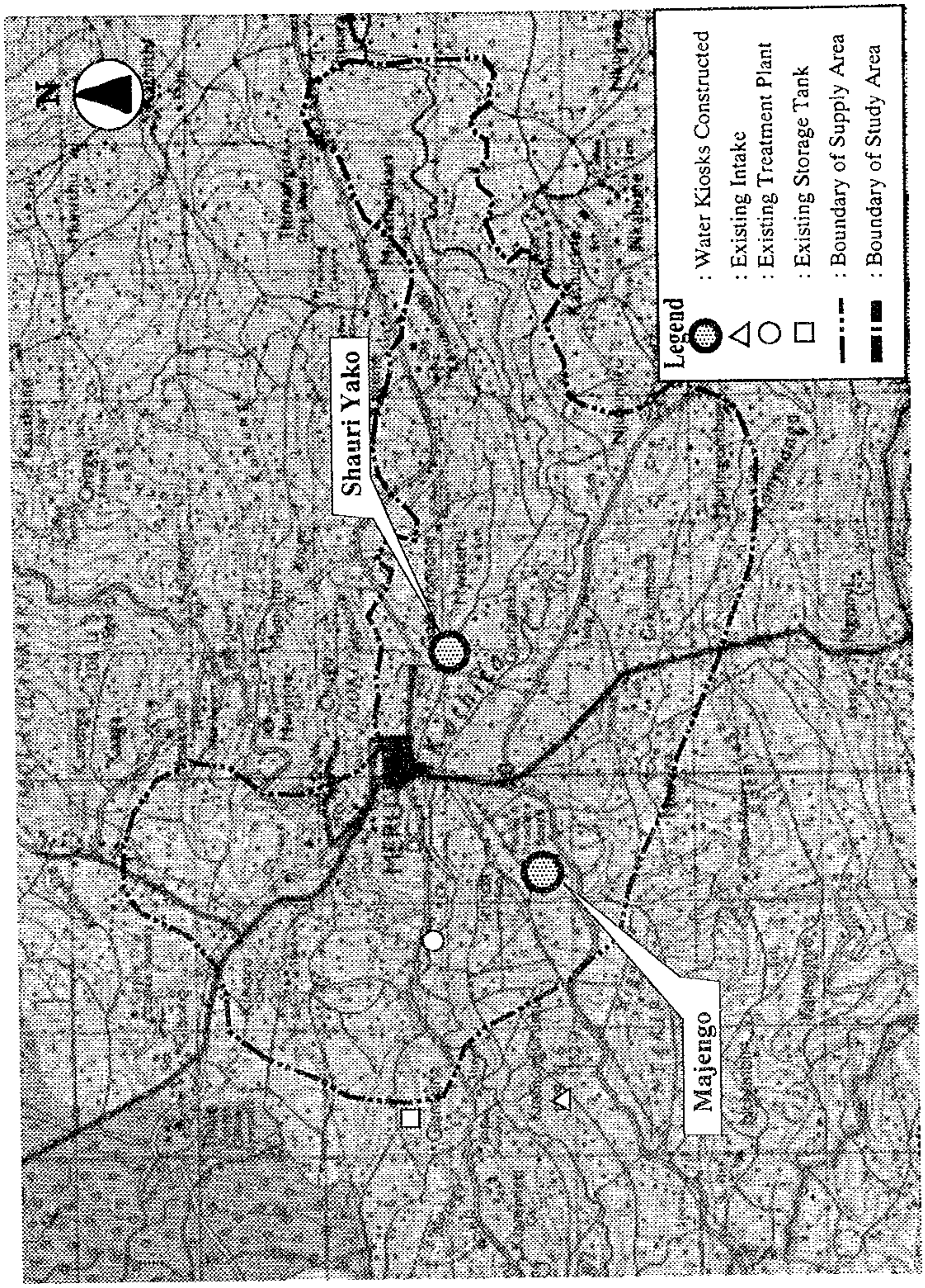
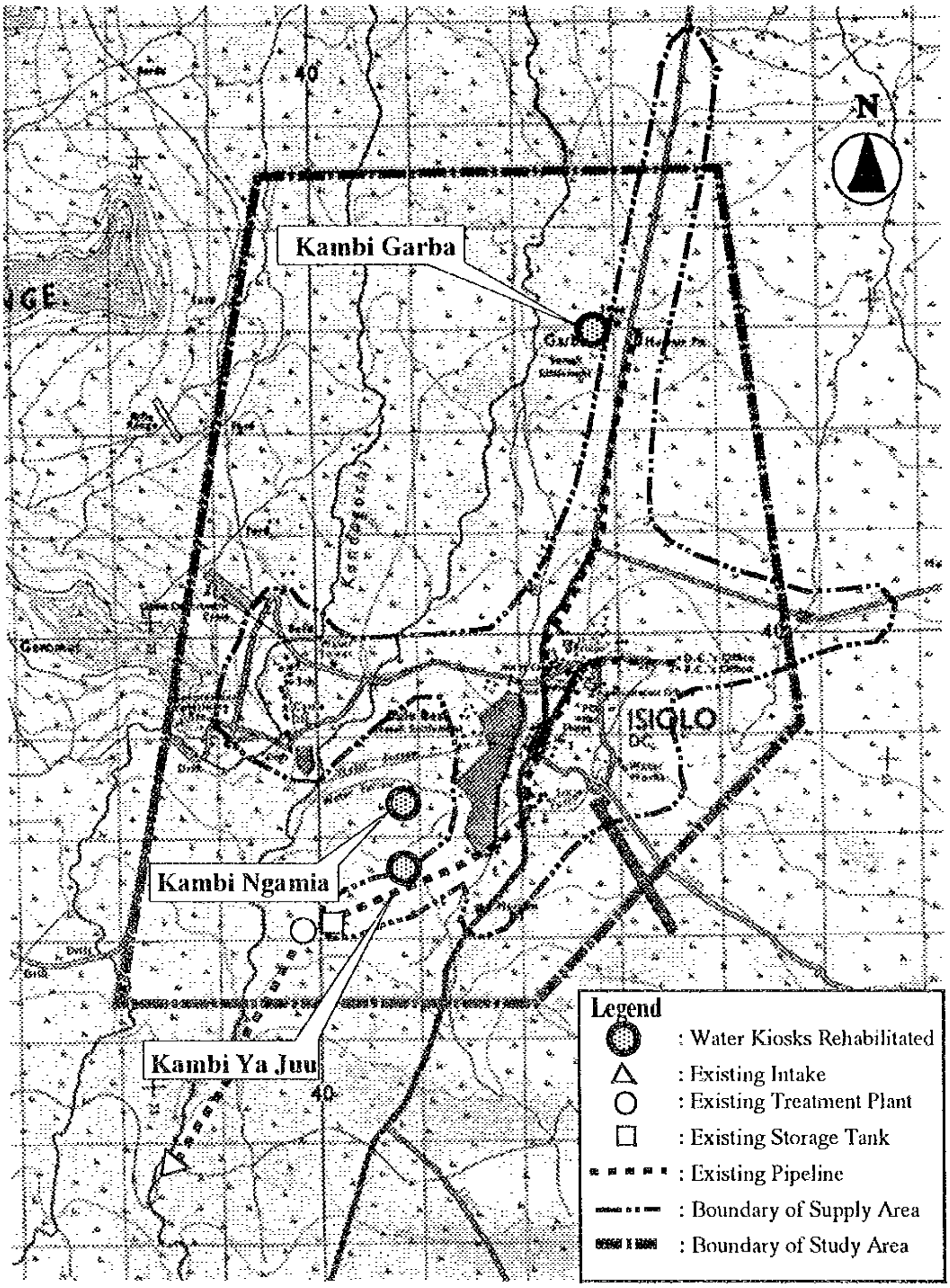
FIGURES

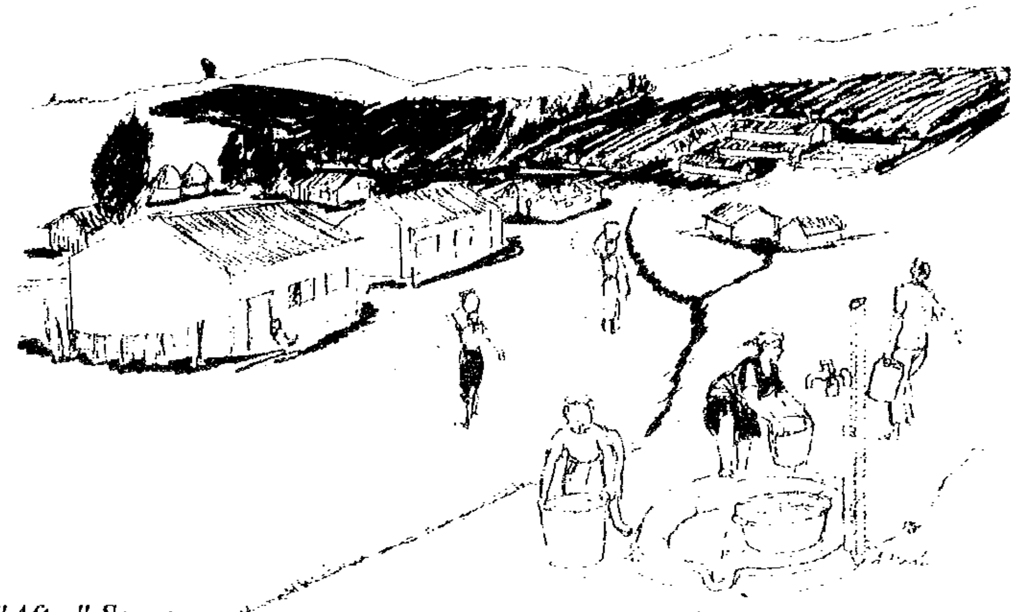


THE STUDY ON THE WATER SUPPLY FOR SEVEN TOWNS IN EASTERN PROVINCE IN THE REPUBLIC OF KENYA	**Figure G5-1**
JAPAN INTERNATIONAL COORERATION AGENCY	**Kiosks Constructed in Meru**



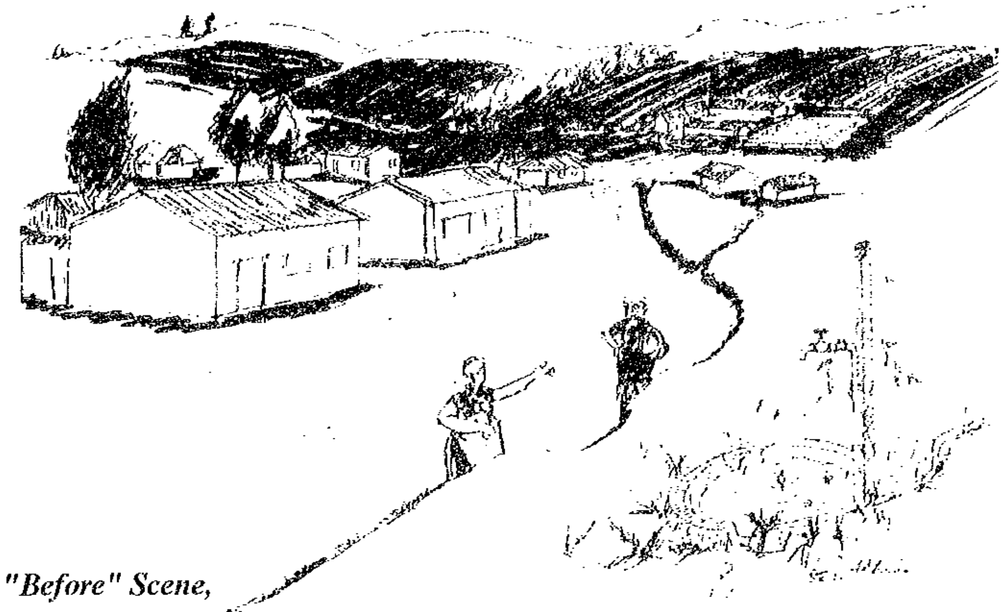
THE STUDY ON THE WATER SUPPLY FOR SEVEN TOWNS IN EASTERN PROVINCE IN THE REPUBLIC OF KENYA	Figure G5-2
JAPAN INTERNATIONAL COORERATION AGENCY	Kiosks Rehabilitated in Isiolo

Posters 3A & 3B: Story with a Gap, Meru



"After" Scene,

Poster 3A: Improved water supply at a CWP in Meru



"Before" Scene,

Poster 3B: Problems experiences at a CWP in Meru

Developed by JICA Study Team

Poster 3C Role Played by Gender in Water and Sanitation Activities (Meru)

Developed by JICA Study Team

Poster 3F Roles and Activities That Men are Engaged in Meru

Farm activities

Carpentry and building

Chewing "Miraa" - a leisure activity

Drinking beer - a leisure activity

Developed by JICA Study Team

Poster 3G Roles Performed by Women in Meru

Child care - bathing children

Cooking for the family

Digging - farm activities

Collecting firewood

Developed by JICA Study Team

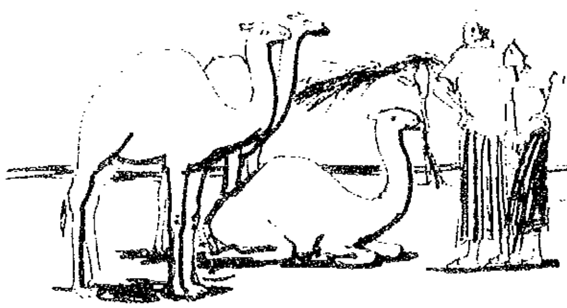
Poster 3K Role Played by Gender in Water and Sanitation Activities

Developed by JICA Study Team

Poster 3M Roles and Activities that Men are Engaged in Isiolo

Religious duties - a Man reading the Koran.

