
effluent	50	200	60	6.88 / 0.9	675
receiving water body u/s	16	20	6		
receiving water body d/s	18	20	10		
Receiving water body	River Mbirio				

	Treatment Method	Disposal
Sludge Processing	No treatment	Municipal garbage dump
Operation & Maintenance		Treatment Works
1. Flow into the treatment works is very low and levels in ponds have to be made up using river water at least once a week		
2. Newly commissioned treatment works provide good level of treatment		
3. Generally well maintained		
4		
5		
		Sewers
1. Insufficient house connections, people are reluctant to connect because of costs		
2. Frequent blockages on old sewer lines		
3		
4		
5		



Facultative Ponds: note inter-pond connections, influent runs underground down the middle of the embankment.

On-going projects	None

Management

Staffing			
	Skilled	Unskilled	
Sewage works and sewer maintenance	2	15	
Bye-law enforcement	-	-	
Other (watchmen)	-	-	

Resources Available		Comments
Council vehicles		Good condition
Sewer rods		Good condition

Sources of Revenue		
Sewer charges		
Connection fees		

Annual Cash Flow, Kshs.			
Year	Revenue	Expenditure	Surplus
1995	No revenue or expenditure figures for the new		
1996	Treatment works		
1997			

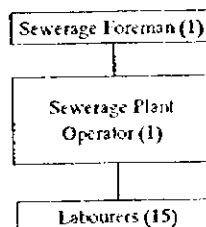
Financial Problems	
	Inaccurate billing due to lack of service to meters

Investment Budget Plan		Target Year
Type of activity		
none		

On - Plot Sanitation

% Population with on-plot sanitation	65%
Method of desludging facility	Privately hired exhauster from Thika
Estimated Quantity of sludge m ³ /year	10
Location of disposal point	Sewage treatment works

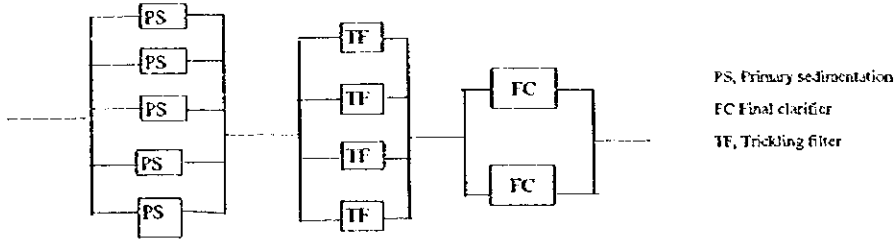
Staff Organization Chart



Name of Urban Center	Nairobi		x	y	
District	Nairobi		Coordinates	(UTM)258705 143242	
Province	Nairobi		Elevation		
Mean Annual Precipitation (mm)	Temperature max & min °C				
	1995	1998	2000	2005	2010
Population Projections	1,857,000	2,240,000	2,243,000	2,639,000	3,023,000
Urban Area (ha)	9000	69300			
Population Density (ppha)	206.3	32.3			
Water Supply	1995	1998	2000	2005	2010
Domestic water demand (m ³ /d)					520,113
Total water consumption (m ³ /d)	300,000	326,700			
Area served (estimated net (ha))	10,553.0	10,553.0	16,881.0		25,879.0
Raw water source	Charia River, Sasumua dam, Buri dam, Kikuyu spring				
Sewerage Facilities	1995	1998	2000	2005	2010
Population Served	415,157	1,000,000	672,900	923,650	1,209,200
Service coverage ratio %	22%	45%	30%	35%	40%
Area served (estimated net (ha))					
Population Density (ppha)					
Wastewater volumes (m ³ /d)		217,000.0	(Estimated)		
No. of sewer connections					

Treatment process

Kariobangi conventional treatment works

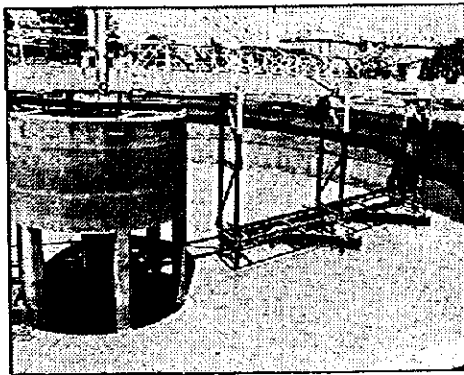


Description & dimensions	Size		Area	Depth	Volume
	Dia. =				
Primary sedimentation tank 4	Dia. =	21.0	346.4	2.60	1050.0
Primary sedimentation tank 1	Dia. =	40.0	1,256.6		3670.0
Rectangular Filters 1	160.0	15.0	2,400.0	1.80	4320.0
Rectangular Filters 2	160.0	15.0	2,400.0	2.80	6720.0
Rectangular Filters 3	160.0	15.0	2,400.0	3.80	9120.0
Rectangular Filters 4	160.0	15.0	2,400.0	4.80	11520.0
Rotary distributor filter 4No.	Dia =	56.0	2,463.0	1.80	All out of order
Final Clarifier 1	Dia =	21.0	346.4	2.80	1800.0
Final Clarifier 2	Dia =	22.0	380.1	2.80	Out of order
Final Clarifier 3	Dia =	38.0	1,134.1	2.90	3200.0
Suldge Dogesters 6 No.	Dia. =	39.0			
Sludge drying beds 64 No.	12.0	12.0	144.0		
	Design Capacity		Actual flow		
	Dry weather	Population	Min	Max	Avg
Hydraulic loading	32,000		43,000	47,000	45,000
BOD loading	BOD	COD	SS	N/P	FC
influent	445	800	1800		
effluent	129	180	1160	6.63/3.05	1275
receiving water body u's	54	120	1225		
receiving water body d's	112	280	1390		
Receiving water body	Nairobi River				

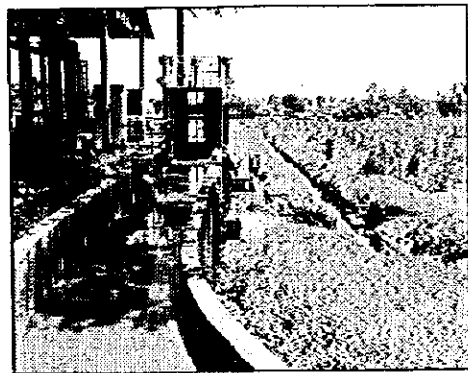
Aftercare Study on
the National Water Master plan

NAIROBI (2/3)

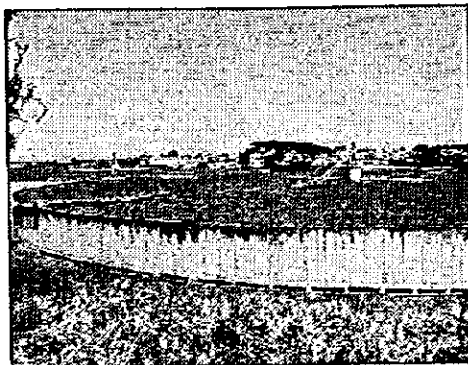
	Treatment Method	Disposal
Sludge Processing	Sludge digester and Drying bed	Sold at 80/- per m ³
Operation & Maintenance	Treatment Works	
	1. Treatment works are overloaded organically but removal efficiency is high despite lack of process control	
	2. Fine screens are not operating due to mechanical/electrical failure	
	3. The 4 small primary clarifiers are not working therefore causing the overloading of the large primary clarifier	
	4. Only two secondary clarifiers out of three are working.	
	5. Rectangular filters are operating but some pumps do not work and some sprinklers are not mobile.	
	6. The four circular filters are out of service.	
	7. There is no process control or monitoring, sludge recirculation and wasting is uncontrolled.	
	8. Digestors are operational but no process control. Retention times are not monitored.	
	Sewers	
	1	
	2	
	3	



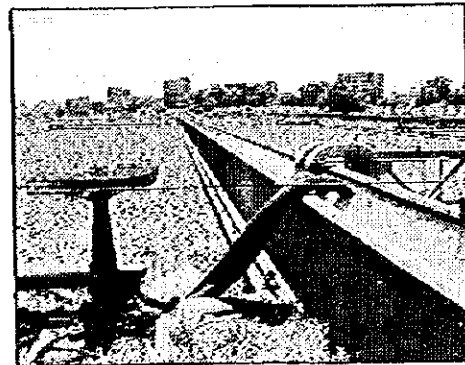
Secondary Clarifier: motorized drive and supporting roller bearings are out of order.



