5.2.3 INDUSTRIAL, INSTITUTIONAL AND COMMERCIAL CONSUMPTION

The ward totals for industrial, institutional and commercial consumers is given in columns C, D and E, respectively, of Table C.5.5. The ward totals used are based on the same percentages as for the domestic ward totals used. The totals are 2,216 m^3/day for industrial consumption, 4,029 m^3/day for institutional consumption and 5,177 m^3/day for commercial consumption. These totals are in addition to the major consumers and represent the aggregated averages of all such consumers using less than 10 m^3/day.

The allocation of the industrial, institutional and commercial ward totals to nodes was based on the same percentages obtained for domestic allocation. These percentages may not be strictly correct for the industrial or institutional components since such sites tend to be sparsely populated. However, considering the relatively low values of these components compared with the domestic total, the allocations can be used for network modeling purposes. Moreover, the major contributions from these components have been allocated separately. The allocation for commercial consumption on the basis of domestic allocation is valid, since commercial premises are located in proportion to the population density.

The industrial ward total, contribution and node total components for each node are given in columns H, I and J respectively of Table C.5.6. Similarly, the institutional components are given in columns K, L and M, while columns N, O and P represent the commercial components.

The nodal grand total given in column Q of Table C.5.6 is the summation of the domestic, industrial, institutional and commercial totals for each node. The total suppressed consumption for Dar-es-Salaam in 1990, excluding leakage, is 125,727 m^3/day. The node totals are used as the base demand at each node during the network analysis with appropriate factors being applied to account for leakage and peaking.

5.3 MODEL CALIBRATION

The network model for the complete city distribution system was prepared for calibration using the data given in Tables C.5.1 and C.5.2. The calibration model data file for the hydraulic network analysis was prepared using all the information given in Figure C.5.2, with the following changes.

(i) The valve connecting nodes 103 and 203 was partially open during the day of the simultaneous pressure measurements for calibration, 3 August 1990. This was included in the calibration model by adding a connection pipe linking nodes 103 and 203. The throttled valve was represented in the model by a 100 mm diameter pipe section between nodes 103 and 203.

(ii) The pipe sections under construction, between nodes 203-219, 219-304 and 218-219 were not included in the calibration model. These sections are due to be commissioned in 1991.

5.3.1 C-VALUE DETERMINATION [1]

Field tests were carried out for six pipe sections within the network in order to determine the Hazen-Williams pipe roughness coefficients for various pipe types. The six sections were selected on the basis of age, pipe material and diameter. The test sections were restricted to short lengths due to the difficulty in shutting off-takes between the section for the duration of the test. Due to inadequate flows within the distribution system, in general, results from only three test sections were used, since flow velocities of the order of 1 m/s were achieved in these sections. The results of the field calibration tests are given below.

from node	to node	section length (m)	diameter (mm)	1990 age	pipe/line material	average c-value
109	142	357	375	27	cast iron	80
118	kawe	200	150	37	cast iron	60
311	312	137	200	37	cast iron	70

These values were used for similar cast iron pipes in the network for the calibration of the model with adjustments being made in some sections to account for different diameters and age of pipe.

5.3.2 CALIBRATION

The calibration data is for the morning peak period of 3 August 1990. The levels in the University (node 100) and Kimara (node 200) reservoirs were 63.3 and 135.9 metres, respectively. Total delivery heads, including ground elevation and pumping head, at Mtoni source were 41.0 metres into the city (node 300) and 98.5 metres to Mbagala (node 350).

The base demand at each node was scaled up by a peaking factor of 2.13 (and is given in Table C.5.7), which represents a leakage factor and a peak to average day (base demands) factor.

The C-values for the pipe sections were selected based upon the limited results of the field tests for cast iron pipes, published tables, previous experience with similar pipes, based on age, diameter and pipe material. Minor adjustments were also made in certain sections in order to obtain a well calibrated

---

* refer to section 4.10, Appendix C.

model.

The hydraulic results of the calibrated model are given in Table C.5.8. Initial results indicate that the sizing of most of the pipes within the primary distribution system in the central area are adequate.