Chewing Miraa - a popular leisure activiy



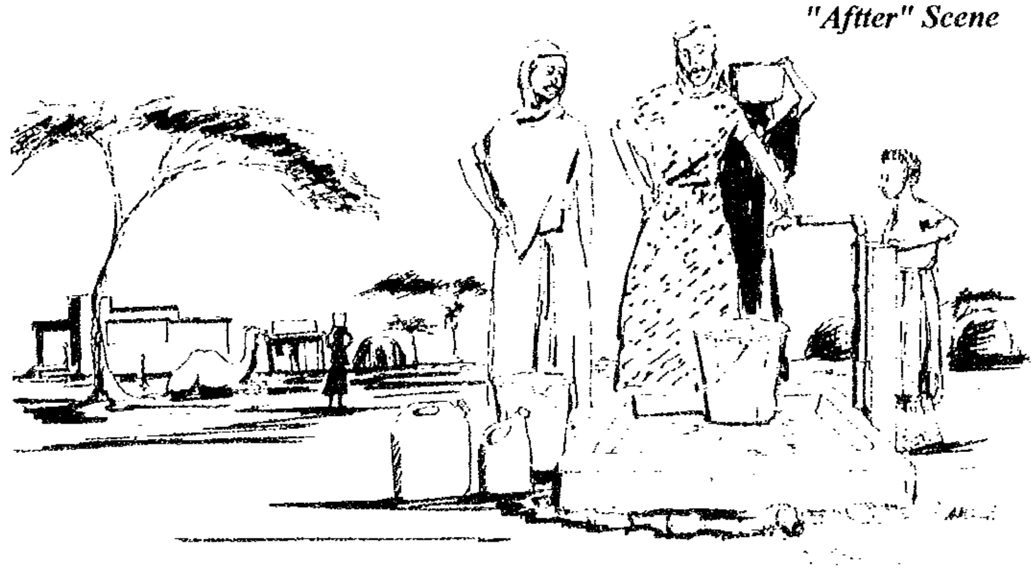
Selling Livestock (Camels)

Collection of limber poles for house Construction

Developed by JICA Study Team

Poster 3N & 3J Story with a Gap Isiolo

Adopted from TCP pages 118 -119



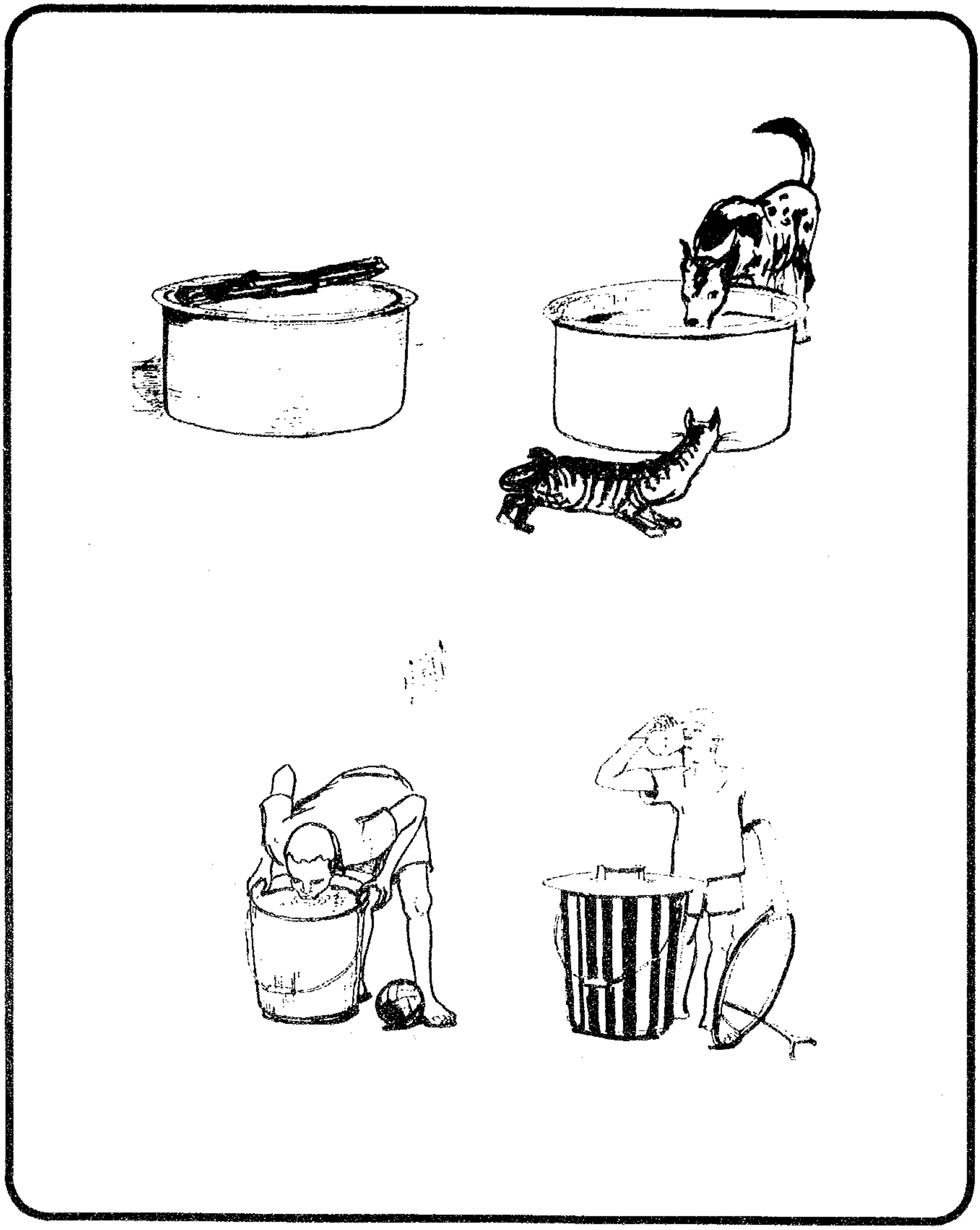
Poster 3N: Improved Water Supply Situation at a CWP in Isiolo

Poster 3J: Problem Experiences at a CWP in Isiolo

Reproduced by JICA Study Team

Poster 4B Water Storage and Usage

(Pocket Chart - Adopted from TCP pages 96 -97)



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Poster 4C: Hand Washing (Meru)

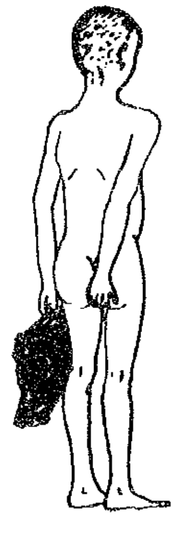
Developed by JICA Study Team

Poster 4E: Ways of Excreta Disposal

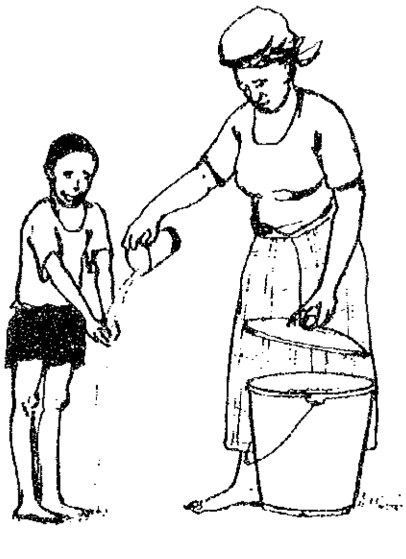
Sanitation Ladder - Adopted from TCP SARRAR Materials developed by PRDWESS.

Defecating in the bush.

Partly constructed pit latrine.



A boy scratches his cleans himself with the open palm.



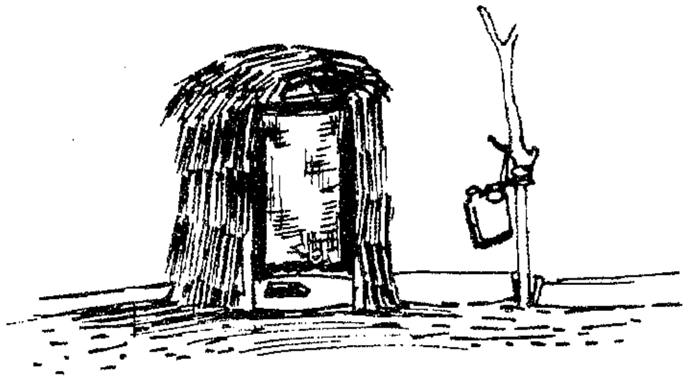
Washing hands after using the latrine.

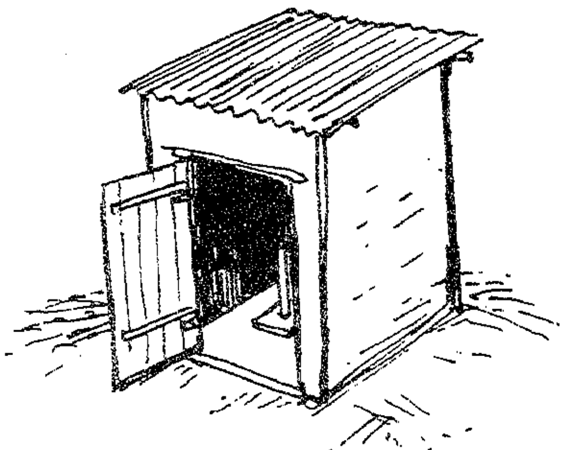
Reproduced by JICA Study Team

Poster 4E1: Ways of Excreta Disposal

-The Sanitation Ladder

Defecating in the bush





Toilet with door and coverplate.

Using the hoe to cover one's feaces in the garden.

Developed by JICA Study Team

Poster 4F: Hand Washing (Isiolo)

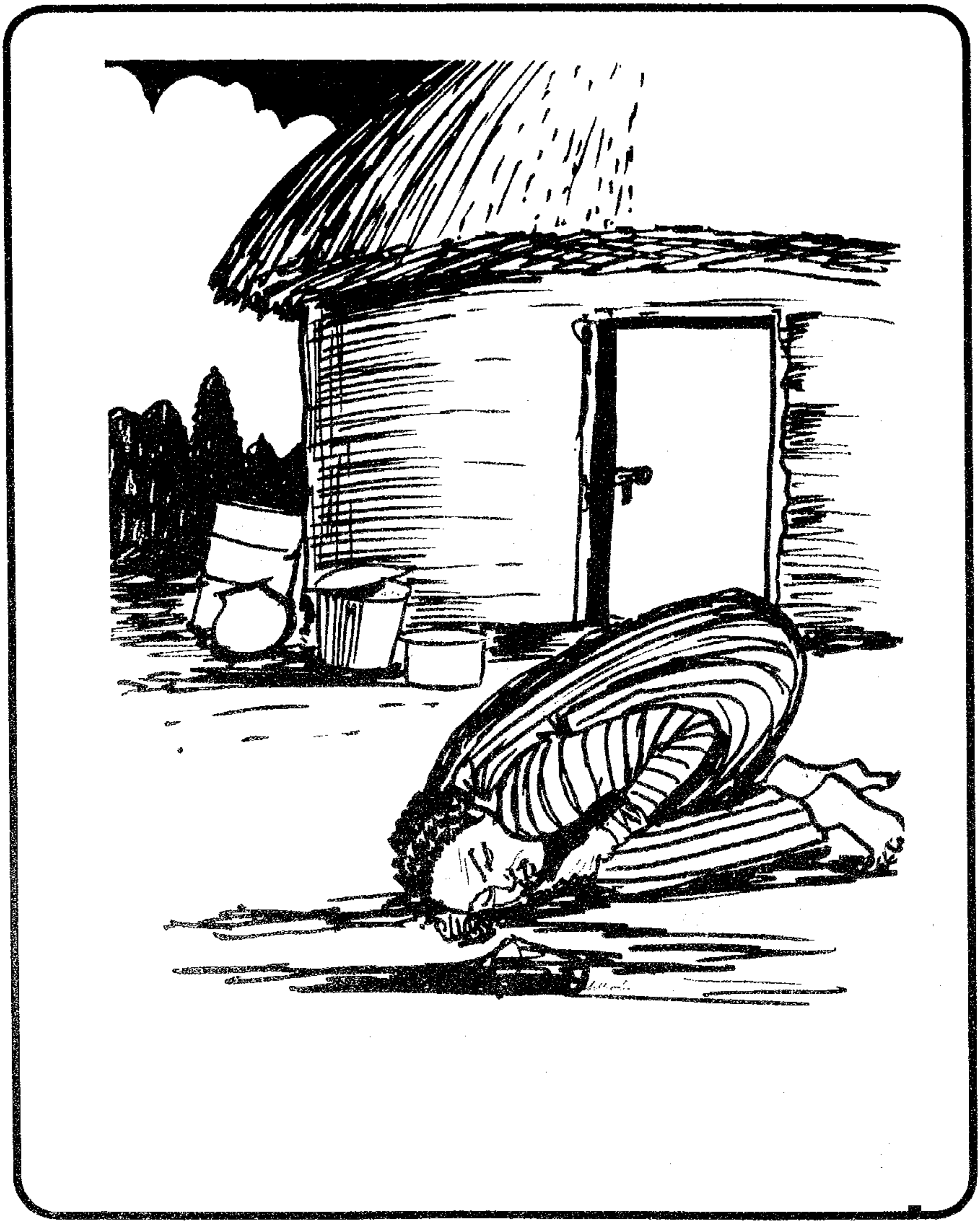
Developed by JICA Study Team

Poster 4G: Compound Cleaning and Solid WasteDisposal

Developed by JICA Study Team

Poster 4K: Consumption of Contaminated "Unsafe Water"