Inflow Channel: note large overflow to the right; drainage goes to Nairobi River



Trickling Filter: note broken rotating distributor



Trickling Filter: note broken travelling distributor and temporary pumping at fixed location

On-going projects

None

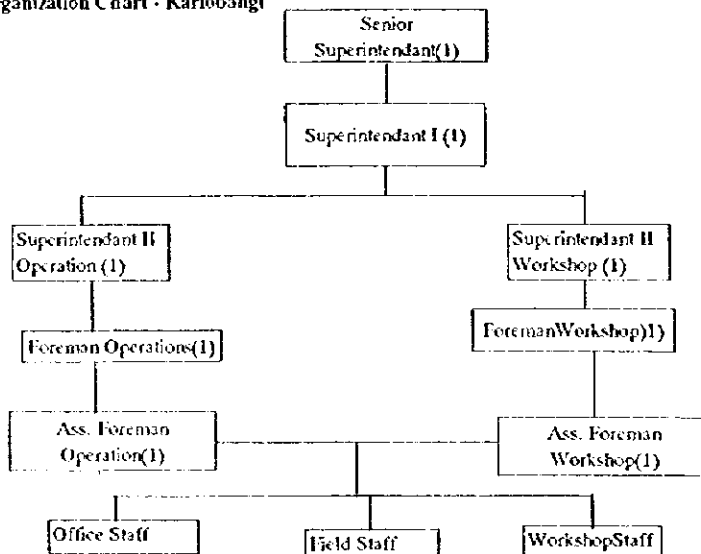
Management

Staffing			
	<i>Skilled</i>	<i>Unskilled</i>	
Sewage works			
Sewer maintenance			
Bye-law enforcement			
Other			
Resources Available		Comments	
		Vehicles	
		Exhausters	
		Sewer cleaning trucks	
Sources of Revenue			
		Sewer charges	
		Connection fees	
		water charges	
		Rates	
Annual Cash Flow, kshs.			
	<i>Year</i>	<i>Revenue</i>	<i>Expenditure</i>
	1995	No information available	
	1996		
	1997		
Financial Problems			
		Corruption	
		Consumer failure to pay bills	
Investment Budget Plan			
	<i>Type of activity</i>		<i>Target Year</i>
	None		

On - Plot Sanitation

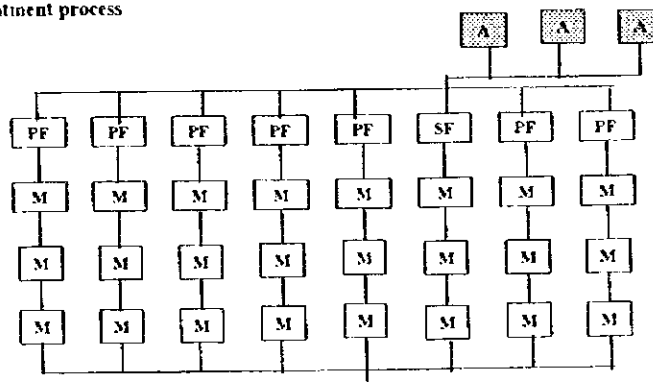
% Population with on plot sanitation	49%
Method of desludging facility	Exhauster
Quantity of sludge m ³ /year	not known
Location of disposal point	In manholes

Staff Organization Chart - Kariobangi



Name of Urban Center	Nairobi		X	Y	
District	Nairobi		Coordinates (UTM) 258705 (143242)		
Province	Nairobi		Elevation		
Mean Annual Precipitation (mm)	Temperature max & min °C				
	1995	1998	2000	2005	2010
Population Projections	1,857,000	2,240,000	2,243,000	2,639,000	3,023,000
Municipal Area (ha)	9000	69,300			
Population Density (ppha)	206.3	32.3			
Water Supply	1995	1998	2000	2005	2010
Domestic water demand (m3/d)					520,113
Total water consumption (m3/d)	300,000	526,700			
Area served (estimated net (ha))	10,553.0	10,553.0	16,881.0		25,879.0
Raw water source	Charis River, Sasumua dam, Kalru dam, Kikuyu spring				
Sewerage Facilities	1995	1998	2000	2005	2010
Population Served	415,157	1,000,000	672,900	923,650	1,209,200
Service coverage ratio %	22%	45%	30%	35%	40%
Area served (estimated net (ha))					
Population Density (ppha)					
Wastewater volumes (m3/d)		217,000.0	(Estimate)		
No. of sewer Connections					

Treatment process

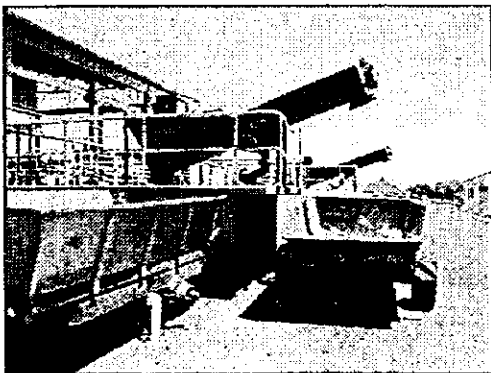


Dundora facility

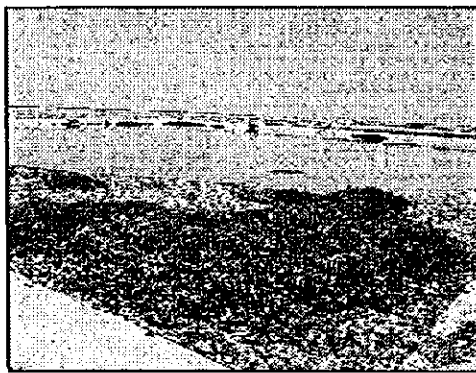
- A, Anaerobic
- PF, Primary facultative
- SF, Secondary facultative
- M, Maturation

Description & dimensions	Size		Area	Depth	Volume
	Length	Width			
Anaerobic ponds 3No.	50.0	50.0	2,500.0	3.00	75000.0
Facultative ponds 8No.	700.0	300.0	210,000.0	1.75	375000.0
First maturation ponds 2 No.	300.0	290.0	87,000.0	1.75	150000.0
First maturation ponds 6 No.	300.0	150.0	45,000.0	1.20	54000.0
Second maturation ponds 2No.	300.0	290.0	87,000.0	1.20	100500.0
Second maturation ponds 6 No.	300.0	150.0	45,000.0	1.20	54000.0
Third maturation pond 2 No.	300.0	290.0	87,000.0	1.20	54000.0
Third maturation pond 6 No.	300.0	150.0	45,000.0	1.20	54000.0
	Design Capacity		Actual flow		
	Dry weather	Population	Min	Max	Avg
Hydraulic loading	80,000		80,000	145,000	112,500
BOD loading	BOD	COD	SS	N/P	FC
influent	440	800	1405		
effluent	120	320	570	5.25/2.46	450
receiving water body u/s	43	160	1630		
receiving water body d/s	46	160	1825		
Receiving water body	Nairobi River				

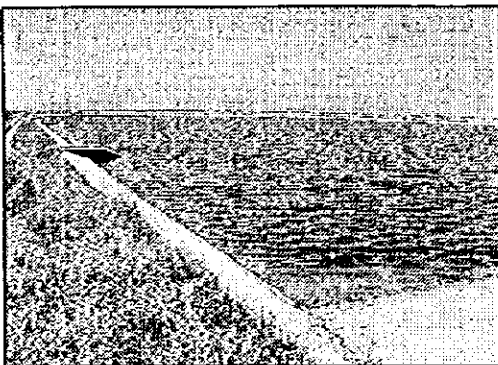
	Treatment Method	Disposal
Sludge Processing	No treatment	
Operation & Maintenance		Treatment Works
1. The old inlet works has been converted for storm overflow		
2. One blowers motor out of order.		
3. The new ponds are properly maintained while the old ponds are being desludged		
4.		
5.		
6.		
Sewers		
1.		
2.		
3.		
4.		
5.		