The model results for the supply nodes and the corresponding estimated or measured source flows are summarized below.

node number	location	measured flow (m^3/d) A	modeled flow (m^3/d) B	%age error C
100	university	193.8	191.1	1.4
200	kimara	63.7	63.9	0.3
300	mtoni-city	7.5	10.6	41.3
350	mtoni-mbagala	3.4	2.8	17.6
	t o t a l s	268.4	268.4	0.0

C = ABS((A - B)/A) * 100)

The results from the measured source flows indicate that the overall model is well balanced with regard to the supply and demand within the distribution system.

A comparison between the measured and modeled total head at the calibration nodes is given in Table C.5.9. The nodes where high suppression takes place like Msasani and the south of Temeke are not included in the Table. Results of all the pressure points on the primary distribution system are tabulated. The percentage error for all the nodes, as well as for those nodes which can be regarded as being actual readings, representing the calibrated model are also tabulated.

The measured total head of 44.0 metres for node 101 could have been a measurement error. Also, since this node is near the University reservoir, which frequently empties completely, the low reading could be attributed to air pockets in the 54-inch main from the reservoir. Moreover, since the total head at the downstream node, number 105, was measured at 51.0 metres, the low reading for 101 was not considered.

The results for nodes 108, 109 and 111 suggest that there could be a throttled section, due perhaps to a partially open valve, between node 105 and 110. This may also be the explanation for the low reading at node 208.

The lower pressure measurement at node 224 could be attributed to the extensive secondary distribution system pipework in the vicinity which, as for the rest of Dar-es-Salaam, is in poor condition and, consequently, hydraulically inefficient.

In general, the results of the calibrated model, represented by the data file given in Table C.5.7 and the results in Table C.5.8, indicate that the model is representative of the primary distribution system of Dar-es-Salaam.

5.4 HYDRAULIC ANALYSIS OF THE PRESENT SYSTEM

Following model construction and calibration, hydraulic analyses of the present system and the rehabilitated system were performed (The latter is dealt in separate chapter).

In general, most of the primary distribution system is adequately sized for the current peak water demand requirement in Dar-es-Salaam. Some current operational aspects can be improved in order to alleviate existing hydraulic inefficiencies brought about by inconsistent valve closures at key locations within the system. However, a major rehabilitation programme is required in order to improve the entire system to an acceptable standard, consistent with providing quality potable water at a reasonable working pressure to each accounted consumer.

The hydraulic analysis of the present system confirms that severe problems associated with the distribution system exist in the following areas, which are illustrated in Figure C.5.3.

(1) Low pressures in the Oyster Bay area affecting distribution from nodes 121, 122, 123, 124 and 125.
(2) Inadequate pressures in Kinondoni between pipe sections 115 to 141, 141 to 130 and 130 to 131. This is mainly due to undersized pipes in these sections.
(3) Inadequate pressure at nodes 103 and 114 in Ubungo, node 142 in Manzese and node 116 in Msasani.
(4) Low pressure at nodes 138, 139, 140 and 145 affecting the distribution in the Kivukoni area.
(5) Inadequate pressure at node 201 in Ubungo along the transmission main from Kimara reservoir.
(6) Inadequate pressure along Pugu road at Vingunguti affecting distribution at nodes 215 and 216.
(7) Low pressure at key node 304, Tazara Junction, severely affecting the distribution to nodes 303, 308, 309, 318, 319, 320 and 322 in the Temeke area.
(8) Low pressure along Uhuru Street affecting nodes 221, 222 and 223.
(9) Ineffective pumping, mainly due to a limited supply, from Mtoni source to the city resulting in low pressures at nodes 301, 302 and 321 in the Mtoni area.
(10) Ineffective pumping to Mbagala resulting in low pressures at nodes 351 and 352.
(11) Inadequately sized pumping main from Mtoni to Mbagala resulting in very high head losses along

the 75 mm main to node 353.

Although available pressures of more than 1 bar within the rest of the network indicate that most of the distribution system should be adequately supplied, this is not reflected in the current level of service. The main problem is the state of the secondary pipe distribution system as shown in Plates 1 and 2. Since most of the secondary distribution system consists of old (greater than 20 years service) cast iron pipes, there is significant loss of hydraulic efficiency in such mains, mainly due to tuberculation of the pipes. Moreover, the absence of any filter media at the Lower Ruvu water treatment plant for more than ten years has contributed to the ineffectiveness of these pipes, due to considerable build-up of fine deposits.