- The aftermath



Developed by JICA Study Team

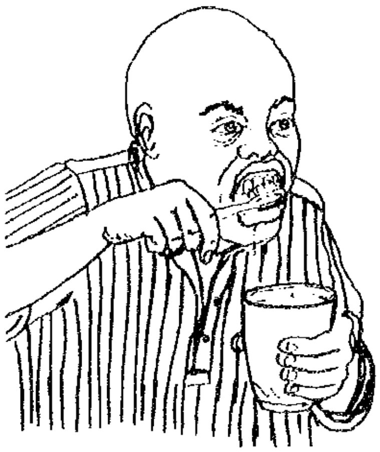
Poster 5: Mosquito Breeding Grounds and its Attack on humans

- Adopted from Environmetnal Health Engineering in the Tropics, page 201

Reproduced by JICA Study Team

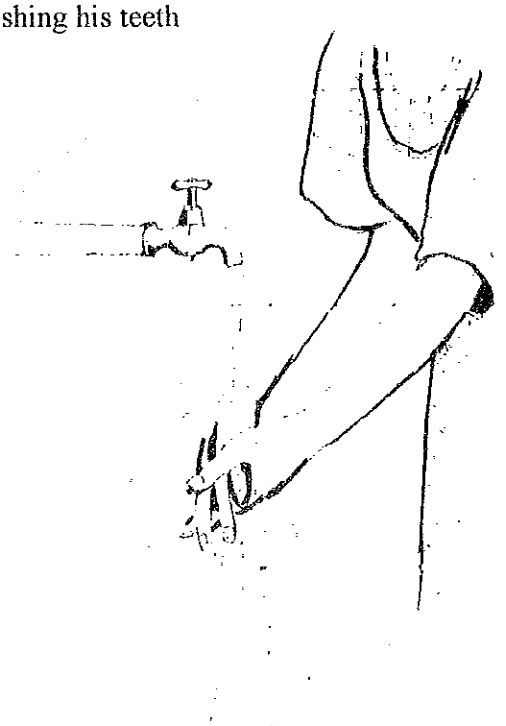
Poster 4H Personal Hygiene Practices

Adopted for TCP pages 102- 103



Brushing his teeth

Washing the face in the morning



Washing hands

Drinking water from the tap

Reproduced by JICA Study Team

THE STUDY ON WATER SUPPLY FOR
SEVEN TOWNS IN EASTER PROVINCE
IN THE REPUBLIC OF KENYA

APPENDIX H

WASTEWATER DISPOSAL FACILITIES

APPENDIX H WASTEWATER DISPOSAL FACILITIES

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1. GENERAL BACKGROUND

1.1 Sanitation and health

The seven schemes included in this study are mostly rural in character, and the existing widespread use of pit-latrines in these relatively low population density areas is the most appropriate form of sanitation for the foreseeable future. The Study of social survey indicated that 88% of the population used pit latrines, many of which however were poorly constructed and maintained.

Isiolo however, where roughly 25% of the population use the bush, was an exception, due to the traditional nomadic way of life of many of its inhabitants.

Nevertheless, roughly 80% of the 700 households interviewed revealed a reasonable knowledge of how water related diseases are conveyed.

Malaria was the most frequent disease reported as affecting households. Typhoid was high in both Meru and Isiolo, suggesting that areas of higher urbanisation may be more prone to such diseases.

Table H-1 provides health statistics obtained from the social survey, and also indicates the current and projected urban levels in the different scheme areas.

Table H-1 Urban Population and Disease Incidence

Scheme	Meru	Nkubu	Isiolo	Chuka	Chogoria	Maua	Tigania
1989 Urban population	35,053	3,578	12,482	1,845	1,314	3,223	0
1989 % urban	28%	52%	67%	6%	5%	100%	0%
2010 Urban population	97,743	9,969	34,785	14,936	3,653	13,344	0
2010 % urban	39%	64%	80%	23%	8%	100%	0%
Number of households reporting diseases in last year: (100 household sample in each scheme)							
Malaria	76	78	62	85	96	51	81
Typhoid	13	4	25	5	5	2	3
Cholera	0	0	5	3	0	2	4
Dysentery	3	1	0	13	8	5	6
Others	44	46	40	58	66	50	66

1.2 Sewerage

Only the centres of Meru and Isiolo have waterborne sewerage systems. In both cases they were intended to serve approximately 30% of the urban population, and discharge to waste stabilization pond systems. The systems were surveyed during the first phase of this study by the Jomo Kenyatta University of Agriculture and Technology. The following is a summary of their main findings.

1.2.1 Meru Sewerage

The sewerage system, constructed in 1974 to serve a population of 20,000, serves only the central part of the town, with a total length of sewers of 7.7 km, discharging an average total flow of 270 m3/day to a treatment plant located just to the east of the market area. The sewerage system, and treatment plant is managed by Meru Municipal Council.

A dairy plant located about 1 km to the south west, pre-treats its effluent of about 60 m3/day before pumping it to the municipal treatment plant.

No design details exist for the Municipal treatment plant. It consists of inlet works, a single waste stabilization pond and an irrigation/soakage system. However, only the pond itself is operational.

The inlet screens to the pond have been removed, and the grit chamber is silted up and is not functioning. The pond itself is oval in shape, with a baffle wall located along its central axis and an estimated volume of 8,000 m3. It was last desludged in 1991.

The outlet passes through what was an irrigation/soakage system, but which has not been used for many years. The outlet from this area was blocked, with effluent overflowing into an open ditch running down the side of Moi Road

The site was unfenced, with access to children and livestock being unrestricted. The area to the north of the pond was, in addition, being used as a solid waste dump.

Average untreated, and treated effluent quality is given in ***Table H-2***:

Table H-2 Influent and effluent water volumes and quality - Meru

	Influent			Effluent		
	Max	Min	Average	Max	Min	Average
Flow (m3/d)	1057	19	270	191	49	127
BOD (mg/l)	725	375	502	250	96	160
Suspended Solids (mg/l)	685	445	621	309	30	197

The sewerage system is managed by the Municipal Council of Meru. The sewerage section comes under the responsibility of the Town Engineer, and is headed by a foreman. An operator inspects daily operations overseen on site by charge hands. There is nobody assigned permanently to the treatment plant, and nobody carries out routine operation and maintenance at the ponds however.

There are no records kept of sewage flows, and there is no local capability for water quality analysis.

1.2.2 Isiolo Sewerage

The sewerage system, constructed in 1984, serves 30% of the population living in the central part of the town, with a total length of sewers of 13.4 km, discharging an average total flow of 630 m3/day to a treatment plant located to the north of the town. The sewerage system, and treatment plant is managed by Isiolo Municipal Council.

The treatment plant consists of inlet works, three anaerobic ponds, one facultative and two maturation ponds. The solid waste dump for Isiolo is located on the same plot and wind blown paper covers the site, including the ponds.

One of the anaerobic ponds has become silted up and is due for emptying.

Average untreated, and treated effluent quality is given in ***Table H-3***:

Table H-3 Influent and effluent water volumes and quality - Isiolo

	Influent			Effluent		
	Max	Min	Average	Max	Min	Average
Flow (m3/d)	1125	353	630	563	330	447
BOD (mg/l)	755	426	605	200	118	251
Suspended Solids (mg/l)	930	383	653	343	47	170

The raw sewage thus appears to be very high strength, and represents about 12.5% of the volume of water supplied to the town.

It should be noted however, that the above analyses were conducted on unfiltered samples. It has been estimated, (Mara, 1992) that between 70 to 90 % of BOD in unfiltered samples of effluent from maturation ponds is due to the algae which will be present. Taking this into account therefore, the above results, while still not acceptable, are not as bad as they initially look. The poor performance may be due to the reduced retention time available in the ponds due to the accumulation of sediment over time.

The waste stabilization ponds are managed under the Works Department of Isiolo Municipal Council, which has a total establishment of 15. Eight attendants are responsible for maintaining the waste stabilization pond and solid waste dump site. However the personnel are not trained, and their understanding of the requirements of their job would appear to be limited.

There are no records kept of sewage flows, and there is no local capability for water quality analysis.

2. FUTURE PROGNOSIS

The provision of increased quantities of water under this project will, at the same time, increase the quantities of wastewater to be disposed of, and will therefore increase the risk of an adverse impact on the environmental health conditions in the areas.

Most consumers will however be living in rural areas, where any impact can be mitigated by simple, well proven, cost effective methods, such as pit latrines for households without individual connections or, septic tanks and soakaways, for houses with individual connections. The main requirement to mitigate any adverse impact is therefore to ensure that households are well aware of the risks to health of poorly constructed and maintained facilities, and to ensure that households have adequate facilities before a water connection is made.

The main problem foreseen is in the urban areas which, as can be seen from Table "**Urban Population and Disease Incidence**", are projected to be increasing at a higher rate than the rural areas, and that by the year 2010, all the urban centres are predicted to become quite sizable towns.

The provision of sewerage facilities to these towns is beyond the scope of the present study, but it is clear that it will be necessary to investigate appropriate alternatives, study affordability issues and, to assess the acceptable housing density for different on-site facilities in different geological and soil conditions.

Nevertheless it is seen that it will be difficult to avoid providing sewerage systems to serve the central commercial and institutional areas of these towns, and, in the case of Isiolo and Meru, to expanding the existing system coverage. All these systems will require wastewater treatment facilities.

3. CONSTRUCTION OF PILOT WASTEWATER TREATMENT PLANT IN MERU

In order to assess the performance of extensions to the existing waste stabilization ponds at Meru, a pilot plant was designed and constructed. Fencing of the entire site was also included for safety and security purposes.

With minor improvements to the inlet and outlet arrangements, the plant was designed to conform with the 1992 longer term proposals of Wanjohi Consulting Engineers prepared on behalf of the Ministry of Local Government. The pilot plant can therefore form part of the long term proposals for wastewater treatment.

After analysis of tenders for the two construction and supervision components of the project, the construction contract was let to Njiru Builders and the contract for construction supervision was let to Mangat I.B. Patel and Partners.

The construction program required commencement by the beginning of September and completion by the middle of October. Considering the extent of the works, this was a fairly ambitious schedule, but was required in order to commence the sampling program as soon as possible, and in order to complete the works prior to the onset of the rainy season which usually occurs in mid October. The works were substantially complete by mid October, and the wastewater was diverted into the new pond on October 24th.

A program of sampling and analysis is on-going. Following the satisfactory completion of this program, appropriate design parameters will be established for the future extensions of the plant.

4. MONITORING OF PILOT WASTEWATER TREATMENT PLANT IN MERU

The sewerage system for Meru Town was constructed in 1974 with no extensions to the system since then despite a large increase in wastewater quantities due to the rapid growth rate of the Town. The wastewater treatment plant is indicated of ***Figure H-5***. It consists of one waste stabilization pond of 7,550 m3 capacity (Wanjohi, 1992), which is insufficient to provide an acceptable effluent quality.

In response to the Scope of Work for the Study, a pilot pond was constructed of 2,000 m3 capacity during the first field work period of the Study Team, as indicated on ***Figure H-5***. This was monitored from December 1996 to February, 1997 by the Jomo Kenyatta University of Agriculture and Technology in order to define design criteria for extension of the pond system.

The pilot pond was designed so that it could be incorporated into the extended system by forming part of the second pond in accordance with preliminary designs prepared by Wanjohi for the Meru Town Council in 1992. Accordingly the pond was 1.75m deep, 39m long and 22.5 m wide at the bottom, with side slopes of 1:2.5.

Wastewater was first diverted into the new pond on October 24th. However, due to blockages in the system, flow rates were very low, and by the commencement of monitoring on 5th December, inflow to the old pond was at 295 m3/day and overflow from the new pond was still at a very low level of only 12 m3/d.

Flow measurements were taken at hourly intervals at the inlet and outlet of the pond system on nine separate days. During the days on which monitoring was conducted, inflows varied widely from 295 m3/day to 1,700 m3/day, averaging at about 1,000 m3/d. The outlet from the new pond however, was more constant, at an average level of 430 m3/day, with a maximum and minimum flow of 478 and 340 m3/day respectively. This suggests a reduction in flow which is far higher than can be attributed to evaporation (estimated at approximately 30 m3/day). Although there would be initial seepage losses from the new pond, there was no evidence that this was significant after the initial period of pond filling. The explanation is probably due to the high level of fluctuations of the inflow, and that the days during which measurements took place (which were not consecutive days), coincided with days of higher than average inflows. Due to the flow attenuation provided by the storage in the pond system, the outflow from the new pond is likely to provide a far more accurate indication of the average flow conditions during this period. Therefore, assuming that there are no other significant losses, the average inflow into the system over the period would have been equal to the average outflow, plus an allowance for evaporation, which comes to approximately 460 m3/day.

A total or 84 samples were analysed for 12 constituents. Samples were taken at 8-00, 12-00, 16-00 and 20-00 hours on nine different days at the inlet to the old works and at the outlet to the new pond, and on three days at the inlet to the new pond.

The results for the first day of monitoring has been taken as being unrepresentative due to the low flows, and the TSS and Faecal Coliform counts for February 26th appear to be anomalous, and have not been included in ***Table H-4***:

Table H-4 Summarised, Average Results of Wastewater Monitoring at Meru

Parameter	Unit	Inlet to old pond	Inlet to new pond	Outlet from new pond	% reduction in old pond	% reduction in new pond
Flow	m3/d	1011	512	430	49%	16%
Adjusted flow (1)	m3/d	460	440	430	4%	2%
BOD	mg/l	563	185	124	67%	33%
TSS	mg/l	536	201	114	68%	43% (2)
FC	Nr/100ml	812	175	104	81%	41% (2)

Notes: (1) Inflow adjusted due to high level of variations, by adding an allowance to the outfall flows.
(2) Omitting results for 26/2/97 which were anomalous

The results indicate that, considering the overloaded state of the ponds, their performance, apart from FC removal, appears to be creditable. The FC removal was much lower than what would normally be expected, due to the unusually low levels recorded at the inlet to the ponds.