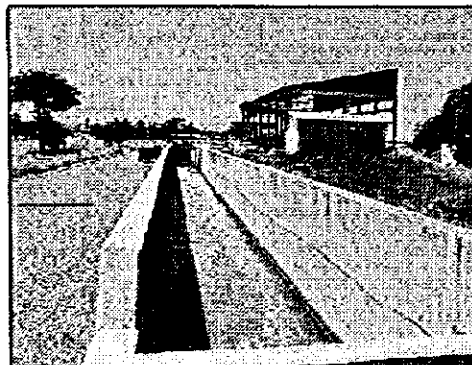
Grit Removal: note very small amount of grit is removed; equipment not operating during visit.



Anaerobic Pond: 2 year old pond suffering from accumulation of sludge & vegetation



Final Maturation Pond: note concrete apron along embankment to reduce growth of grass into the pond.



Influent Channel: note highwater mark on wall

On going projects

None

Management

Staffing			
	Skilled	Unskilled	
Sewage works and Sewer maintenance	40	20	
Bye-law enforcement	-	-	
Other	-	-	
Resources Available		Comments	
Vehicles		Good condition	
Exhausters		Good condition	
Sewer cleaning trucks		Good condition	
Sources of Revenue			
Sewer charges			
Connection fees			
water charges			
Rates			
Annual Cash Flow, Kshs.			
Year	Revenue	Expenditure	Surplus
1995	Information not available		
1996			
1997			
Financial Problems		Corruption	
		Consumer failure to pay bills	
Investment Budget Plan		Target Year	
Type of activity			
Rehabilitation of ponds and replacement of parts		1998	
Sewer expansion and unblocking lines		1998	

On - Plot Sanitation

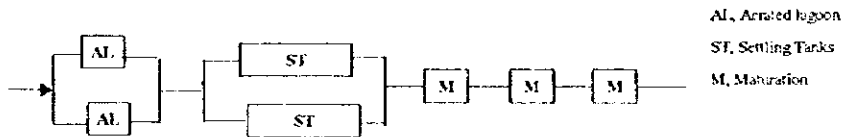
% Population with on plot sanitation	49%
Method of desludging facility	Exhauster
Quantity of sludge m ³ /year	not known
Location of disposal point	In manholes

Staff Organization Chart - Dandora

Not available

Name of Urban Center	Naivasha		x	y	
District	Nakuru		Coordinates		36 27 00 42
Province	Rift valley		Elevation		
Mean Annual Precipitation (mm)	Temperature max & min °C				
	1995	1998	2000	2005	2010
Population Projections	51,442	60,000	89,460	140,157	168,905
Urban Area (ha)	90		90	90	90
Population Density (ppha)	571.6		994.0	1,557.3	1,876.7
Water Supply	1995	1998	2000	2005	2010
Domestic water demand (m3/d)					22,876
Total water consumption (m3/d)	864	762			
Area served (estimated net (ha))	288.0		784.0		1,453.0
Raw water source	Boreholes				
Sewerage Facilities	1995	1998	2000	2005	2010
Population Served	15,000	30,000	13,419	28,031	42,226
Service coverage ratio %	29%	30%	15%	20%	25%
Area served (estimated net (ha))					
Population Density (ppha)					
Wastewater volumes (m3/d)					
No. of connections		2012			

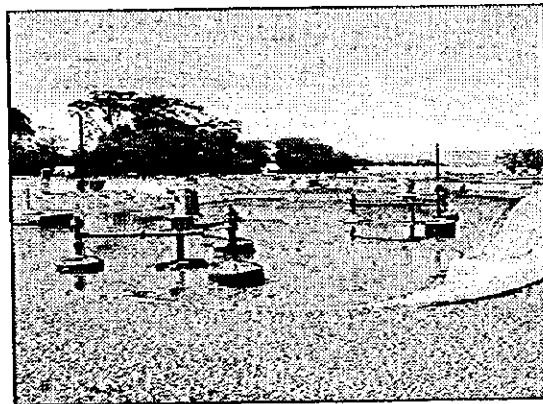
Treatment process



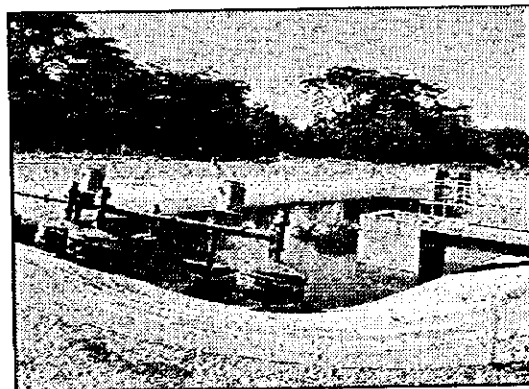
Description & dimensions	Dimensions at top water level		Area	Depth	Volume
Aerated lagoon 1	23	46	1,060	3.00	2125
Aerated lagoon 2	22	48	1,060	3.00	2125
Maturation pond 1	69	50	3,440	1.80	6200
Maturation pond 2	69	50	3,440	1.50	6200
Maturation Pond 3	69	50	3,440	1.50	6200
Settling tank 1	5.5	5.5	30.3	5.60	
Settling tank 2	5.5	5.5	30.3	5.60	
Sludge Thickener - 2 No.					
Sludge drying beds - 8 No.					

	Design Capacity		Actual flow		
	Dry weather	Population	Min	Max	Avg
Hydraulic loading	2,035		700		700
BOD loading					
	BOD	COD	SS	N/p	FC
influent	664	2000	630		
effluent	60	100	180	20.5,9.4	
receiving water body u's	-	-	-	-	-
receiving water body d's	-	-	-	-	-
Receiving water body	Lake Naivasha via a sewer				

	Treatment Method	Disposal
Sludge Processing	Sludge thickener and Sludge drying beds	No disposal
Operation & Maintenance		
Treatment Works		
1. All mechanical equipment inoperative since 1992 when motor starters were stolen.		
2. Aerated lagoons and secondary facultative pond needs to be de-sludged		
3. Flow measuring device is required at the inlet works.		
4. All mechanical units needs to be serviced		
5. Install sludge drying beds filter media		
6.		
Sewers		
1. Sewer reticulation could be increased; flows into the treatment works are very low.		
2. The pumping station which was constructed in 1985 was abandoned before completion. This project should be completed.		
3. The sewers are properly maintained with few reported blockages (2/week)		
4		
5		



Oxidation Lagoon: note sludge build-up and aerators not operating



Oxidation lagoon: note that lagoon is not in use

On-going projects	Preparation of Bill of Quantities for the rehabilitation of the Works is underway