Some improvement to the distribution system can be made immediately by operational changes in the primary distribution system. However, a long term, systematic rehabilitation programme is required in order to restore the water supply and distribution system to an acceptable standard. The major rehabilitation recommendations are given elsewhere, together with improvements that can be made to the distribution system in the immediate future.

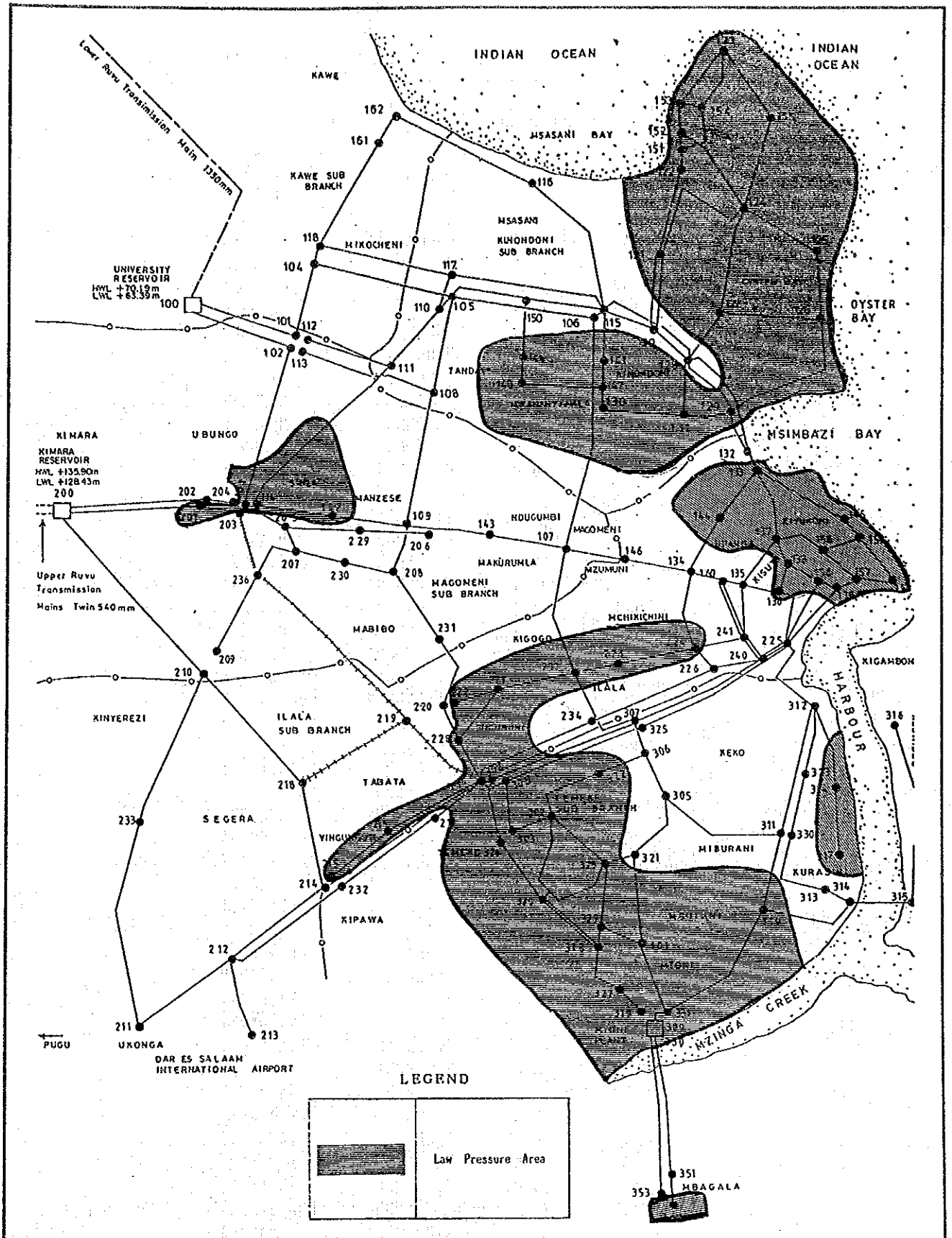

FIG. C.5.3 LOW PRESSURE AREA

THE STUDY ON REHABILITATION OF DAR ES SALAAM WATER SUPPLY

TABLE C.5.1 NODE DATA FOR HYDRAULIC NETWORK ANALYSIS IN 1990

NODE NO.	GL(m)	SUB BRANCH	LOCATION
101	38.0	KAWE	KAWE
102	38.0	MAGOMENI	UBUNGO
103	58.0	MAGOMENI	UBUNGO
104	23.0	KAWE	KAWE
105	20.0	MAGOMENI	TANDALE
106	15.0	KINONDONI	MWA'YAMALA
107	17.0	MAGOMENI	MZIMUNI
108	26.6	MAGOMENI	TANDALE
109	38.0	MAGOMENI	MANZESE
110	20.0	MAGOMENI	TANDALE
111	33.3	MAGOMENI	TANDALE
112	38.0	MAGOMENI	MANZESE
113	38.0	MAGOMENI	MANZESE
114	58.0	MAGOMENI	UBUNGO
115	15.0	KINONDONI	MSASANI
116	3.0	KINONDONI	MSASANI
117	20.0	KINONDONI	MSASANI
118	23.0	KINONDONI	MSASANI
120	12.5	KINONDONI	KINONDONI
121	8.0	KINONDONI	MSASANI
122	4.0	KINONDONI	MSASANI
123	9.0	KINONDONI	MSASANI
124	4.0	KINONDONI	OYSTER BAY
125	4.0	KINONDONI	OYSTER BAY
126	4.5	KINONDONI	OYSTER BAY
127	8.0	KINONDONI	OYSTER BAY
128	14.0	KINONDONI	MSASANI
129	6.0	KINONDONI	KINONDONI
130	16.0	KINONDONI	KINONDONI
131	8.5	KINONDONI	KINONDONI
132	3.0	KINONDONI	KINONDONI
133	6.0	ILALA	UP'A EAST
134	12.5	ILALA	JANGWANI
135	10.0	ILALA	UP'A EAST
136	10.5	ILALA	KISUTU
137	6.0	ILALA	UP'A EAST
138	7.0	ILALA	KISUTU