The average loading rate for the initial pond comes to approximately 1,300 kg BOD/ha /d at 1,010 m3/d, and 600 kg BOD/ha/d at 460 m3/d. This has to be compared with the normal recommended design loading range for facultative ponds of between 100 and 400 kg/ha/d. The pond is thus severely overloaded and, especially at the inlet zone of the pond, it will be tending to act as an Anaerobic pond, which are usually loaded at a rate of over 3,000 kg/ha/d. Improved treatment could be gained by constructing a proper anaerobic pond about 3 m deep upstream of the original pond, with a retention capacity of about 1 day. This would have the effect of reducing the loading rate on the original pond to close to the usually accepted design loading rates for facultative ponds.

Although the monitoring results are useful to give a good indication of the extent of overloading and treatment efficiency, a number of factors combined to reduce to benefits of the monitoring exercise of the pilot pond:

Daily flows varied from 300 to 1,700 m3/day due to blockages in the reticulation system. The system was not therefore in equilibrium.

- The original intention of the monitoring exercise was to load the new pond at different levels to determine its efficiency at different loading rates. However the fact that the flows varied by such a high degree made this impossible to achieve.

- Pond systems require time for the necessary microbial populations to build up to effect waste stabilisation. The low flows during filling the pond, and during the initial monitoring period will have hindered this process.

- The faecal coliform counts of both influent and effluent were far lower than for normal sewage flows, indicating either high levels of dilution or errors in collection, transportation or analysis. Whatever the reasons, it means that the results can not be used to estimate the first order reaction constant for the die-off rate for E-Coli.

- Pond effluents contain large concentrations of algae which are essential for the treatment processes and which are not necessarily detrimental to the downstream eco-system. To determine the efficiency of removal of soluble BOD it is necessary to analyse filtered effluent samples. As the analysis was conducted on un-filtered samples, the actual soluble BOD removal efficiency will be considerably higher than indicated by the results.

5. CONCLUSIONS

The existing pond system, even with the added pilot pond is, totally overloaded and can not produce effluent of acceptable quality.

The system urgently needs to be extended to provide effluent in accordance with normal standards for discharge to inland water courses as shown in ***Table H-5***:

Table H-5 Recommended Effluent Standards

Parameter	Recommended Effluent Standards*
BOD_5 (MG/L)	<20
E.Coli (Nr/100 ml)	<3000
Total Suspended Solids (mg/l)	<20

* *Source: Water Pollution Control Office, Nairobi.*

The location of the existing ponds however, is unacceptable for long term planning, as it lies adjacent to commercial and domestic housing, and is at a higher elevation to much of the Town, which can not therefore be connected without pumping. Long term planning should provide for gravity flow from the whole of the town, with a treatment plant suitably located away from any areas of housing density.

The results of the monitoring exercise generally support the use of existing design criteria for waste stabilization ponds as proposed by Mara. (Waste Stabilization Ponds - A design manual for Eastern Africa; ODA; 1992). The use of which is proposed for the design of a new pond system, or extensions to the existing system.

For illustrative purposes, a preliminary design of a waste stabilization system has been prepared based on the above design recommendations, and the assumptions as shown in ***Table H-6***:

Table H-6 Wastewater Treatment Design Assumptions

Criteria	Design Assumption	Unit
Design population	100,000	
Design flow rate	10,000	m3/d
BOD of raw sewage	563	mg/l
FC content of raw sewage	100,000,000	per 100 ml
Required effluent BOD	20	mg/l (filtered sample)
Required effluent FC	1,000	per 100 ml
Mean temp of coldest month	15	deg C
Nr of parallel Anaerobic ponds	6	
Nr of parallel Facultative ponds	3	
Nr of parolee Maturation ponds	3	
Anaerobic loading rate	200	g/m3/d
Facultative loading rate	167	kg/ha/d
1st Maturation pond loading	125	kg/ha/d
FC removal rate	1.09	d-1

The preliminary design uses an equivalent domestic population of 100,000. Before finalisation of the design it will be necessary to undertake a consumer survey of the population to determine the likely affordability of households, and to determine the extent of contributions from institutions, industry and commerce. The results of the design exercise are summarised in ***Table H-7***:

Table H-7 Outline Design of Future Waste Stabilization Ponds for Meru

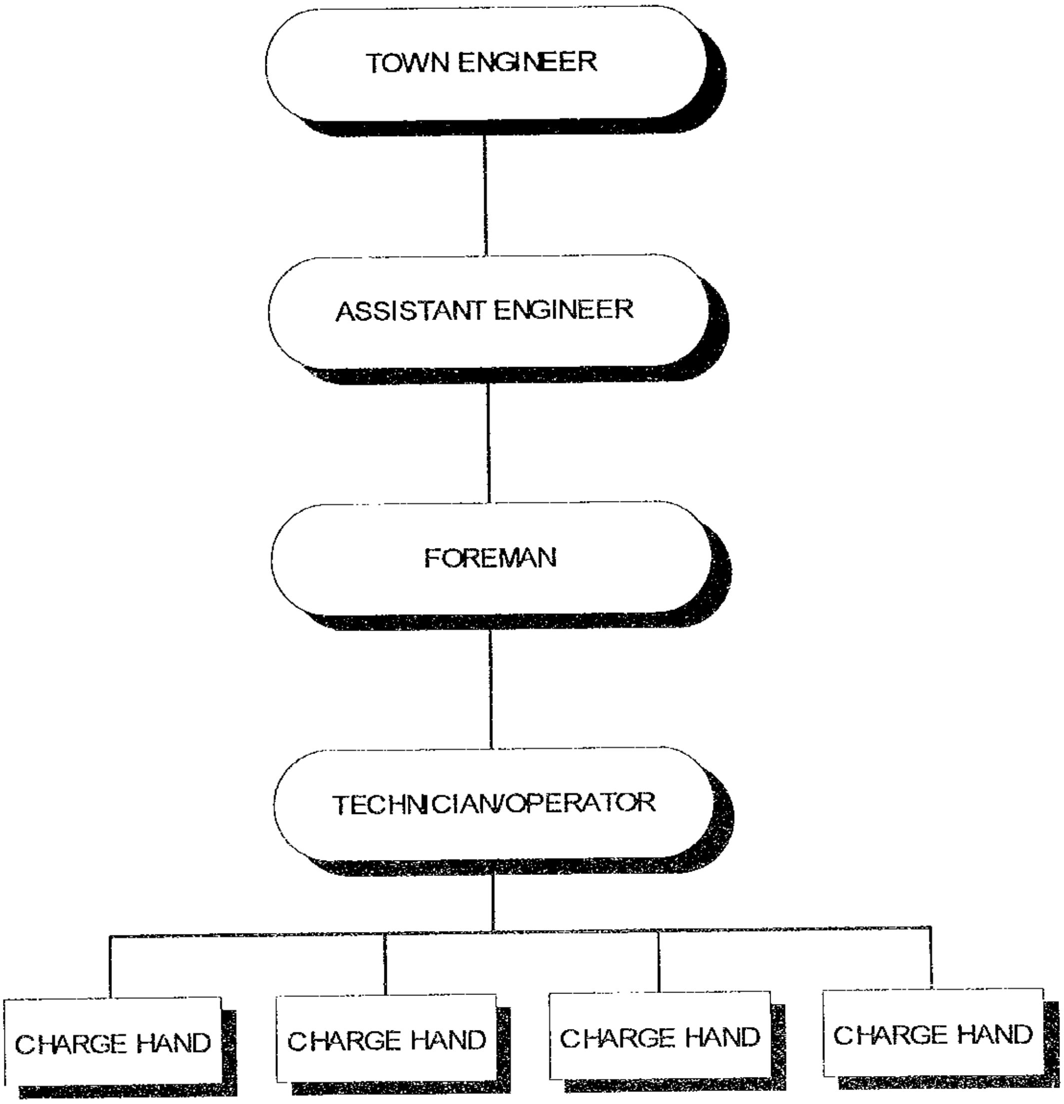
Pond	Depth	Total volume (m3)	Total Retention (days)	Operational ponds *(1)*	Length of single pond *(2)* (m)	Breadth of single pond *(2)* (m)
Anaerobic	3.0	28,150	2.8	6	40	40
Facultative	1.5	253,300	26.7	3	336	169
1st Maturation	1.5	175,000	20.3	3	279	139
2nd Maturation	1.5	37,325	4.5	3	129	64
3rd Maturation	1.5	37,325	4.5	3	129	64

Note: (1) Total number of anaerobic ponds to be increased to 9, to allow for annual desludging.
(2) Mid depth dimensions

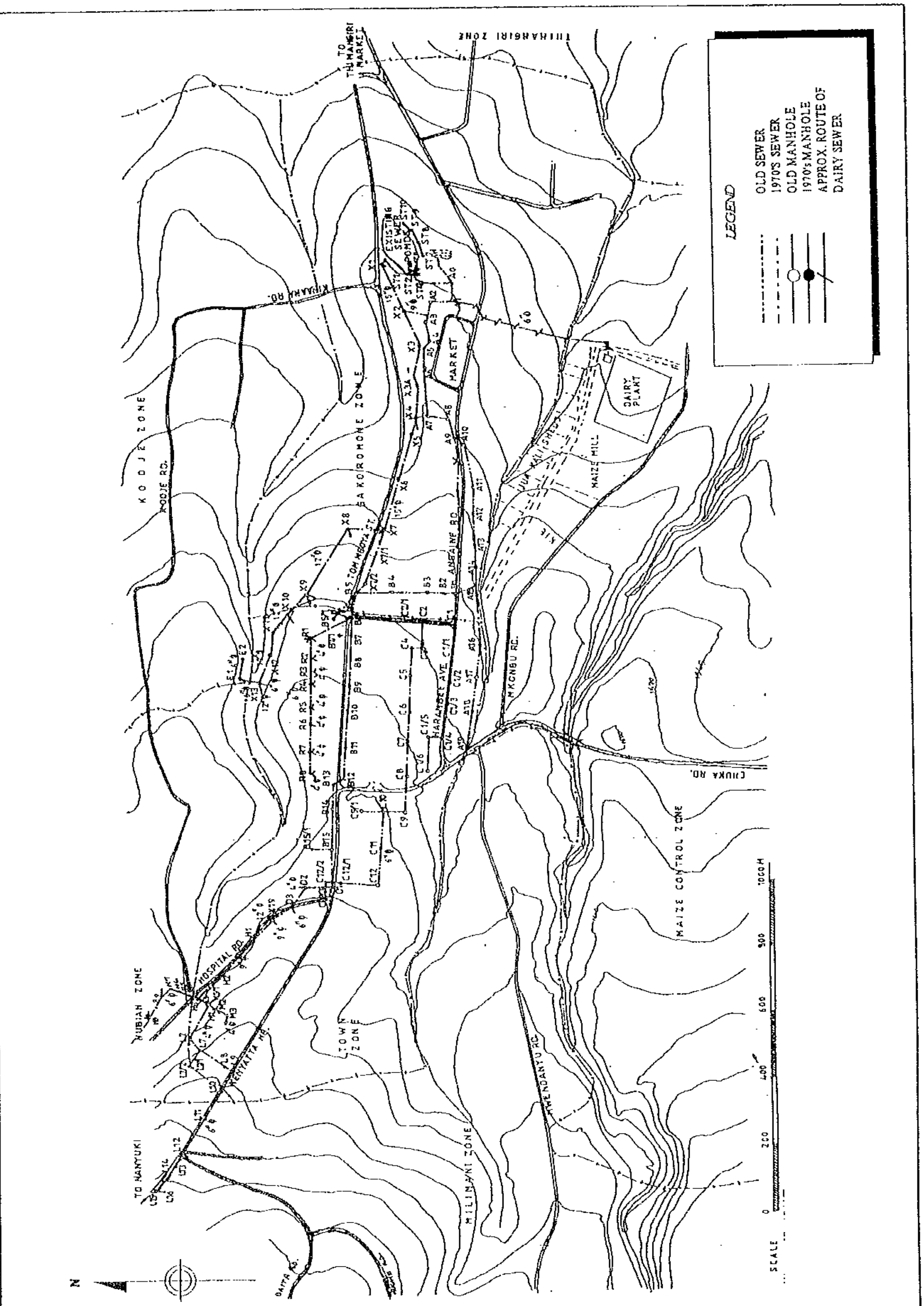
A conceptual general layout plan for the pond system is indicated on ***Figure H-6***. This indicates the requirement for a site measuring approximately 1,000m x 650 m, and clearly illustrates that the land available at the existing wastewater treatment plant site is totally inadequate.

The acquisition of a suitable piece of land for the construction of a wastewater treatment plant is a priority.