Management

Staffing			
	Skilled	Unskilled	
Sewage works	2	2	
Sewer maintenance	1	6	
Bye-law enforcement	-		
Other (watchmen)	-		

Resources Available	Comments
1 No. rodding machine	Out of order
1 set of sewer rods	In good condition
1 No. exhauster - 9000 litres	In good condition
Wheelbarrow/Jenbes etc.	In good condition

Sources of Revenue
Sewer charges
Exhauster fees
Connection fees
Blockages charges

Annual Cash Flow, kshs.			
Year	Revenue	Expenditure	Surplus
1995	1,434,953	370,422	1,064,532
1996	919,712	468,980	450,732
1997	1,259,849	526,041	733,808

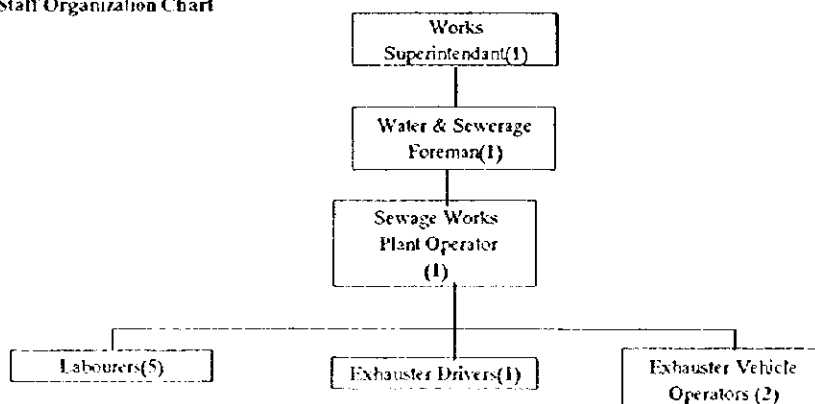
Financial Problems
Inaccurate billing due to lack of service to meters
Consumer failure to pay bills

Investment Budget Plan	
Type of activity	Target Year
Rehabilitation of the sewage works - BOQ preparation in progress	

On - Plot Sanitation

% Population with on plot sanitation	70%
Method of desludging facility	Council Exhauster
Quantity of sludge m ³ /year	4320 (480 trips /year)
Location of disposal point	Abandoned quarries

Staff Organization Chart



Name of Urban Center	Nakuru		x	y	
District	Nakuru		Coordinates		
Province	Rift Valley		Elevation 1750 - 2000m amsl		
Mean Annual Precipitation (mm)	Temperature max & min °C				
	1995	1998	2000	2005	2010
Population Projections		150,000	(There are two Sewage Treatment Works for this population)		
Urban Area (ha)		25,000.0			
Population Density (ppha)					
Water Supply	1995	1998	2000	2005	2010
Domestic water demand (m³/d)					
Total water consumption (m³/d)		28,457			
Area served (estimated net (ha))		4,410.0			
Raw water Source	Borcholes Rivers				
Sewerage Facilities	1995	1998	2000	2005	2010
Population Served		89,100			
Service coverage ratio %		22%			
Area served (estimated net (ha))		1,660.0			
Population Density (ppha)		53.8			
Wastewater volumes (m³/d)					
Sewerage connections		5610			
Treatment process (Njoro Sewage Treatment Works)					
AP - Anaerobic Pond F - Facultative pond FMP - First Maturation pond RF - Rock Filter SMP - Second Maturation pond TMP - Third Maturation pond GP - Grass plot					
Note: 3AP implies three Anaerobic Ponds in Parallel					
Description & dimensions	No. of Ponds	Size	Area	Depth	Total Volume
6,000 cu m/d line					
AP	3.0		2,300.0	3.00	6,900
FP	2.0		51,700.0	2.00	103,400
FMP	2.0		22,200.0	1.50	33,300
SMP	2.0		5,500.0	1.50	8,250
TMP	2.0		5,500.0	1.50	8,250
3,600 cu m/d line					
AP	3.0		1,400.0	3.00	4,200
FP	2.0		32,600.0	2.00	65,200
FMP	2.0		13,200.0	1.50	19,800
SMP	2.0		2,900.0	1.50	4,350
TMP	2.0		2,900.0	1.50	4,350
		Design Capacity	Actual flow		
		Dry weather	Population	Min	Max
		800			
		9,600		2,789	6,668
		BOD	COD	SS	N.P
		745	>2000	1330	
		effluent			
		receiving water body u/s	Enjoro River		

	Treatment Method	Disposal
Sludge Processing	Sludge Drying Bed	Municipal garbage dump
Operation & Maintenance		
<p>Treatment Works</p> <p>1. The ponds were constructed recently and are in good working order. The 6,000 cu.m/d line was constructed in 1994 while the 3,600 cu.m/d line was constructed in 1997. The new 3,600cu.m/d line was constructed after decommissioning the old system built in 1973.</p>		
<p>2. It is early to assess the performance of the newly constructed rock filters and grass plots.</p>		
Sewers		
<p>1. The pumping station at Mwariki was rehabilitated in 1997.</p>		
<p>2. Over 70% of the sewers in the town reticulation system are 150 mm dia. and are prone to frequent blockages. On average about 4 blockages are reported daily.</p>		
<p>3. There are intentional sewer blockages in the southern part of the town to facilitate vegetable growing with untreated sewage.</p>		
<p>4. The old pitch fibre sewers installed in 1955 have collapsed and the sewage permanently overflows via open stormwater drains.</p>		
<p>5. High sewer corrosion due to discharge of chemicals from industries (mainly from battery manufacturing firm) is prevalent on the western part of town.</p>		



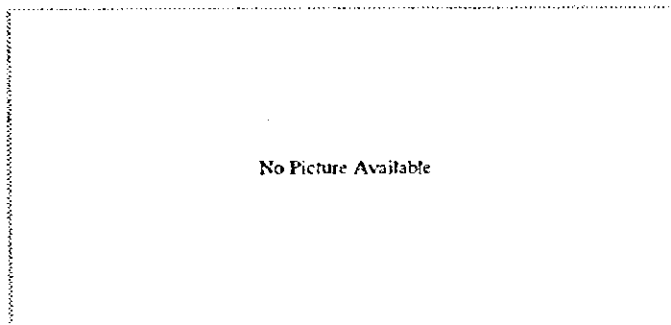
On-going projects	
No on going project.	

Aftercare Study on
the National Water Masterplan

Nakuru Town(1/2)

Name of Urban Center	Nakuru		X	Y	
District	Nakuru		Coordinates		
Province	Rift Valley		Elevation: 1760 - 2000m asl		
Mean Annual Precipitation (mm)	Temperature max & min °C				
	1995	1998	2000	2005	2010
Population Projections		250,000	(There are two Sewage Treatment Works for this Population)		
Urban Area (ha)		29,000.0			
Population Density (ppha)					
Water Supply	1995	1998	2000	2005	2010
Domestic water demand (m ³ /d)					
Total water consumption (m ³ /d)		29,457			
Area served (estimated net (ha))		4,410.0			
Raw water Source	Boreholes/Rivers				
Sewerage Facilities	1995	1998	2000	2005	2010
Population Served		89,260			
Service coverage ratio %		26%			
Area served (estimated net (ha))		1,660.0			
Population Density (ppha)		53.8			
Wastewater volumes (m ³ /d)					
Sewerage connections		9610			
Treatment process (Town Sewage Treatment Works)					
<p>AP - Anaerobic Pond F - Facultative pond FMP - First Maturation pond RF - Rock Filter SMP - Second Maturation pond TMP - Third Maturation pond GP - Grass plot PC - Primary Clarifier BF - Biological Filter FC - Final Clarifier</p>					
Note: 3AP implies three Anaerobic Ponds in Parallel					
Description & dimensions	No. of Ponds	Size	Area	Depth	Total Volume
3,200cu.m/d line					
AP	3.0		1,200.0	3.00	3,600
FP	2.0		31,100.0	2.00	62,200
FMP	2.0		12,700.0	1.50	19,050
SMP	2.0		2,400.0	1.50	3,600
TMP	2.0		2,400.0	1.50	3,600
3,400 cu.m/d line					
PC	1.0	Dia. 19.0	283.0	2.35	668
BF	1.0	Dia. 33.6	886.0	1.20	1,063
FC	1.0	Dia. 21.8	373.0	3.00	1,119
FP	2.0		23,800.0	2.00	47,600
FMP	2.0		9,500.0	1.50	14,250
SMP	2.0		2,600.0	1.50	3,900
TMP	2.0		2,600.0	1.50	3,900
Design Capacity					
	Dry weather	Population	Min	Max	Avg
BOD Loading mg/l	800				
Hydraulic loading	6,600		3,728	5,591	4,648
	BOD	COD	SS	NP	FC
Influent (1997)	1150	1961	1030		
Effluent	16				
receiving water body u/s	Lake Nakuru				