139	6.5	ILALA	KIVUKONI
140	5.0	ILALA	KIVUKONI
141	15.5	KINONDONI	KINONDONI
142	48.0	MAGOMENI	UBUNGO
143	26.0	MAGOMENI	NDUGUMBI
144	10.5	ILALA	UP'A WEST
145	3.5	ILALA	KIVUKONI
146	6.0	MAGOMENI	MAGOMENI
147	16.0	KINONDONI	KINONDONI
148	23.0	KINONDONI	MWA'YAMALA
149	21.0	KINONDONI	MWA'YAMALA
150	12.0	KINONDONI	MWA'YAMALA
151	3.0	KINONDONI	MSASANI

TABLE C.5.1 NODE DATA FOR HYDRAULIC NETWORK ANALYSIS IN 1990

NODE NO.	GL(m)	SUB BRANCH	LOCATION
152	5.0	KINONDONI	MSASANI
153	6.0	KINONDONI	MSASANI
154	6.0	KINONDONI	MSASANI
155	6.0	KINONDONI	MSASANI
156	6.5	ILALA	KIVUKONI
157	6.5	ILALA	KIVUKONI
158	6.5	ILALA	KIVUKONI
159	5.0	ILALA	KIVUKONI
160	10.0	ILALA	UP'A EAST
161	9.0	KINONDONI	MSASANI
162	3.0	KINONDONI	MSASANI
201	88.5	MAGOMENI	UBUNGO
202	88.5	MAGOMENI	UBUNGO
203	58.0	MAGOMENI	UBUNGO
204	58.0	MAGOMENI	UBUNGO
205	52.5	MAGOMENI	UBUNGO
206	34.0	MAGOMENI	MANZESE
207	52.5	MAGOMENI	UBUNGO
208	35.5	MAGOMENI	MABIBO
209	50.0	ILALA	KINYEREZI
210	70.5	ILALA	KINYEREZI
211	56.5	ILALA	UKONGA
212	53.0	ILALA	UKONGA
213	54.0	ILALA	AIRPORT
214	48.7	ILALA	KIPAWA
215	48.7	ILALA	VINGUNGUTI
216	37.7	ILALA	VINGUNGUTI
217	35.3	ILALA	KIPAWA
218	43.0	ILALA	TABATA
219	25.5	ILALA	TABATA
220	20.0	ILALA	BUGURUNI
221	26.0	ILALA	BUGURUNI
222	20.0	ILALA	BUGURUNI
223	20.0	ILALA	ILALA
224	16.0	ILALA	MCHI'CHINI
225	11.5	ILALA	MCHAFUKOGE
226	16.5	ILALA	GEREZANI
228	34.0	ILALA	BUGURUNI
229	48.0	MAGOMENI	UBUNGO
230	45.0	MAGOMENI	UBUNGO
231	28.0	MAGOMENI	MABIBO
232	49.0	ILALA	KIPAWA
233	80.0	ILALA	KINYEREZI
234	21.5	ILALA	ILALA
236	50.0	MAGOMENI	UBUNGO
237	22.0	ILALA	ILALA
240	13.0	ILALA	GEREZANI
241	13.0	ILALA	GEREZANI
301	32.5	TEMEKE	MIBURANI
302	26.0	TEMEKE	TEMEKE