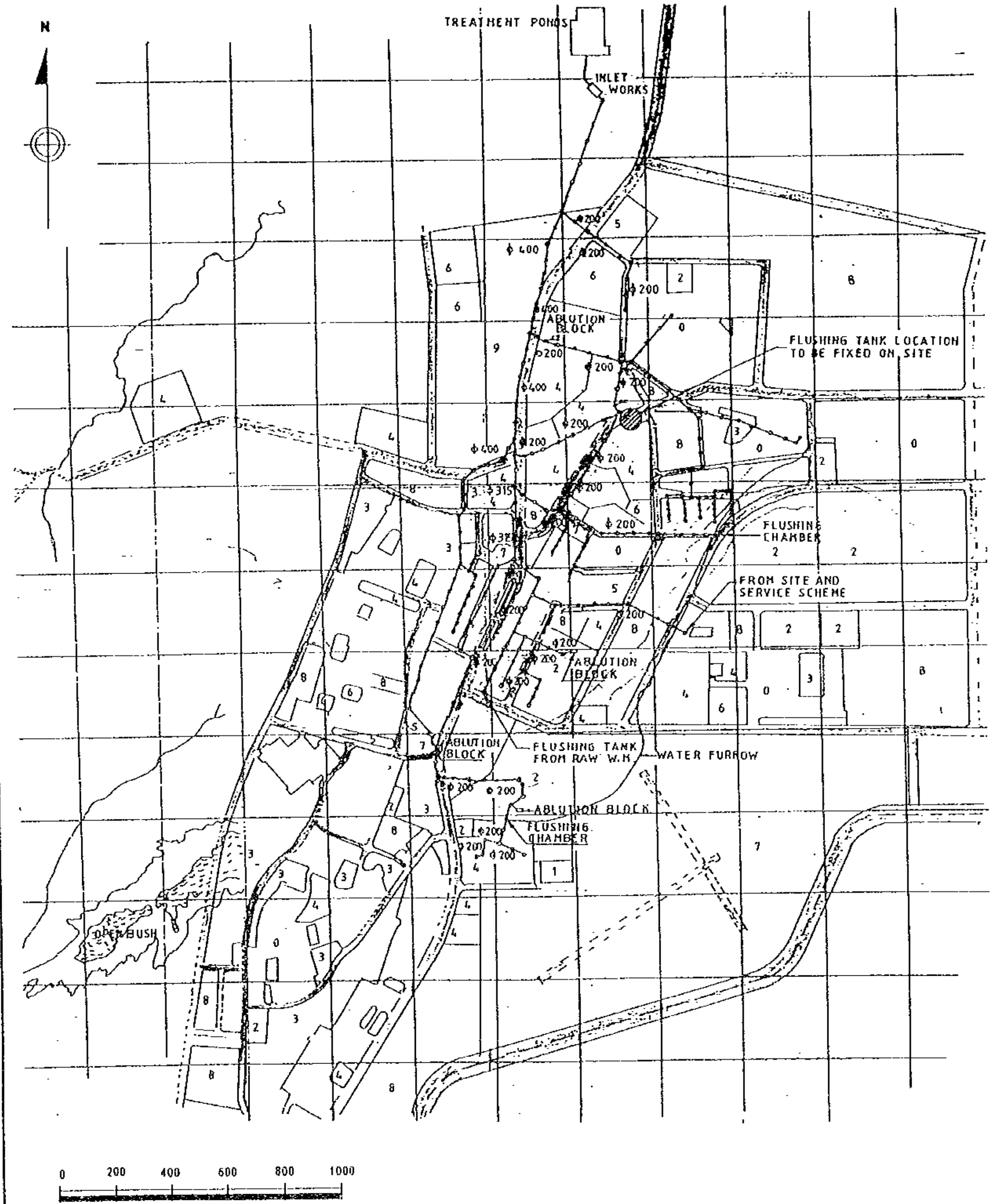
FIGURES



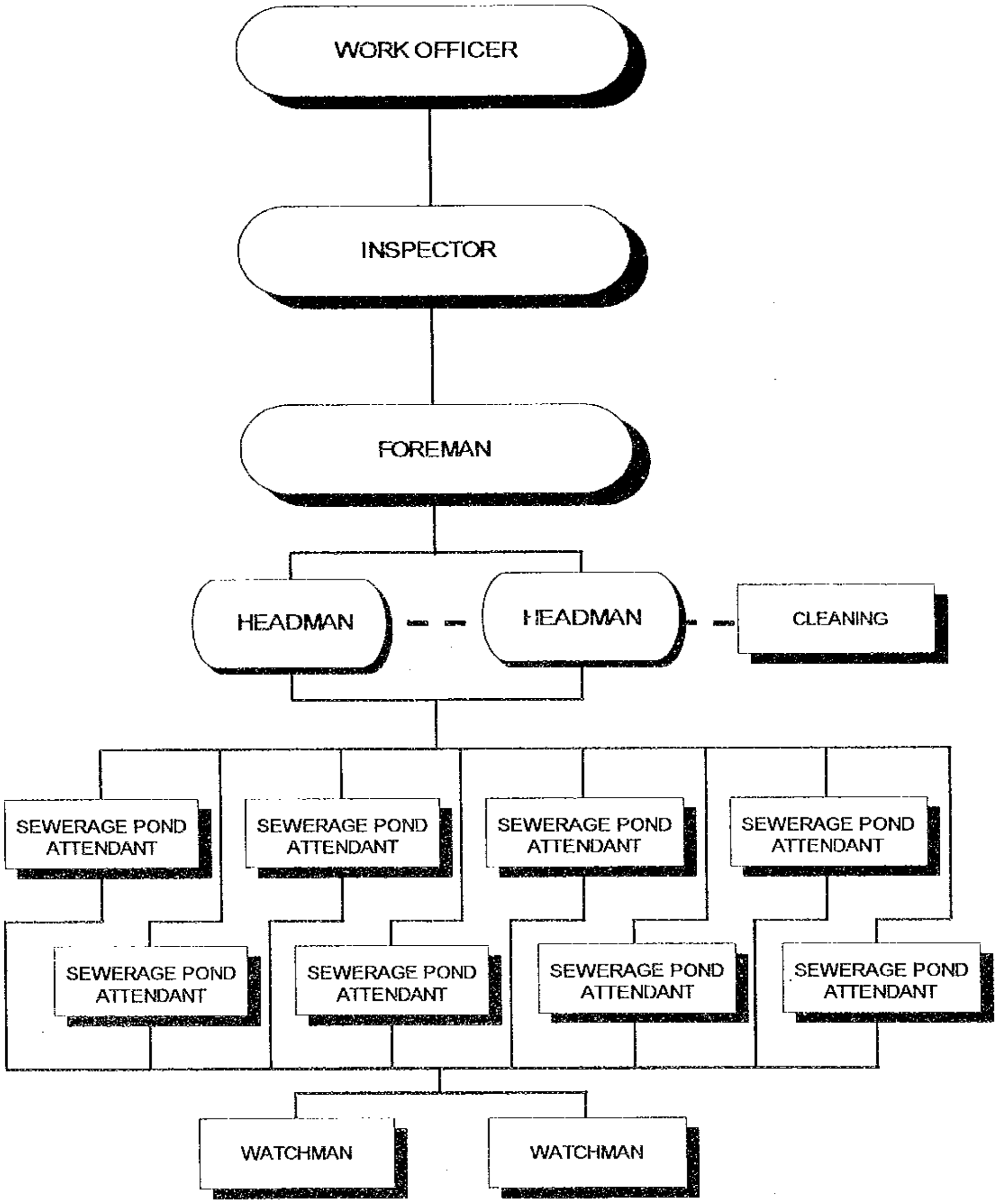
THE STUDY ON THE WATER SUPPLY FOR SEVEN TOWNS IN EASTERN PROVINCE IN THE REPUBLIC OF KENYA	Figure H-1
JAPAN INTERNATIONAL COOPERATION AGENCY	Existing Organization Structure in Meru Town



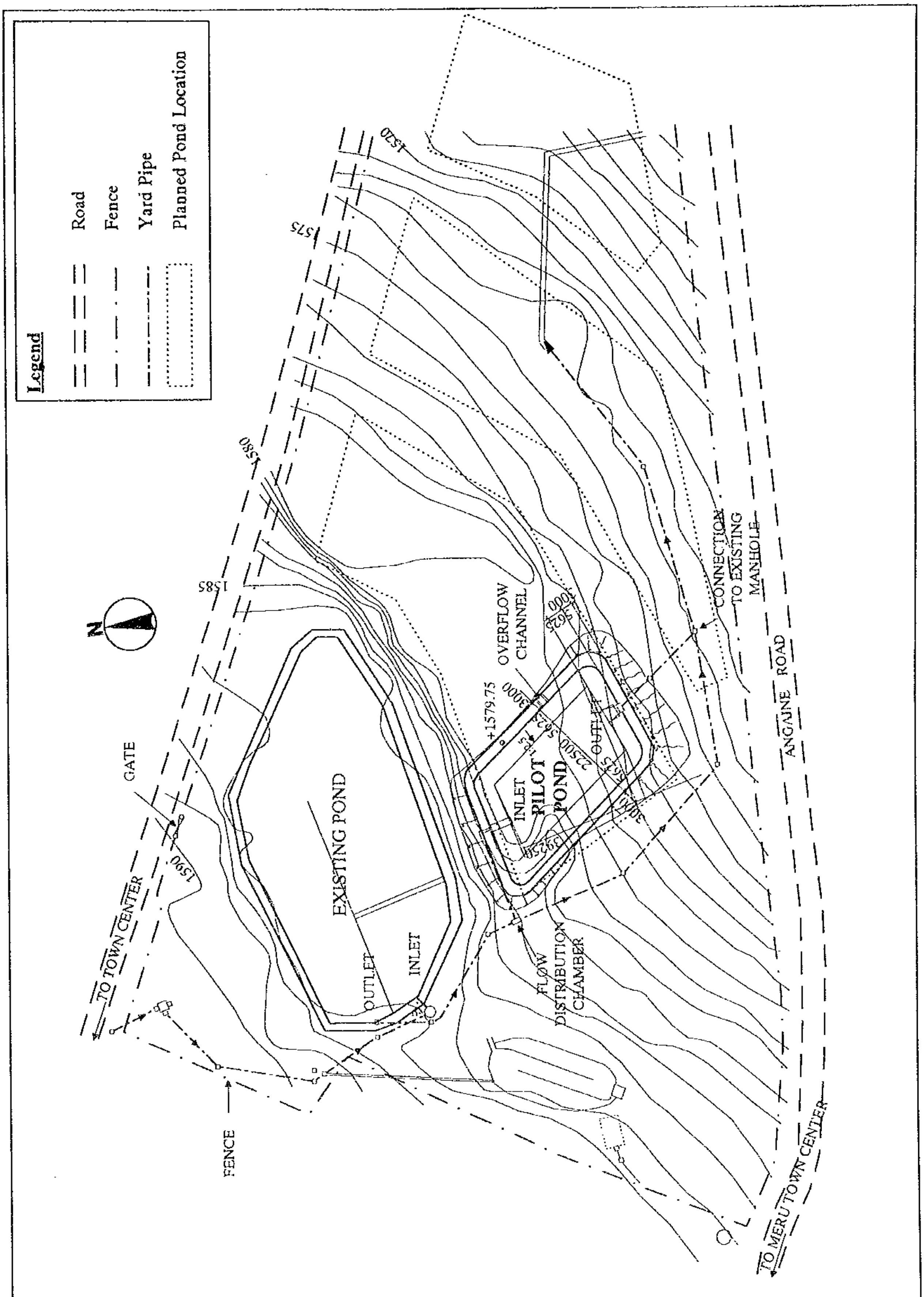
THE STUDY ON THE WATER SUPPLY FOR SEVEN TOWNS IN EASTERN PROVINCE IN THE REPUBLIC OF KENYA	Figure H-2 Existing Sewerage Layout in Meru Town
JAPAN INTERNATIONAL COOPERATION AGENCY	



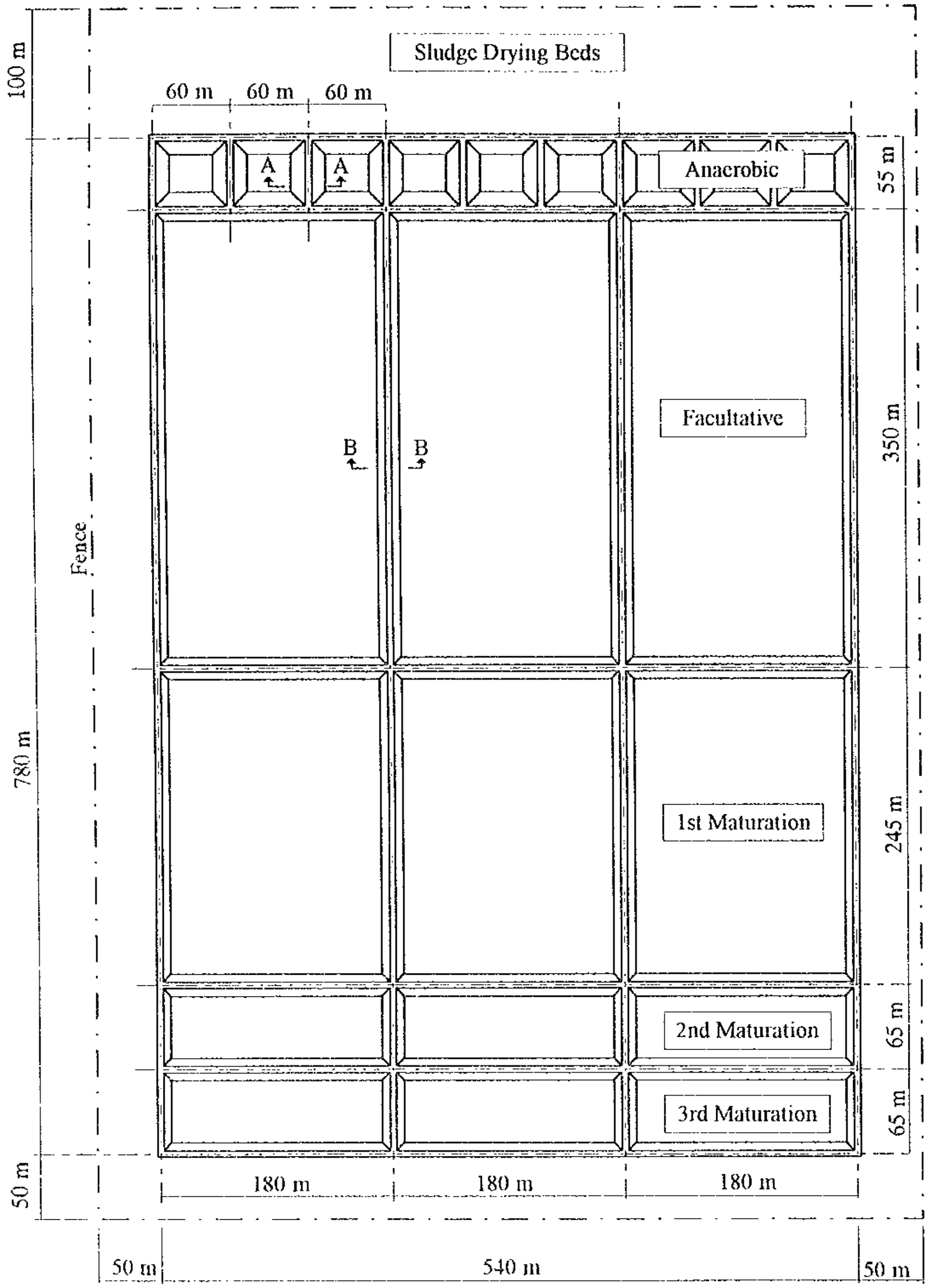
THE STUDY ON THE WATER SUPPLY FOR SEVEN TOWNS IN EASTERN PROVINCE IN THE REPUBLIC OF KENYA	Figure H-3 Existing Sewerage Layout in Isiolo Town
JAPAN INTERNATIONAL COOPERATION AGENCY	