	Treatment Method	Disposal
Sludge Processing	No treatment	
Operation & Maintenance		
Treatment Works		
1. Facility is not well maintained and treatment process is not efficient.		
2. Screening and grit are not being removed frequently enough		
3. The ponds are covered with scum reducing light penetration and treatment efficiency		
4. Grass cut for areas surrounding ponds. Rest of the area is bushy and marshy.		
5. Site used for garbage		
6. Staff houses and offices vandalised, but repairable.		
Sewers		
1. Most of the town is sewered		
2. No regular cleaning or inspection of lines		
3. Some concrete pipes have ingrown roots.		
4.		



On-going projects	None

Management

Staffing		Skilled	Unskilled
Sewage works and sewer maintenance		4	11
Bye-law enforcement		-	-
Other		-	-

Resources Available	Comments
1 No. Exhauster lorry	Good condition
1 No. Pick-up	Good condition
1 No. Tractor	Good condition
1 No. winch machine	Good condition
1 No. diesel pump	Good condition
1 No. Rodding machine	Good condition
Sewer rods and tools	Good condition

Sources of Revenue	
Sewer charges	
Connection fees	

Annual Cash Flow, Kshs.	Year	Revenue	Expenditure	Surplus
	1995			-
	1996			-
	1997			-

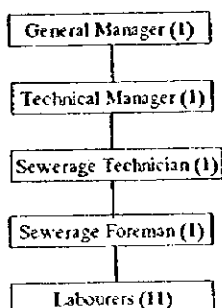
Financial Problems	
	Inaccurate billing due to water service not metered
	Consumer failure to pay bills
	Insufficient funding for rehabilitation and maintenance

Investment Budget Plan	Type of activity	Target Year
	None	

On - Plot Sanitation

% Population with on-plot sanitation	55%
Method of desludging facility	Municipal Council Exhauster
Estimated Quantity of sludge m ³ /year	12200
Location of disposal point	Sewage treatment works

Staff Organization Chart



Aftercare Study on
the National Water Master plan

NGONG (2/3)

Sludge Processing	Treatment Method	Disposal
	No treatment	No disposal
Operation & Maintenance		Treatment Works
1. The system has been neglected. Ponds inlets/outlets are damaged and covered with vegetation		
2. Insufficient waste water flow; no effluent. Second pond is covered with vegetation and is dry while the first pond is half way filled with water weed		
3. Inlet works have been covered with silt		
4. Lack of adequate staff. Only two unskilled labourers are supposed to man the sewer reticulation and sewage works		
5.		
Sewers		
1. The original 6" diameter pitch fibre sewers laid in 1950s have been replaced with 8" uPVC sewers.		
2. Low flows are received at the sewers due to insufficient water supply- rationing done once or twice per week		
3. Blockages are due to low flows		
4		
5		



Primary Waste Stabilization Pond: note heavy overgrowth

On-going projects	None

Management

Staffing			
	Skilled	Unskilled	
Sewage works	-	1	
Sewer maintenance	-	1	
Bye-law enforcement	-		
Other	-		

Resources Available		Comments
	1 Exhauster - 2000l	In good condition
	1 set of sewer rods	In good condition
	Slashers/jembes	In good condition

Sources of Revenue	
	Sewer charges
	Connection fees

Annual Cash Flow, kshs.			
Year	Revenue	Expenditure	Surplus
1995	14,000	The 2 No. staff	Revenue not
1996	17,300	are paid by the	enough to pay for
1997	17,300	Council	the 2 No. staff

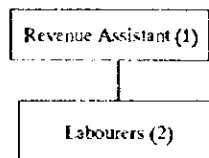
Financial Problems	
	Sewer tariffs are based on flat rate 960kshs/yr which is low.
	Consumer failure to pay bills which are collected together with plot rates - about 15 persons out of 85 pays for sewer per year
	Lack of other sources of revenue

Investment Budget Plan	Type of activity	Target Year
	None	

On - Plot Sanitation

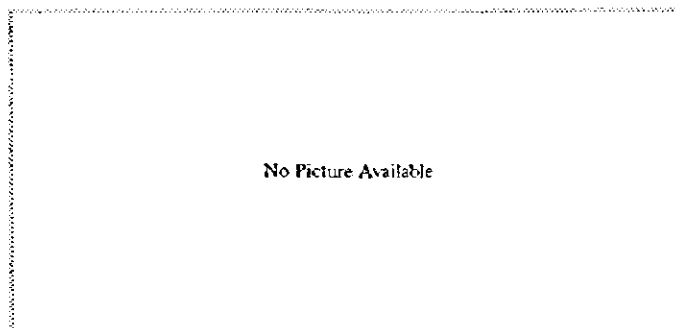
% Population with on-plot sanitation	95%
Method of desludging facility	One Council Exhauster and 6 private firms undertaking the work
Quantity of sludge m ³ /year	480 for the council exhauster(240 trips /year)
Location of disposal point	At Sewage Works

Staff Organization Chart



Name of Urban Center	Nyahururu				x	y
District	Laikipia				Coordinates	
Province	Rift Valley				Elevation	
Mean Annual Precipitation (mm)						Temperature max & min °C
	1995	1998	2000	2005	2010	
Population Projections	19,446	60,000	32,704	50,393	60,186	
Municipal Area (ha)						10,400.0
Population Density (ppha)						5.8
Water Supply	1995	1998	2000	2005	2010	
Domestic water demand (m ³ /d)						8,161
Total water consumption (m ³ /d)	2,500					
Area served (estimated net (ha))	106.0					448.0
Raw water source						
Sewerage Facilities	1995	1998	2000	2005	2010	
Population Served	3,239	18,000	4,909	10,079	15,046	
Service coverage ratio %	17%					25%
Area served (estimated net (ha))						
Population Density (ppha)						
Wastewater volumes (m ³ /d)						3,436
No. of sewerage connections						1511
Treatment process						
<pre> graph LR A1[AL] --- B[] A2[AL] --- B B --- C[SF] C --- D[M] </pre> <p>AL, Aerated lagoon SF, Secondary facultative M, Maturation pond</p>						
Description & dimensions	Size		Area	Depth	Volume	
Aerated lagoon 1	46.0	46.0	2,116.0	4.50	7077.0	
Aerated lagoon 2	46.0	46.0	2,116.0	4.50	7077.0	
Secondary Facultative Pond	288.0	59.0	16,992.0	1.25	19433.0	
Maturation pond	301.3	56.3	16,963.2	1.25	19353.0	
	Design Capacity		Actual flow			
	Dry weather	Population	Min	Max	Avg	
Hydraulic loading	2,500					
BOD loading	199					
	BOD	COD	SS	TN / TP	TC	
influent	300	800	1515			
effluent	50	120	920	5.38 / 2.20	615	
receiving water body u/s	30	60	1500			
receiving water body d/s						
Receiving water body	Ewaso Narok River upstream of two water supply intakes					

	Treatment Method	Disposal
Sludge Processing	No treatment	No treatment
Operation & Maintenance		
Treatment Works		
1. Aerated ponds are in series; first pond is full of sludge		
2. Floating aerators are difficult to service and lubricate.		
3. Laboratory is well operated and test are carried regularly and properly recorded		
4. Erosion protection slabs are failing and sliding away from the embankment		
5. Scum baffles have been removed and are required to prevent scum from migrating into pond and effluent		
6. Aerators are used alternately due to power fluctuations.		
Sewers		
1. Frequent blockages (approximately 1300 per year)		
2.		
3.		
4.		
5.		