TABLE C.5.1 NODE DATA FOR HYDRAULIC NETWORK ANALYSIS IN 1990

NODE NO.	GL(m)	SUB BRANCH	LOCATION
303	30.0	TEMEKE	KEKO
304	33.3	ILALA	BUGURUNI
305	17.5	TEMEKE	KEKO
306	18.5	TEMEKE	KEKO
307	19.0	ILALA	ILALA
308	34.6	ILALA	BUGURUNI
309	34.8	ILALA	BUGURUNI
310	22.5	TEMEKE	MTONI
311	16.5	TEMEKE	MIBURANI
312	8.0	TEMEKE	KURASINI
313	15.5	TEMEKE	KURASINI
314	8.0	TEMEKE	MTONI
315	10.0	TEMEKE	VIJIBWENI
316	12.5	TEMEKE	KIGAMBONI
317	15.5	TEMEKE	KURASINI
318	40.5	TEMEKE	TEMEKE
319	38.5	TEMEKE	MTONI
320	34.0	TEMEKE	TEMEKE
321	21.0	TEMEKE	TEMEKE
322	23.5	TEMEKE	KEKO
323	12.5	TEMEKE	KURASINI
324	16.5	TEMEKE	KURASINI
325	19.0	TEMEKE	KEKO
326	35.0	TEMEKE	TEMEKE
327	40.0	TEMEKE	MIBURANI
328	26.0	TEMEKE	TEMEKE
329	32.0	TEMEKE	TEMEKE
330	17.0	TEMEKE	KURASINI
331	37.0	TEMEKE	MTONI
351	58.5	TEMEKE	MBAGALA
352	61.5	TEMEKE	MBAGALA
353	61.5	TEMEKE	MBAGALA