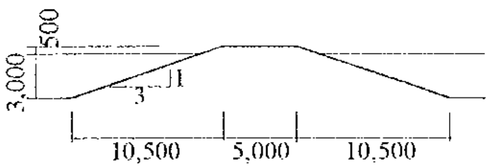
THE STUDY ON THE WATER SUPPLY FOR SEVEN TOWNS IN EASTERN PROVINCE IN THE REPUBLIC OF KENYA	Figure H-4 Existing Organization Structure in Isiolo Town
JAPAN INTERNATIONAL COOPERATION AGENCY	



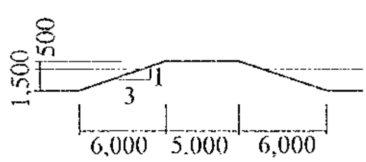
THE STUDY ON THE WATER SUPPLY FOR SEVEN TOWNS IN EASTERN PROVINCE IN THE REPUBLIC OF KENYA	Figure H-5
JAPAN INTERNATIONAL COOPERATION AGENCY	General Layout of Wastewater Pond in Meru



General Layout Plan 1:5000



Section A-A 1:500



Section B-B 1:500

THE STUDY ON THE WATER SUPPLY FOR SEVEN TOWNS IN EASTERN PROVINCE IN THE REPUBLIC OF KENYA	Figure H-6
JAPAN INTERNATIONAL COOPERATION AGENCY	General Layout for Future Meru Waste Stabilization Ponds

ATTACHMENT

POSTERS FOR HEALTH EDUCATION

Table H-1 Flow measurement result in Meru (1/4)

Location Inlet
Base reading = 0 cm
Cd average = 0.5135
date : Sep/5/'96

Time	Reading cm	Flow Height m	Discharge m3/sec	Discharge lit./sec	Discharge m3/hr
8:00	11.50	0.115	0.00544	5.44	19.58
9:00	10.60	0.106	0.00444	4.44	15.98
10:00	10.00	0.100	0.00384	3.84	13.82
11:00	9.00	0.090	0.00295	2.95	10.62
12:00	12.30	0.123	0.00644	6.44	23.18
13:00	11.40	0.114	0.00532	5.32	19.15
14:00	11.50	0.115	0.00544	5.44	19.58
15:00	10.90	0.109	0.00476	4.76	17.14
16:00	8.90	0.089	0.00287	2.87	10.33
17:00	10.70	0.107	0.00454	4.54	16.34
18:00	10.00	0.100	0.00384	3.84	13.82
19:00	9.30	0.093	0.00320	3.20	11.52
20:00	7.90	0.079	0.00213	2.13	7.67
21:00	8.00	0.080	0.00220	2.20	7.92
22:00	7.80	0.078	0.00206	2.06	7.42
23:00	7.10	0.071	0.00163	1.63	5.87
0:00	6.50	0.065	0.00131	1.31	4.72
1:00	5.90	0.059	0.00103	1.03	3.71
2:00	5.60	0.056	0.00090	0.90	3.24
3:00	6.10	0.061	0.00111	1.11	4.00
4:00	5.40	0.054	0.00022	0.22	0.79
5:00	5.60	0.056	0.00090	0.90	3.24
6:00	9.20	0.092	0.00311	3.11	11.20
7:00	11.00	0.110	0.00487	4.87	17.53
Total					268.38

Table H-1 Flow measurement result in Meru (2/4)

Location Outlet
Base reading = 0.27 cm
date : Sep/5/'96
Cd average = 0.8462

Time	Reading cm	Flow Height m	Discharge m3/sec	Discharge lit./sec	Discharge m3/hr
8:00	4.51	0.042	0.00074	0.74	2.66
9:00	5.53	0.053	0.00137	1.37	4.93
10:00	6.30	0.060	0.00178	1.78	6.41
11:00	6.09	0.058	0.00163	1.63	5.87
12:00	6.76	0.065	0.00215	2.15	7.74
13:00	6.57	0.063	0.00200	2.00	7.20
14:00	6.40	0.061	0.00186	1.86	6.70
15:00	6.43	0.062	0.00188	1.88	6.77
16:00	6.46	0.062	0.00191	1.91	6.88
17:00	6.74	0.065	0.00213	2.13	7.67
18:00	6.79	0.065	0.00217	2.17	7.81
19:00	6.85	0.066	0.00222	2.22	7.99
20:00	5.67	0.054	0.00135	1.35	4.86
21:00	6.10	0.058	0.00164	1.64	5.90
22:00	6.27	0.060	0.00176	1.76	6.34
23:00	5.67	0.054	0.00135	1.35	4.86
0:00	5.89	0.056	0.00150	1.50	5.40
1:00	5.63	0.054	0.00133	1.33	4.79
2:00	5.09	0.048	0.00102	1.02	3.67
3:00	4.89	0.046	0.00092	0.92	3.31
4:00	4.59	0.043	0.00078	0.78	2.81
5:00	4.37	0.041	0.00068	0.68	2.45
6:00	4.08	0.038	0.00057	0.57	2.05
7:00	4.19	0.039	0.00061	0.61	2.20
Total					127.26

Table H-1 Flow measurement result in Meru (3/4)

Location Inlet
Base reading = 0 cm
Cd average = 0.5135

date : Sep/12/'96

Time	Reading cm	Flow Height m	Discharge m3/sec	Discharge lit./sec	Discharge m3/hr
8:00	10.90	0.109	0.00476	4.76	17.14
9:00	11.50	0.115	0.00544	5.44	19.58
10:00	11.20	0.112	0.00509	5.09	18.32
11:00	10.20	0.102	0.00403	4.03	14.51
12:00	10.80	0.108	0.00465	4.65	16.74
13:00	9.20	0.092	0.00311	3.11	11.20
14:00	10.00	0.100	0.00384	3.84	13.82
15:00	9.80	0.098	0.00365	3.65	13.14
16:00	13.20	0.132	0.00768	7.68	27.65
17:00	15.90	0.159	0.01223	12.23	44.03
18:00	8.20	0.082	0.00234	2.34	8.42
19:00	9.00	0.090	0.00295	2.95	10.62
20:00	8.10	0.081	0.00227	2.27	8.17
21:00	7.40	0.074	0.00181	1.81	6.52
22:00	8.20	0.082	0.00234	2.34	8.42
23:00	6.10	0.061	0.00111	1.11	4.00
0:00	6.40	0.064	0.00126	1.26	4.54
1:00	6.30	0.063	0.00121	1.21	4.36
2:00	6.00	0.060	0.00107	1.07	3.85
3:00	5.90	0.059	0.00103	1.03	3.71
4:00	5.90	0.059	0.00103	1.03	3.71
5:00	6.00	0.060	0.00107	1.07	3.85
6:00	6.00	0.060	0.00107	1.07	3.85
7:00	8.80	0.088	0.00279	2.79	10.04
Total					280.19

Table H-1 Flow measurement result in Meru (4/4)

Location Outlet
Base reading = 0.27 cm
Cd average = 0.8462

Time	Reading cm	Flow Height m	Discharge m3/sec	Discharge lit./sec	Discharge m3/hr
8:00	4.60	0.043	0.00078	0.78	2.81
9:00	5.29	0.050	0.00113	1.13	4.07
10:00	5.25	0.050	0.00111	1.11	4.00
11:00	5.25	0.050	0.00111	1.11	4.00
12:00	5.72	0.055	0.00139	1.39	5.00
13:00	5.91	0.056	0.00151	1.51	5.44
14:00	5.79	0.055	0.00143	1.43	5.15
15:00	5.68	0.054	0.00136	1.36	4.90
16:00	5.97	0.057	0.00155	1.55	5.58
17:00	5.75	0.055	0.00141	1.41	5.08
18:00	6.21	0.059	0.00172	1.72	6.19
19:00	6.04	0.058	0.00160	1.60	5.76
20:00	4.78	0.045	0.00086	0.86	3.10
21:00	5.65	0.054	0.00154	1.54	5.54
22:00	5.14	0.049	0.00105	1.05	3.78
23:00	5.36	0.051	0.00117	1.17	4.21
0:00	5.14	0.049	0.00105	1.05	3.78
1:00	4.87	0.046	0.00091	0.91	3.28
2:00	4.85	0.046	0.00090	0.90	3.24
3:00	4.68	0.044	0.00082	0.82	2.95
4:00	4.34	0.041	0.00067	0.67	2.41
5:00	4.27	0.040	0.00064	0.64	2.30
6:00	4.08	0.038	0.00057	0.57	2.05
7:00	4.13	0.039	0.00059	0.59	2.12
Total					96.73

Table H-2 Results of Water Quality Test at Meru Wastewater Disposal Facility

PARAMETER	Unit	5th Sept /96								12th Sept /96							
		Inlet				outlet				Inlet				outlet			
		8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00
Air Temperature	℃	18	29	27	21	18	29	25	20	11	18	25	19	11	18	25	19
Water Temperature	℃	20	21	21	20	19	25	28	24	14	16	19	20	13	16	21	21
pH		7.7	7.8	7.9	7.8	7.3	8.2	8.5	8.3	8.0	7.0	8.2	7.9	7.0	7.2	7.9	8.1
BOD	mg/l	530	725	375	515	146	151	137	146	496	493	463	470	96	128	250	225
Faecal coliform	No./100ml	800	spoilt	1200	1500	200	250	290	350	600	500	700	500	215	235	250	225
Nitrates	mg/l	0.12	0.09	0.35	0.19	0.42	0.31	0.75	0.55	nil	nil	nil	nil	0.18	0.55	0.25	0.53
Nitrite	mg/l	0.32	0.77	1.00	0.70	0.11	0.36	0.02	0.01	nil	nil	nil	nil	0.001	0.011	0.025	0.003
Ammonia	mg/l	nil	nil	nil	nil	nil	0.02	nil	nil	nil	0.023	0.038	0.11	nil	nil	nil	nil
Sulfide	mg/l	0.496	0.453	0.391	0.269	0.185	0.169	0.210	0.101	0.700	0.516	0.569	0.352	0.01	0.015	0.03	0.05
Phosphorus (anino-naphthol-sulfonic method)	mg/l	0.0325	0.0225	0.0375	0.0200	0.0150	0.0188	0.0100	0.0113	0.03	0.02	0.03	0.02	0.010	0.015	0.030	0.050
Phenols	mg/l	0.700	0.270	0.160	0.123	0.30	0.15	0.10	0.10	0.070	0.025	0.010	0.012	0.06	0.02	0.01	0.01
Phosphorus	mg/l	0.03	0.02	0.04	0.02	0.015	0.020	0.010	0.010	0.0275	0.0225	0.0315	0.0195	0.0125	0.0135	0.0275	0.0450
Total suspended solids	mg/l	500	675	535	445	233	268	215	253	685	710	795	625	30	125	309	144

Table H-3 Flow mearurement result in Isiolo (1/4)

Location Inlet
Base reading = 40.7 cm date : Sep/5/'96
Cd average = 0.6545

Time	Reading cm	Flow Height m	Discharge m3/sec	Discharge lit./sec	Discharge m3/hr
8:00	54.50	0.138	0.01094	10.94	39.38
9:00	54.30	0.136	0.01055	10.55	37.98
10:00	54.00	0.133	0.00997	9.97	35.89
11:00	54.00	0.133	0.00997	9.97	35.89
12:00	53.20	0.125	0.00854	8.54	30.74
13:00	52.60	0.119	0.00755	7.55	27.18
14:00	53.00	0.123	0.00820	8.20	29.52
15:00	52.90	0.122	0.00804	8.04	28.94
16:00	52.50	0.118	0.00740	7.40	26.64
17:00	54.50	0.138	0.01094	10.94	39.38
18:00	50.40	0.097	0.00453	4.53	16.31
19:00	51.10	0.104	0.00539	5.39	19.40
20:00	52.00	0.113	0.00664	6.64	23.90
21:00	52.50	0.118	0.00740	7.40	26.64
22:00	53.40	0.127	0.00890	8.90	32.04
23:00	52.30	0.116	0.00710	7.10	25.56
0:00	52.30	0.116	0.00710	7.10	25.56
1:00	51.80	0.111	0.00635	6.35	22.86
2:00	51.70	0.110	0.00621	6.21	22.34
3:00	50.00	0.109	0.00607	6.07	21.83
4:00	51.80	0.093	0.00410	4.10	14.76
5:00	51.80	0.111	0.00635	6.35	22.86
6:00	51.70	0.110	0.00621	6.21	22.34
7:00	52.50	0.118	0.00740	7.40	26.64
Total					654.61