On-going projects	None

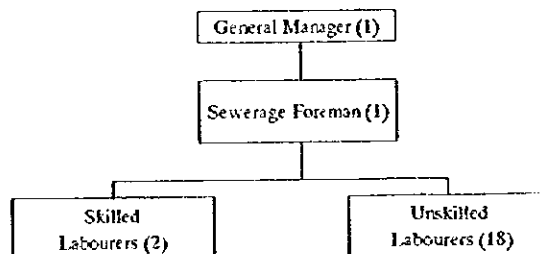
Management

Staffing			
	Skilled	Unskilled	
Sewage works	2	7	
Sewer maintenance	2	11	
Bye-law enforcement	-	-	
Other (watchmen)	-	-	
Resources Available		Comments	
1 No. Exhauster lorry		Good condition	
Sewer rods		Good condition	
Sources of Revenue			
Sewer charges			
Exhauster fees			
Blockage removal charges			
Connection fees			
Annual Cash Flow, Kshs.			
Year	Revenue	Expenditure	Surplus
1995	No	92,430	-
1996	information	85,958	-
1997	available	125,392	-
Financial Problems		Insufficient funding for rehabilitation and maintenance	
		Consumer failure to pay bills	
Investment Budget Plan			
Type of activity	Target Year		
Desludging of ponds	1998		
Rehabilitation and expansion of treatment works	1998		
Rehabilitation and expansion of sewer system	1998		

On - Plot Sanitation

% Population with on-plot sanitation	70%
Method of desludging facility	Municipal Council Exhauster
Estimated Quantity of sludge m ³ /year	No information
Location of disposal point	Sewage treatment works

Staff Organization Chart

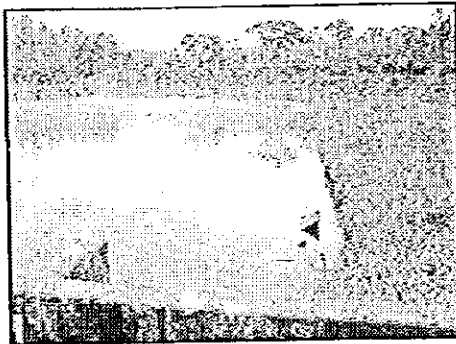


Name of Urban Center	Nyeri		x	y	
District	Nyeri		Coordinates		
Province	Central		Elevation		
Mean Annual Precipitation (mm)	Temperature max & min °C				
	1995	1998	2000	2005	2010
Population Projections	123,508	142,000	191,728	282,940	331,393
Municipal Area (ha)	164	2000	164	164	164
Population Density (ppha)	753.1	7.1	1,169.1	1,725.2	2,020.7
Water Supply	1995	1998	2000	2005	2010
Domestic water demand (m3/d)					44,987
Total water consumption (m3/d)	5,890	7,000			
Area served (estimated net (ha))	724.0		1,632.0		2,768.0
Raw water source	Chania River				
Sewerage Facilities	1995	1998	2000	2005	2010
Population Served	427	1,100	38,346	84,882	132,557
Service coverage ratio %	0%	5%	20%	30%	40%
Area served (estimated net (ha))					
Population Density (ppha)					
Wastewater volumes (m3/d)			500		
No. of connections			73		
Treatment process	Kijango ponds				
<p>A. Anaerobic PF, Primary facultative SF, Secondary facultative M, Maturation</p>					
Description & dimensions	Size (Top of embankment)		Area	Depth	Volume
Anaerobic pond 1	32.0	22.0	704.0	3.00	704.0
Anaerobic pond 2	32.0	22.0	704.0	3.00	704.0
Anaerobic pond 3	32.0	22.0	704.0	3.00	704.0
Anaerobic pond 4	32.0	22.0	704.0	3.00	704.0
Primary facultative pond 1	135.0	50.0	6,750.0	1.75	7760.0
Primary facultative pond 2	135.0	50.0	6,750.0	1.75	7760.0
Secondary facultative pond 1	52.0	25.0	1,300.0	1.75	2200.0
Secondary facultative pond 2	52.0	25.0	1,300.0	1.75	2200.0
Maturation Pond 1	27.0	27.0	729.0	1.50	1050.0
Maturation Pond 2	27.0	27.0	729.0	1.50	1050.0
Maturation Pond 3	27.0	27.0	729.0	1.50	1050.0
Maturation Pond 4	27.0	27.0	729.0	1.50	1050.0
	Design Capacity		Actual flow		
	Dry weather	Population	Min	Max	Avg
Hydraulic loading	2,000		300		300
BOD loading	689				
	BOD	COD	SS	N	FC
influent	560	1100	1000		
effluent	185	350	200	8	
receiving water body t/s	20	40	1160		
receiving water body d/s					
Receiving water body					

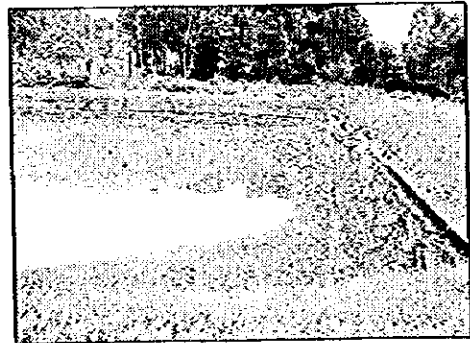
Aftercare Study on
the National Water Master plan

NYERI (2/3)

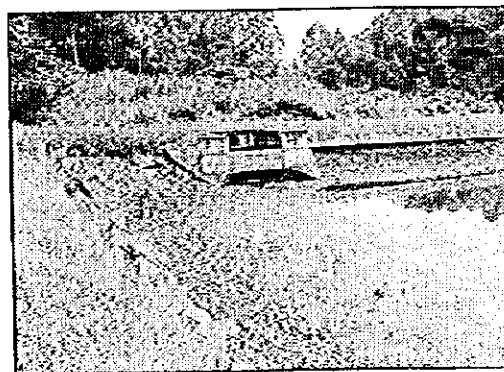
Sludge Processing	Treatment Method	Disposal
	Drying	Sold as manure
Operation & Maintenance		
Treatment Works		
1. Pond inlet structures have settled creating a gap; this interferes with the flow and in some places is causing erosion		
2. Erosion protection slabs are failing and some have fallen into the ponds.		
3. Anaerobic ponds last desludged in 1997 and is not regularly done due to low flow		
4. The sludge drying beds have never been used and are full of rainwater		
5. Inflow is very low due to pump station problems		
6. Apart from sludge drying beds, facility is in good condition but requires regular maintenance		
Sewers		
1. Pumping station is out of order frequently and therefore inflow to the ponds is very low. Frequent power failures experienced		
2. Pumps are difficult to maintain due to the lack of seals, and some motor starters have been scavenged for use elsewhere.		
3. Currently only one pump is working and is catering for the sewage flow. A new pump is to be installed in the near future.		
4. KCC contribute 60% of the total sewage flow but no monitoring of their effluent after pre-treatment		
5		



Second maturation pond: note failure of erosion protection due to abnormally high water levels



Third maturation pond: note failure of erosion protection & slope erosion



Third maturation pond: note failure of erosion protection & slope erosion in foreground, and baffled outlet structure in background.