TABLE C.5.2 PIPE DATA FOR HYDRAULIC NETWORK ANALYSIS IN 1990

FROM NODE	TO NODE	DIAMETER (mm)	DATE LAID	1990 AGE	PIPE/LINE MATERIAL	LENGTH (m)
100	101	1,350	1976	14	STL/BTMN	1,820
100	102	800	1986	4	DI/CMNT	1,820
101	104	1,350	1976	14	PSCP	1,030
102	103	700	1976	14	STL/BTMN	2,700
104	105	1,350	1976	14	PSCP	1,900
105	106	1,200	1976	14	PSCP	2,500
105	108	750	1976	14	PSCP	1,440
105	110	525	1963	27	STL/BTMN	35
105	150	450	1963	27	STL/BTMN	1,200
150	115	450	1963	27	STL/BTMN	1,300
106	107	1,200	1976	14	PSCP	3,420
107	143	375	1963	27	CST-IRON	1,435
107	146	375	1963	27	CST-IRON	825
107	237	1,050	1976	14	PSCP	2,400
237	307	1,050	1976	14	PSCP	1,600
108	109	750	1976	14	PSCP	1,810
108	113	800	1986	4	DI/CMNT	2,280
109	142	375	1963	27	CST-IRON	900
109	143	375	1963	27	CST-IRON	2,315
109	208	600	1976	14	PSCP	1,530
110	111	525	1963	27	STL/BTMN	1,535
110	117	150	1977	13	CST-IRON	55
111	112	825	1976	14	STL/BTMN	940
111	114	525	1963	27	STL/BTMN	3,000
114	142	375	1963	27	CST-IRON	1,220
115	116	150	1953	37	CST-IRON	2,000
104	118	200	1976	14	uPVC	200
118	161	200	1976	14	uPVC	1,600
161	162	150	1976	14	uPVC	500
116	162	150	1953	37	CST-IRON	1,700
115	117	200	1953	37	CST-IRON	2,275
115	120	450	1963	27	STL/BTMN	1,000
115	128	200	1953	37	CST-IRON	1,370
115	141	200	1953	37	CST-IRON	700
117	118	150	1953	37	CST-IRON	1,900
120	121	250	1975	15	DI/CMNT	1,120
120	121	200	1969	21	uPVC	1,120
121	124	200	1969	21	uPVC	1,600
120	128	450	1963	27	STL/BTMN	400
121	122	200	1969	21	DI/CMNT	1,255
122	151	200	1988	2	DI/CMNT	500
151	152	200	1988	2	DI/CMNT	300
152	153	200	1988	2	DI/CMNT	500
153	123	150	1988	2	DI/CMNT	1,300
151	154	150	1966	24	uPVC	800
153	154	125	1966	24	CST-IRON	750
123	154	150	1966	24	uPVC	1,200
152	124	150	1966	24	CST-IRON	1,200
123	155	150	1966	24	CST-IRON	1,500
155	124	150	1966	24	CST-IRON	1,300
124	125	100	1966	24	CST-IRON	545
124	127	150	1969	21	CST-IRON	1,800
125	126	150	1966	24	CST-IRON	1,040
126	127	150	1966	24	CST-IRON	650

TABLE C.5.2 PIPE DATA FOR HYDRAULIC NETWORK ANALYSIS IN 1990

FROM NODE	TO NODE	DIAMETER (mm)	DATE LAID	1990 AGE	PIPE/LINE MATERIAL	LENGTH (m)
127	128	200	1953	37	CST-IRON	700
128	129	300	1953	37	CST-IRON	950
128	131	150	1958	32	CST-IRON	1,050
128	132	300	1963	27	STL/BTMN	1,430
129	126	100	1955	35	CST-IRON	2,640
129	132	400	1987	3	DI/CMNT	480
130	131	150	1955	35	CST-IRON	850
130	147	200	1955	35	CST-IRON	350
147	141	200	1955	35	CST-IRON	600
147	148	150	1976	14	uPVC	1,600
148	149	150	1976	14	uPVC	400
149	150	200	1976	14	uPVC	950
131	129	150	1955	35	CST-IRON	725
132	133	400	1987	3	DI/CMNT	200
133	144	300	1953	37	CST-IRON	1,020
133	137	150	1958	32	CST-IRON	1,540
133	145	150	1958	32	CST-IRON	1,740
134	160	400	1974	16	STL/BTMN	500
160	135	400	1974	16	STL/BTMN	330
156	225	150	1960	30	CST-IRON	850
137	158	200	1962	28	CST-IRON	750
157	158	200	1962	28	CST-IRON	600
158	159	150	1962	28	CST-IRON	750
134	144	300	1953	37	CST-IRON	1,025
134	146	400	1986	4	DI/CMNT	1,005
134	224	200	1974	16	CST-IRON	1,160
135	136	150	1960	30	CST-IRON	640
135	137	250	1963	27	CST-IRON	940
136	138	150	1958	32	CST-IRON	600
136	225	150	1953	37	CST-IRON	340
137	138	150	1958	32	CST-IRON	420
138	156	200	1953	37	CST-IRON	410
139	156	200	1953	37	CST-IRON	250
139	157	200	1953	37	CST-IRON	350
140	157	200	1953	37	CST-IRON	680
139	225	150	1953	37	CST-IRON	850
140	159	150	1958	32	CST-IRON	1,140
145	159	150	1958	32	CST-IRON	600
200	201	525	1959	31	STL/BTMN	3,650
200	202	525	1959	31	STL/BTMN	3,650
200	210	600	1975	15	STL/BTMN	5,000
201	203	525	1959	31	STL/BTMN	900
202	204	525	1959	31	STL/BTMN	970
203	205	525	1959	31	STL/BTMN	100
205	229	400	1959	31	STL/BTMN	990
205	207	525	1959	31	STL/BTMN	460
206	229	400	1959	31	STL/BTMN	985
207	230	525	1959	31	STL/BTMN	1,125
207	236	600	1975	15	STL/BTMN	800
236	209	600	1975	15	STL/BTMN	3,000
208	231	525	1959	31	STL/BTMN	1,970
208	230	525	1959	31	STL/BTMN	1,125
210	218	450	1975	15	STL/BTMN	2,700
210	233	300	1975	15	CST-IRON	2,920