Table H-3 Flow mearurement result in Isiolo (2/4)

Location Outlet
Base reading = 0.8 cm date : Sep/5/'96
Cd average = 0.4

Time	Reading cm	Flow Height m	Discharge m3/sec	Discharge lit./sec	Discharge m3/hr
8:00	16.80	0.160	0.00472	4.72	16.99
9:00	16.30	0.155	0.00436	4.36	15.70
10:00	14.80	0.140	0.00338	3.38	12.17
11:00	16.80	0.160	0.00472	4.72	16.99
12:00	17.20	0.164	0.00502	5.02	18.07
13:00	15.50	0.147	0.00382	3.82	13.75
14:00	17.40	0.166	0.00518	5.18	18.65
15:00	17.30	0.165	0.00510	5.10	18.36
16:00	17.30	0.165	0.00510	5.10	18.36
17:00	17.40	0.166	0.00518	5.18	18.65
18:00	17.50	0.167	0.00525	5.25	18.90
19:00	18.00	0.172	0.00566	5.66	20.38
20:00	18.40	0.176	0.00600	6.00	21.60
21:00	18.50	0.177	0.00608	6.08	21.89
22:00	18.40	0.176	0.00600	6.00	21.60
23:00	18.40	0.176	0.00600	6.00	21.60
0:00	18.30	0.175	0.00591	5.91	21.28
1:00	18.30	0.175	0.00591	5.91	21.28
2:00	18.40	0.176	0.00600	6.00	21.60
3:00	18.30	0.175	0.00591	5.91	21.28
4:00	17.40	0.166	0.00518	5.18	18.65
5:00	17.40	0.166	0.00518	5.18	18.65
6:00	18.50	0.177	0.00608	6.08	21.89
7:00	19.00	0.182	0.00652	6.52	23.45
Total					461.72

Table H-3 Flow mearurement result in Isiolo (3/4)

Location Inlet
Base reading = 0 cm
Cd average = 0.5135

date : Sep/12/'96

Time	Reading cm	Flow Height m	Discharge m3/sec	Discharge lit./sec	Discharge m3/hr
8:00	53.60	0.129	0.00924	9.24	33.26
9:00	55.50	0.148	0.01303	13.03	46.91
10:00	53.40	0.127	0.00880	8.80	31.68
11:00	52.75	0.121	0.00780	7.80	28.08
12:00	52.75	0.121	0.00780	7.80	28.08
13:00	53.50	0.128	0.00906	9.06	32.62
14:00	53.90	0.132	0.00980	9.80	35.28
15:00	52.30	0.116	0.00710	7.10	25.56
16:00	50.80	0.101	0.00501	5.01	18.04
17:00	50.80	0.101	0.00501	5.01	18.04
18:00	52.30	0.116	0.00709	7.09	25.52
19:00	52.00	0.113	0.00664	6.64	23.90
20:00	51.80	0.111	0.00635	6.35	22.86
21:00	53.00	0.123	0.00820	8.20	29.53
22:00	52.00	0.113	0.00664	6.64	23.90
23:00	52.80	0.121	0.00787	7.87	28.33
0:00	51.30	0.106	0.00566	5.66	20.38
1:00	51.50	0.108	0.00593	5.93	21.35
2:00	50.00	0.093	0.00408	4.08	14.69
3:00	49.90	0.092	0.00397	3.97	14.29
4:00	50.00	0.093	0.00408	4.08	14.69
5:00	50.00	0.093	0.00408	4.08	14.69
6:00	51.40	0.107	0.00579	5.79	20.84
7:00	53.70	0.130	0.00942	9.42	33.91
Total					606.43

Table H-3 Flow mearurement result in Isiolo (4/4)

Location Outlet
Base reading = 0.27 cm
Cd average = 0.8462

Time	Reading cm	Flow Height m	Discharge m3/sec	Discharge lit./sec	Discharge m3/hr
8:00	16.10	0.153	0.00422	4.22	15.19
9:00	16.20	0.154	0.00429	4.29	15.44
10:00	16.00	0.152	0.00415	4.15	14.94
11:00	15.90	0.151	0.00408	4.08	14.69
12:00	16.10	0.153	0.00422	4.22	15.19
13:00	16.20	0.154	0.00429	4.29	15.44
14:00	16.50	0.157	0.00450	4.50	16.20
15:00	16.50	0.157	0.00450	4.50	16.20
16:00	18.80	0.180	0.00634	6.34	22.82
17:00	18.30	0.175	0.00591	5.91	21.28
18:00	17.70	0.169	0.00541	5.41	19.48
19:00	17.60	0.168	0.00533	5.33	19.19
20:00	17.50	0.167	0.00525	5.25	18.90
21:00	18.00	0.172	0.00566	5.66	20.38
22:00	17.40	0.166	0.00518	5.18	18.65
23:00	17.60	0.168	0.00533	5.33	19.19
0:00	17.50	0.167	0.00525	5.25	18.90
1:00	17.40	0.166	0.00518	5.18	18.65
2:00	17.40	0.166	0.00518	5.18	18.65
3:00	16.50	0.157	0.00450	4.50	16.20
4:00	16.80	0.160	0.00472	4.72	16.99
5:00	17.60	0.168	0.00533	5.33	19.19
6:00	17.80	0.170	0.00549	5.49	19.76
7:00	18.20	0.174	0.00582	5.82	20.95
Total					432.47

Table H-4 Results of Water Quality Test at Isiolo Wastewaater Disposal Facility

PARAMETER	Unit	5th Sept /96								12th Sept /96							
		Inlet				outlet				Inlet				outlet			
		8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00
Air Temperature	℃	21	35	34	27	21	35	34	27	21	32	29	26	21	32	29	26
Water Temperature	℃	18	25	25	23	18	23	24	24	24	26	25	25	16	22	25	23
pH		8.0	7.7	7.5	7.6	8.5	8.5	9.0	8.5	8.0	7.5	7.9	7.5	8.5	8.5	8.9	8.5
BOD	mg/l	755	775	690	725	156	130	118	125	522	426	491	456	153	169	200	160
Faecal coliform	No./100ml	300	450	550	600	175	150	225	250	550	450	500	300	100	160	200	160
Nitrates	mg/l	0.38	0.42	0.10	0.07	0.20	0.16	0.15	0.17	nil	0.01	0.03	0.03	0.43	0.13	0.20	nil
Nitrite	mg/l	0.16	0.28	0.55	0.07	1.47	2.18	0.15	0.50	0.01	0.03	nil	nil	2.540	3.690	0.300	0.275
Ammonia	mg/l	nil	0.005	nil	nil	nil	nil	nil	0.001	nil	nil	nil	nil	nil	nil	nil	nil
Sulfide	mg/l	0.970	0.764	0.679	0.678	0.205	0.198	0.134	0.184	0.533	0.436	0.620	0.734	0.36	0.392	0.38	0.29
Phosphorus (anino-naphthol-sulfonic method)	mg/l	0.0275	0.0215	0.0525	0.0500	0.0250	0.0175	0.0180	0.0200	0.02	0.02	0.02	0.02	0.025	0.023	0.016	0.020
Phenols	mg/l	0.600	0.250	0.150	0.100	0.02	0.02	0.02	0.02	0.550	0.350	0.250	0.300	0.50	0.40	0.30	0.30
Phosphorus	mg/l	0.03	0.02	0.04	0.04	0.020	0.015	0.020	0.020	0.0140	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200
Total suspended solids	mg/l	460	513	385	440	343	270	223	186	930	830	805	865	47	125	63	104

Table H-5 Flow Measurement Monitoring Result (1/6)

Unit: m3/hr

Date	Dec/5/'96		Dec/19/'96	
Location	Old Pond Inlet	New Pond Outlet	Old Pond Inlet	New Pond Outlet
Base reading =	-	-	-	-
Cd average =	0.5135	0.402	0.5135	0.402
8:00	24.12	0.36	51.84	8.28
9:00	19.44	0.36	110.88	8.28
10:00	15.48	0.36	60.12	9.36
11:00	15.48	0.36	88.20	10.80
12:00	19.44	0.36	19.44	12.24
13:00	24.12	0.36	19.44	13.68
14:00	26.64	0.36	17.64	16.92
15:00	19.44	0.36	13.68	18.72
16:00	13.68	0.36	17.64	15.48
17:00	12.24	0.36	13.68	18.72
18:00	12.24	0.36	17.64	16.92
19:00	13.68	0.36	17.64	16.92
20:00	5.76	0.36	78.12	18.72
21:00	5.76	0.72	68.76	18.72
22:00	15.48	1.08	68.76	16.92
23:00	13.68	1.08	68.76	18.72
0:00	6.84	1.44	51.84	16.92
1:00	5.76	1.08	51.84	15.48
2:00	5.76	0.72	17.64	15.48
3:00	3.96	0.36	44.64	10.80
4:00	3.96	0.36	44.64	12.24
5:00	2.52	0.36	60.12	9.36
6:00	3.96	0.36	60.12	9.36
7:00	5.76	0.00	48.24	9.36
Total	295.20	12.24	1111.32	338.40

Table H-5 Flow Measurement Monitoring Result (2/6)

Unit : m3/hr

	Jan/2/'97		Jan/16/'97	
Location	Old Pond Inlet	New Pond Outlet	Old Pond Inlet	New Pond Outlet
Base reading =	-	-	-	-
Cd average =	0.5135	0.402	0.5135	0.402
8:00	51.84	7.20	73.44	13.68
9:00	60.12	8.28	83.16	15.48
10:00	44.64	8.28	78.12	20.88
11:00	48.24	9.36	68.76	18.72
12:00	44.64	10.80	60.12	16.92
13:00	44.64	12.24	51.84	18.72
14:00	60.12	15.48	44.64	20.88
15:00	44.64	13.68	38.16	25.20
16:00	44.64	15.48	44.64	25.20
17:00	48.24	16.92	41.40	20.88
18:00	44.64	16.92	38.16	20.88
19:00	44.64	18.72	44.64	25.20
20:00	44.64	18.72	51.84	27.36
21:00	48.24	20.88	44.64	20.88
22:00	44.64	43.92	44.64	18.72
23:00	44.64	43.92	44.64	16.92
0:00	44.64	37.80	38.16	16.92
1:00	55.80	37.80	38.16	16.92
2:00	44.64	16.92	38.16	16.92
3:00	41.40	18.72	38.16	16.92
4:00	34.92	16.92	32.04	16.92
5:00	19.44	13.68	38.16	13.68
6:00	38.16	10.80	44.64	16.92
7:00	44.64	10.80	51.84	16.92
Total	1086.84	444.24	1172.16	458.64

Table H-5 Flow Measurement Monitoring Result (3/6)

Unit: m3/hr

Date	Jan/29/'97		Feb/15/'97	
Location	Old Pond Inlet	New Pond Outlet	Old Pond Inlet	New Pond Outlet
Base reading =	-	-	-	-
Cd average =	0.5135	0.402	0.5135	0.402
8:00	78.12	16.92	68.76	12.24
9:00	78.12	20.88	78.12	13.68
10:00	73.44	25.20	83.16	15.48
11:00	68.76	20.88	60.12	18.72
12:00	68.76	16.92	51.84	16.92
13:00	78.12	25.20	51.84	16.92
14:00	83.16	25.20	44.64	23.04
15:00	78.12	23.04	44.64	25.20
16:00	78.12	16.92	41.40	25.20
17:00	68.76	13.68	38.16	23.04
18:00	68.76	16.92	44.64	20.88
19:00	78.12	20.88	41.40	25.20
20:00	83.16	25.20	38.16	23.04
21:00	88.20	20.88	38.16	20.88
22:00	68.76	18.72	44.64	23.04
23:00	64.08	16.92	51.84	16.92
0:00	51.84	13.68	44.64	20.88
1:00	51.84	13.68	44.64	25.20
2:00	60.12	10.80	41.40	25.20
3:00	60.12	10.80	44.64	20.88
4:00	60.12	8.28	38.16	18.72
5:00	68.76	8.28	38.16	16.92
6:00	73.44	12.24	38.16	13.68
7:00	78.12	13.68	38.16	16.92
Total	1708.92	415.80	1149.48	478.80

Table H-5 Flow Measurement Monitoring Result (4/6)

Unit : m3/hr

	Feb/26/'97		
Location	Old Pond Inlet	New Pond Intlet	New Pond Outlet
Base reading =	-	-	-
Cd average =	0.5135	0.63	0.402
8:00	26.64	15.48	10.80
9:00	51.84	15.48	10.80
10:00	51.84	17.64	12.24
11:00	32.04	19.80	13.68
12:00	32.04	22.32	15.48
13:00	38.16	22.32	16.92
14:00	26.64	22.32	18.72
15:00	26.64	19.80	20.88
16:00	29.16	22.32	20.88
17:00	32.04	22.32	23.04
18:00	13.68	22.32	25.20
19:00	15.48	17.64	16.92
20:00	13.68	22.32	16.92
21:00	17.64	22.32	18.72
22:00	21.60	22.32	20.88
23:00	26.64	22.32	20.88
0:00	38.16	17.64	23.04
1:00	44.64	17.64	20.88
2:00	32.04	17.64	16.92
3:00	26.64	17.64	18.72
4:00	13.68	15.48	16.92
5:00	13.68	15.48	13.68
6:00	21.60	15.48	13.68
7:00	0.00	15.48	13.68
Total	646.20	461.52	420.48