On-going projects	None

Management

Staffing			
	Skilled	Unskilled	
Sewage works and sewer maintenance	2	5	
Bye-law enforcement	-	-	
Other (watchmen)	-	-	

Resources Available		Comments
Sewer rods		Good condition
Tools		Good condition

Sources of Revenue	
Sewer charges	
Connection fees	

Annual Cash Flow, Kshs. (Includes revenue and expenditure for Nyeri Conventional Treatment works)				
Year	Revenue	Expenditure	Surplus	
1995	13,195,513	8,598,292	4,597,221	
1996	13,619,396	9,532,444	4,086,953	
1997	22,475,233	10,543,773	11,931,460	

Financial Problems	
Consumer failure to pay bills	

Investment Budget Plan		
Type of activity		Target Year
None		

On - Plot Sanitation

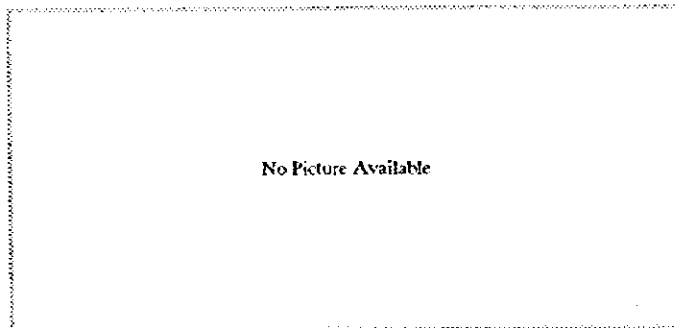
% Population with on plot sanitation	80%
Method of desludging facility	Ministry of Public Works Exhauster
Estimated Quantity of sludge m ³ /year	No information available
Location of disposal point	Sewage treatment works or buried

Staff Organization Chart

Not available

Name of Urban Center	Nyeri					x	y
District	Nyeri					Coordinates	
Province	Central					Elevation	
Mean Annual Precipitation (mm)						Temperature max & min °C	
	1995	1998	2000	2005	2010		
Population Projections	123,508	142,000	191,728	282,940	331,393		
Municipal Area (ha)	164	20,000.0	164	164	164		
Population Density (ppha)	753.1	7.1	1,169.1	1,725.2	2,020.7		
Water Supply	1995	1998	2000	2005	2010		
Domestic water demand (m3/d)					44,897		
Total water consumption (m3/d)	5,890	7,000					
Area served (estimated net (ha))	724.0	2,000.0	1,632.0	2,768.0			
Raw water source	Chania River						
Sewerage Facilities	1995	1998	2000	2005	2010		
Population Served	2,478	36,000	38,346	84,882	132,557		
Service coverage ratio %	6%	10%	20%	30%	40%		
Area served (estimated net (ha))							
Population Density (ppha)							
Wastewater volumes (m3/d)		2,000.0					
No. of connections		1,865					
Treatment process Conventional							
<pre> graph LR ST1[ST] --> HBF1[HBF] ST2[ST] --> HBF2[HBF] HBF1 --> IHT[IHT] HBF2 --> IHT IHT --> LTF1[LTF] IHT --> LTF2[LTF] LTF1 --> FIT[FIT] LTF2 --> FIT FIT --> M1[M] M1 --> M2[M] M2 --> M3[M] </pre>				<ul style="list-style-type: none"> ST Sedimentation tanks HBF High rate biological filters IHT Intermediate humus tank LTF Low rate biological filters FIT Final humus tank M Maturation ponds 			
Description & dimensions	Size		Area	Depth	Volume		
Sedimentation tanks	dia =	15.0	176.0	3.00	528.0		
Sedimentation tanks	dia =	15.0	176.0	3.00	528.0		
High rate biological filters	dia =	24.0	452.0	3.00	1356.0		
High rate biological filters	dia =	24.0	452.0	3.00	1356.0		
Intermediate humus tank	dia =	18.0	254.0	2.00	508.0		
Low rate biological filters	dia =	34.0	907.0	2.00	1814.0		
Low rate biological filters	dia =	34.0	907.0	2.00	1814.0		
Final humus tanks	dia =	18.0	254.0	2.00	508.0		
Final humus tanks	dia =	18.0	254.0	2.00	508.0		
First maturation pond	46.0	38.0	1,748.0	1.80	3146.4		
Second maturation pond	46.0	38.0	1,748.0	1.80	3146.4		
Third maturation pond	46.0	36.0	1,656.0	1.80	2980.8		
	Design Capacity		Actual flow				
	Dry weather	Population	Min	Max	Avg		
Hydraulic loading	6.100		912	3,144	2,028		
BOD loading	2,379						
	BOD	COD	SS	IN / TP	TC		
influent	372	900	1050				
effluent	87	450	760	10.25 / 1.7	490		
receiving water body u/s	21	40	1153				
receiving water body d/s	23	40	1124				
Receiving water body	Chania river						

	Treatment Method	Disposal
Sludge Processing	Sludge digestion lagoons 4x (25x20x8), 4 months retention sludge drying beds	Sold at 75 Shs/ton
Operation & Maintenance		Treatment Works
1. Grit removal Blowers not in working condition		
2. Insufficient wastewater flow, only half the process is actually in operation.		
3. Concrete erosion protection in maturation ponds has failed and needs rehabilitation.		
4. High river flows have damaged third maturation pond which is now empty awaiting repair. Outlet chamber and pipe have been washed away.		
5. 1 No. humus tank not in use due to an underground leak		
6. Effluent could be improved with better process control.		
7. Automatic flow recorder not working.		
8. Sludge drying beds flooded due to recent rains		
9. Treatment works generally well maintained		
Sewers		
1. The trunk sewer has been damaged in places due to the recent rains. Still awaiting repair. Sewage discharging into river.		
2. Sewer lines serving the central part of the town are overloaded.		
3		
4		
5		



On-going projects	None

Management

Staffing			
	Skilled	Unskilled	
Sewage works	5	13	
Sewer maintenance	2	3	
Bye-law enforcement	-	-	
Other (watchmen)	-	-	

Resources Available		Comments
1 No. council vehicle		Good condition
Sewer rods		Good condition

Sources of Revenue		
Sewer charges		
Connection fees		

Annual Cash Flow, Kshs.	(Includes revenue and expenditure for Kiganjo Treatment works)			
	Year	Revenue	Expenditure	Surplus
	1995	13,195,513	8,598,292	4,597,221
	1996	13,619,396	9,532,444	4,086,953
	1997	22,475,233	10,543,773	11,931,460

Financial Problems	
Bad debts	
Consumer failure to pay bills	

Investment Budget Plan	Type of activity	Target Year
	None	

On - Plot Sanitation

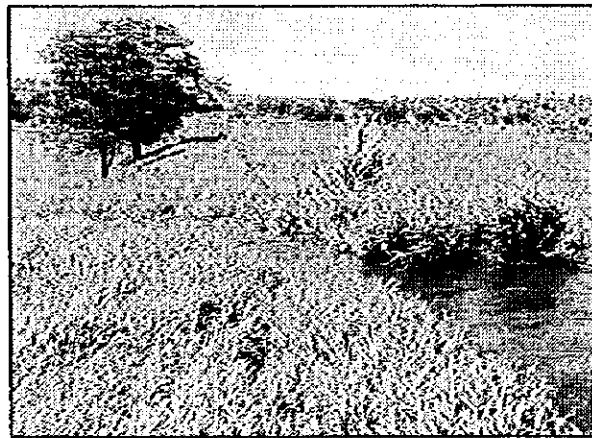
% Population with on-plot sanitation	60%
Method of desludging facility	Ministry of Public Works Exhauster
Estimated Quantity of sludge m ³ /year	No information available
Location of disposal point	Sewage treatment works

Staff Organization Chart

Not available

Name of Urban Center	Thika		x	y	
District	Kiambu	Coordinates	37° 05'	01° 04'	
Province	Central	Elevation			
Mean Annual Precipitation (mm)	Temperature max & min °C				
	1995	1998	2000	2005	2010
Population Projections	73,718	155,170	116,312	166,252	190,350
Municipal Area (ha)	185	9,500.0	185	185	185
Population Density (ppha)	398.5	16.7	628.7	898.7	1,028.9
Water Supply	1995	1998	2000	2005	2010
Domestic water demand (m ³ /d)					25,742
Total water consumption (m ³ /d)	11,400	24,000			
Area served (estimated net (ha))	441.0		1,012.0		1,624.0
Raw water source	Chania River				
Sewerage Facilities	1995	1998	2000	2005	2010
Population Served	11,718	87,230	23,262	49,876	76,140
Service coverage ratio %	16%	16%	20%	30%	40%
Area served (estimated net (ha))		1,500.0			
Population Density (ppha)		58.2			
Wastewater volumes (m ³ /d)		10,000			
No. of sewer connections		6000			
Treatment process					
<p>PF, Primary facultative SF, Secondary facultative T, Tertiary M, Maturation</p>					
Description & dimensions	Dimensions at TWL		Area	Depth	Volume
Primary pond - 6No.	64.5	124.0	7,998	1.50	11916
Secondary pond - 6 No.	64.5	124.0	7,998	1.50	11916
Tertiary pond - 6 No.	64.5	124.0	7,998	1.50	11916
Maturation pond 1	64.5	153.0	9,869	1.50	14710
Maturation pond 2	64.5	153.0	9,869	1.50	14710
	Design Capacity		Actual flow		
	Dry weather	Population	Min	Max	Avg
Hydraulic loading	6.100		2,000	3,000	2,500
BOD loading	2.257				
	BOD	COD	SS	N/P	FC
influent	570	800	1900		
effluent	40	120	1170	13/0.8	360
receiving water body u/s	25	80	1000		
	32	80	1050		
Receiving water body	Korou river				

	Treatment Method	Disposal
Sludge Processing	No treatment	No treatment
Operation & Maintenance		
Treatment Works		
1. The sewage has a lot of industrial waste and the ponds are highly overloaded. Current flow is about 10,000 m ³ /d any season the flow to the treatment works is more than 50% the current DWF.		
2. Embankment protection is in serious disrepair and the precast water protection slabs have fallen to bottom of ponds.		
3. The grit removal facilities do not function and a large amount of grit has been deposited in primary ponds.		
4. Flow splitting is unsatisfactory resulting in unequal loading to ponds		
5. Heavy build up of sludge in all primary ponds, reducing retention times. Grass along the edges is growing into the ponds.		
Sewers		
1. There are about 26.3 km of 150mm diameter sewers in the town which is causing frequent blockages (about 1700 blockages are reported per year)		
2. Intentional sewer blockage for irrigation is common and this should be discouraged		
3. The pumping station in the northern part of town frequently breaks down causing direct discharge of effluent to the river.		
4.		



Primary Facultative Pond: note high water levels, overflow across the top of the embankment, tall grass and trees indicating lack of basic maintenance.



Secondary Facultative Pond: note hydraulic surcharge conditions at interconnection chamber, tall grass and trees, poor embankment maintenance.

On-going projects	Proposals for rehabilitating the existing works as an immediate measure is underway

Management

Staffing			
	Skilled	Unskilled	
Sewage works	11	7	
Sewer maintenance	16	8	
Bye-law enforcement	-	-	
Other	-	-	

Resources Available	Comments
2 cars	In good condition
sewer rods	In good condition
Winching and Rota machines	In good condition

Sources of Revenue	
	Sewer charges
	Connection fees
	water charges

Annual Cash flow, kshs.	Year	Revenue	Expenditure	Surplus
	1995			
	1996			
	1997			

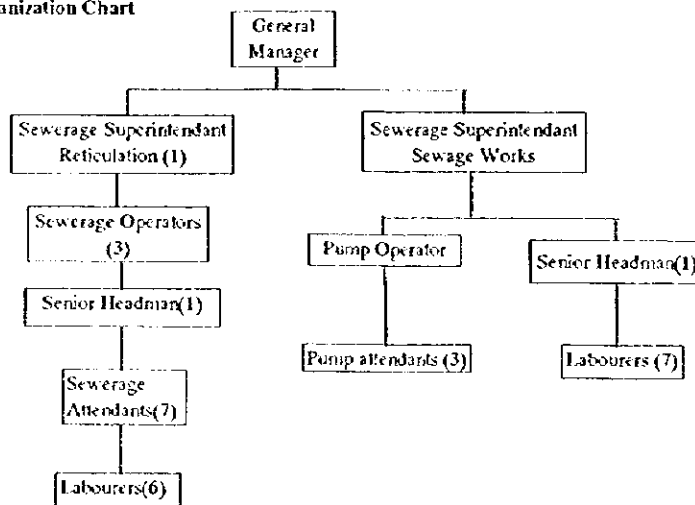
Financial Problems	
	Inaccurate billing system
	Consumer failure to pay bills
	High cost of pumping water to the distribution reservoirs

Investment Budget Plan	Type of activity	Target Year
	Rehabilitation of the existing sewage works	

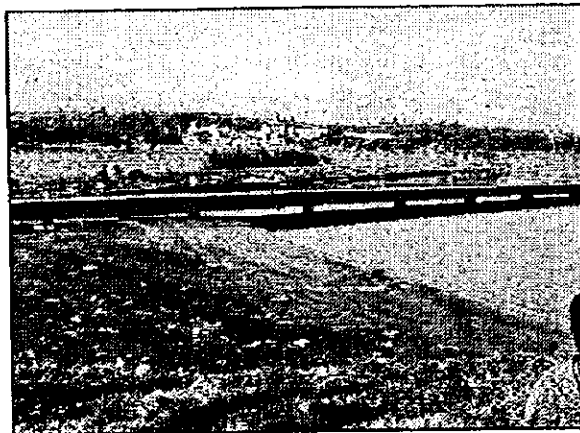
On - Plot Sanitation

% Population with on plot sanitation	44%
Method of desludging facility	Council exhauster from Public health Dept.
Quantity of sludge m ³ /year	not known
Location of disposal point	Manholes in trunk sewers

Staff Organization Chart



	Treatment Method	Disposal
Sludge Processing	To date no treatment	To date no treatment
Operation & Maintenance		
Treatment Works		
1. Primary and secondary ponds are choked with sludge; needs de-sludging		
2. Interpond connection is broken and needs to be repaired		
3. The site needs to be fenced up		
4. Access road to the site needs to be upgraded.		
5 Inlet works is required		
6		
Sewers		
1. Most of the sewers are undersize (40% are 100 and 150 mm in diameter)		
2		
3		
4		
5		



Primary Facultative Pond: note long inlet structure and extensive scum blanket



Secondary Facultative Pond: note children playing near overflow weir

On-going projects

None