Table 5-5 Flow Measurement Monitoring Result (5/6)

Unit : m3/hr

	Feb/27/'97		
Location	Old Pond Inlet	New Pond Intlet	New Pond Outlet
Base reading =	-	-	-
Cd average =	0.5135	0.63	0.402
8:00	21.60	13.32	10.80
9:00	21.60	13.32	10.80
10:00	38.16	13.32	10.80
11:00	32.04	17.64	13.68
12:00	26.64	22.32	13.68
13:00	38.16	27.72	16.92
14:00	38.16	27.72	23.04
15:00	32.04	22.32	20.88
16:00	32.04	27.72	23.04
17:00	38.16	27.72	23.04
18:00	44.64	27.72	25.20
19:00	29.16	27.72	25.20
20:00	29.16	33.84	27.36
21:00	26.64	33.84	27.36
22:00	32.04	33.84	25.20
23:00	38.16	33.84	25.20
0:00	44.64	27.72	23.04
1:00	32.04	27.72	25.20
2:00	32.04	27.72	20.88
3:00	26.64	24.84	20.88
4:00	26.64	24.84	16.92
5:00	21.60	22.32	16.92
6:00	24.12	17.64	13.68
7:00	0.00	17.64	16.92
Total	726.12	594.36	476.64

Table H-5 Flow Measurement Monitoring Result (6/6)

Unit : m3/hr

	Feb/28/'97		
Location	Old Pond Inlet	New Pond Intlet	New Pond Outlet
Base reading =	-	-	-
Cd average =	0.5135	0.63	0.402
8:00	34.92	17.64	16.92
9:00	68.76	22.32	16.92
10:00	41.40	33.84	23.04
11:00	41.40	33.84	25.20
12:00	38.16	33.84	20.88
13:00	44.64	33.84	23.04
14:00	3.96	33.84	23.04
15:00	7.92	33.84	25.20
16:00	3.96	24.84	27.36
17:00	3.96	17.64	25.20
18:00	5.76	15.48	23.04
19:00	7.92	13.32	23.04
20:00	5.76	13.32	25.20
21:00	3.96	13.32	25.20
22:00	2.52	15.48	20.88
23:00	1.44	15.48	20.88
0:00	3.96	15.48	16.92
1:00	3.96	3.24	16.92
2:00	2.52	13.32	15.48
3:00	3.96	11.52	13.68
4:00	1.44	11.52	10.80
5:00	1.44	8.64	8.28
6:00	1.44	8.64	6.12
7:00	0.00	17.64	1.08
Total	335.16	461.88	454.32

Table H-6 Results of Water Quality Monitoring at Meru Pilot Pond (1/6)

PARAMETER	Unit	5th Dec /96								19th Dec /96							
		Old Pond Inlet				New Pond Outlet				Old Pond Inlet				New Pond Outlet			
		8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00
Air Temperature	°C	20	29	27	22	20	29	27	22	21	28	28	20	20	25	26	26
Water Temperature	°C	20	21	21	20	19	25	23	22	20	21	20	20	20	21	21	22
pH		7.7	7.8	7.8	7.9	7.3	8.2	8.3	8.4	7.5	7.8	7.7	7.6	8.3	8.3	8.0	8.3
BOD	mg/l	500	700	450	480	130	150	120	120	525	650	525	500	126	160	140	135
Faecal coliform	No./100ml	850	1100	1200	1500	150	200	260	300	800	1000	900	850	135	220	240	250
Nitrates	mg/l	0.14	0.10	0.09	0.12	0.45	0.30	0.70	0.55	0.15	0.13	0.10	0.14	0.40	0.33	0.63	0.50
Nitrite	mg/l	0.30	0.70	0.90	0.60	0.11	0.40	0.20	0.25	0.28	0.65	0.83	0.58	0.13	0.35	0.25	0.28
Ammonia	mg/l	3.50	3.85	3.75	4.00	2.75	3.00	2.50	3.25	3.25	3.50	3.50	3.75	3.75	2.50	2.75	2.80
Sulfide	mg/l	0.510	0.458	0.390	0.275	0.405	0.350	0.278	0.175	0.490	0.427	0.415	0.260	0.053	0.145	0.055	0.055
Phenols	mg/l	0.700	0.300	0.400	0.250	0.275	0.150	0.125	0.125	0.650	0.425	0.400	0.350	0.225	0.125	0.150	0.150
Phosphorus	mg/l	0.033	0.028	0.035	0.040	0.015	0.020	0.010	0.010	0.040	0.038	0.035	0.030	0.020	0.020	0.015	0.018
Total suspended solids	mg/l	525	670	500	450	200	240	260	250	530	690	525	500	225	200	250	260

Table H-6 Results of Water Quality Monitoring at Meru Pilot Pond (2/6)

PARAMETER	Unit	2nd Jan /97								16th Jan /97							
		Old Pond Inlet				New Pond Outlet				Old Pond Inlet				New Pond Outlet			
		8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00
Air Temperature	°C	22	32	30	24	22	32	30	25	21	32	29	22	21	32	30	23
Water Temperature	°C	21	21	22	21	22	21	22	21	20	21	22	21	20	22	22	21
pH		7.5	7.7	7.8	7.9	8.3	8.4	8.0	8.3	7.8	7.9	7.8	7.8	8.2	8.5	8.0	8.4
BOD	mg/l	500	510	550	525	110	120	160	140	505	650	575	500	120	140	135	120
Faecal coliform	No./100ml	850	825	815	800	135	140	160	150	820	1120	1100	1300	125	180	200	180
Nitrates	mg/l	0.14	0.15	0.12	0.10	0.45	0.38	0.35	0.40	0.13	0.10	0.12	0.11	0.43	0.30	0.25	0.45
Nitrite	mg/l	0.35	0.45	0.43	0.50	0.18	0.20	0.25	0.15	0.30	0.50	0.45	0.55	0.13	0.15	0.20	0.10
Ammonia	mg/l	3.80	3.75	3.60	3.50	2.50	2.15	3.25	3.00	3.75	3.60	3.80	3.75	2.00	2.50	3.00	3.80
Sulfide	mg/l	0.550	0.464	0.375	0.400	0.035	0.030	0.028	0.033	0.500	0.450	0.400	0.325	0.038	0.035	0.040	0.040
Phenols	mg/l	0.700	0.450	0.450	0.500	0.250	0.250	0.300	0.180	0.650	0.350	0.350	0.300	0.200	0.225	0.275	0.175
Phosphorus	mg/l	0.022	0.030	0.030	0.030	0.015	0.020	0.018	0.020	0.030	0.030	0.035	0.033	0.013	0.015	0.018	0.015
Total suspended solids	mg/l	525	625	600	575	156	160	140	150	530	650	525	500	180	150	180	200

Table H-6 Results of Water Quality Monitoring at Meru Pilot Pond (3/6)

PARAMETER	Unit	29th Jan /97								15th Feb /97							
		Old Pond Inlet				New Pond Outlet				Old Pond Inlet				New Pond Outlet			
		8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00
Air Temperature	°C	22	33	30	24	22	33	30	24	23	33	31	23	23	33	31	23
Water Temperature	°C	21	20	20	22	20	22	22	21	22	23	22	20	22	23	22	20
pH		7.2	7.4	7.5	7.6	8.3	8.5	8.3	8.2	7.3	7.5	7.4	7.8	8.4	8.2	8.5	8.3
BOD	mg/l	450	480	450	500	125	130	140	120	495	500	500	530	120	140	120	150
Faecal coliform	No./100ml	850	900	850	900	120	160	180	140	900	850	800	825	120	150	160	160
Nitrates	mg/l	0.14	0.13	0.13	0.12	0.40	0.33	0.20	0.50	0.15	0.13	0.12	0.14	0.43	0.33	0.20	0.40
Nitrite	mg/l	0.25	0.35	0.20	0.20	0.15	0.10	0.25	0.15	0.30	0.40	0.38	0.45	0.10	0.10	0.15	0.15
Ammonia	mg/l	4.00	4.50	3.00	2.50	2.50	1.50	2.00	3.00	4.50	5.00	4.25	3.75	2.75	2.50	2.75	2.00
Sulfide	mg/l	0.450	0.400	0.300	0.250	0.030	0.033	0.028	0.025	0.500	0.450	0.380	0.480	0.035	0.030	0.033	0.035
Phenols	mg/l	0.450	0.400	0.450	0.450	0.150	0.200	0.200	0.275	0.650	0.380	0.500	0.450	0.250	0.275	0.200	0.200
Phosphorus	mg/l	0.030	0.025	0.020	0.020	0.010	0.010	0.020	0.015	0.025	0.028	0.020	0.025	0.010	0.015	0.010	0.015
Total suspended solids	mg/l	480	550	575	500	160	140	180	180	530	600	650	575	175	150	160	180

Table H-6 Results of Water Quality Monitoring at Meru Pilot Pond (4/6)

PARAMETER	Unit	26th Feb /97											
		Old Pond Inlet				Old Pond Outlet				New Pond Outlet			
		8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00
Air Temperature	°C	21	33	30	23	21	33	30	23	21	33	30	23
Water Temperature	°C	21	21	21	21	21	21	21	21	21	21	21	21
pH		7.3	7.4	7.2	7.5	8.6	8.2	8.3	8.4	8.1	7.9	8.2	8.0
BOD	mg/l	635	630	590	550	200	240	120	115	200	180	220	250
Faecal coliform	No./100ml	600	650	700	750	90	80	120	140	150	200	180	220
Nitrates	mg/l	0.12	0.13	0.10	0.12	0.30	0.30	0.20	0.30	0.20	0.18	0.15	0.10
Nitrite	mg/l	0.25	0.26	0.30	0.30	0.10	0.13	0.18	0.20	0.18	0.20	0.23	0.20
Ammonia	mg/l	4.00	4.25	3.50	3.85	2.25	1.75	2.75	1.50	3.00	3.50	2.75	2.65
Sulfide	mg/l	0.524	0.493	0.381	0.599	0.089	0.093	0.098	0.091	0.113	0.099	0.108	0.094
Phenols	mg/l	0.148	0.300	0.462	0.700	0.061	0.156	0.050	0.197	0.070	0.174	0.050	0.200
Phosphorus	mg/l	0.025	0.020	0.025	0.028	0.010	0.015	0.013	0.010	0.015	0.015	0.020	0.015
Total suspended solids	mg/l	520	500	525	480	120	110	150	106	200	180	220	250

Table H-6 Results of Water Quality Monitoring at Meru Pilot Pond (5/6)

PARAMETER	Unit	27th Feb /97											
		Old Pond Inlet				Old Pond Outlet				New Pond Outlet			
		8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00
Air Temperature	°C	22	32	30	24	22	32	30	24	22	32	30	24
Water Temperature	°C	22	21	22	21	22	21	22	21	22	21	22	21
pH		7.5	7.4	7.3	7.6	8.0	8.0	8.1	8.2	8.5	8.2	8.4	8.6
BOD	mg/l	695	590	680	660	175	100	120	235	75	90	90	120
Faecal coliform	No./100ml	500	800	720	580	150	120	180	160	100	80	120	110
Nitrates	mg/l	0.14	0.13	0.12	0.10	0.13	0.18	0.20	0.23	0.10	0.25	0.30	0.20
Nitrite	mg/l	0.20	0.30	0.30	0.28	0.15	0.10	0.15	0.10	0.10	0.05	0.15	0.10
Ammonia	mg/l	4.75	4.00	4.80	3.90	3.75	3.00	2.00	2.50	3.00	1.50	1.75	2.00
Sulfide	mg/l	0.513	0.361	0.400	0.599	0.106	0.082	0.100	0.090	0.076	0.087	0.096	0.090
Phenols	mg/l	0.585	0.510	0.300	0.549	0.159	0.033	0.185	0.190	0.048	0.000	0.160	0.187
Phosphorus	mg/l	0.020	0.015	0.025	0.020	0.015	0.010	0.015	0.010	0.005	0.013	0.003	0.018
Total suspended solids	mg/l	500	510	500	550	200	150	180	250	150	100	120	80

Table H-6 Results of Water Quality Monitoring at Meru Pilot Pond (6/6)

PARAMETER	Unit	28th Feb /97											
		Old Pond Inlet				Old Pond Outlet				New Pond Outlet			
		8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00	8:00	12:00	16:00	20:00
Air Temperature	°C	23	33	31	23	23	33	31	23	23	33	31	23
Water Temperature	°C	21	22	21	20	21	22	20	20	21	22	21	20
pH		7.2	7.6	7.4	7.3	8.0	7.9	7.8	8.1	8.6	8.2	8.4	8.1
BOD	mg/l	675	700	555	700	240	160	190	290	130	110	120	160
Faecal coliform	No./100ml	625	610	585	575	200	250	180	160	100	120	80	120
Nitrates	mg/l	0.10	0.11	0.13	0.10	0.13	0.15	0.10	0.14	0.25	0.23	0.20	0.20
Nitrite	mg/l	0.23	0.28	0.27	0.25	0.17	0.13	0.15	0.14	0.15	0.10	0.14	0.15
Ammonia	mg/l	4.80	3.75	3.50	3.00	3.00	2.75	2.85	2.50	2.50	2.00	2.75	2.25
Sulfide	mg/l	0.520	0.321	0.265	0.209	0.107	0.125	0.101	0.106	0.080	0.092	0.077	0.084
Phenols	mg/l	0.405	0.630	0.288	0.486	0.097	0.107	0.156	0.079	0.037	0.152	0.105	0.070
Phosphorus	mg/l	0.010	0.018	0.020	0.019	0.013	0.010	0.018	0.010	0.015	0.010	0.020	0.012
Total suspended solids	mg/l	525	575	500	510	250	200	225	150	100	120	106	136