TABLE C.5.2 PIPE DATA FOR HYDRAULIC NETWORK ANALYSIS IN 1990

FROM NODE	TO NODE	DIAMETER (mm)	DATE LAID	1990 AGE	PIPE/LINE MATERIAL	LENGTH (m)
211	212	400	1975	15	DI/CMNT	1,890
211	233	300	1975	15	CST-IRON	2,925
212	213	150	1975	15	DI/CMNT	1,145
212	214	400	1975	15	DI/CMNT	1,875
212	232	250	1975	15	DI/CMNT	1,895
215	216	400	1975	15	DI/CMNT	1,435
216	304	300	1975	15	DI/CMNT	2,385
217	232	250	1975	15	DI/CMNT	1,990
217	304	300	1975	15	DI/CMNT	1,655
218	214	400	1975	15	STL/BTMN	2,100
220	228	450	1959	31	STL/BTMN	1,025
220	231	525	1959	31	STL/BTMN	1,970
221	222	300	1970	20	CST-IRON	645
221	223	300	1970	20	CST-IRON	1,625
221	228	300	1965	25	STL/BTMN	1,270
223	224	300	1970	20	CST-IRON	1,125
224	241	300	1970	20	CST-IRON	900
224	226	200	1974	16	CST-IRON	435
225	240	250	1975	15	DI/CMNT	400
226	240	250	1975	15	DI/CMNT	675
225	240	550	1975	15	STL/BTMN	400
240	307	550	1975	15	STL/BTMN	1,675
225	240	300	1975	15	DI/CMNT	400
240	325	300	1975	15	DI/CMNT	1,600
240	241	300	1970	20	CST-IRON	350
240	241	250	1972	18	CST-IRON	350
135	241	250	1975	15	CST-IRON	600
160	241	250	1972	18	CST-IRON	850
160	241	200	1972	18	CST-IRON	850
225	312	400	1974	16	STL/BTMN	1,245
226	234	250	1977	13	DI/CMNT	1,775
228	304	300	1959	31	STL/BTMN	645
234	304	250	1977	13	DI/CMNT	1,995
300	331	375	1953	37	CST-IRON	50
331	301	375	1953	37	CST-IRON	1,515
331	310	250	1953	37	CST-IRON	2,415
301	321	375	1953	37	CST-IRON	1,895
302	303	200	1972	18	CST-IRON	700
303	309	200	1964	26	CST-IRON	800
302	322	150	1968	22	CST-IRON	1,100
304	308	550	1975	15	STL/BTMN	275
304	309	300	1975	15	DI/CMNT	420
305	306	375	1953	37	CST-IRON	600
305	311	200	1953	37	CST-IRON	1,415
305	321	375	1953	37	CST-IRON	1,475
306	307	375	1953	37	CST-IRON	700
306	322	150	1968	22	CST-IRON	850
308	307	550	1975	15	STL/BTMN	2,325
308	326	350	1979	11	DI/CMNT	1,100
309	325	300	1975	15	DI/CMNT	2,600
310	311	250	1953	37	CST-IRON	1,125
310	314	250	1960	30	CST-IRON	1,600
311	312	200	1953	37	CST-IRON	2,485
312	323	400	1974	16	STL/BTMN	1,050

TABLE C.5.2 PIPE DATA FOR HYDRAULIC NETWORK ANALYSIS IN 1990

FROM NODE	TO NODE	DIAMETER (mm)	DATE LAID	1990 AGE	PIPE/LINE MATERIAL	LENGTH (m)
312	324	200	1953	37	CST-IRON	1,600
313	314	200	1974	16	uPVC	950
313	330	400	1974	16	STL/BTMN	1,900
330	323	400	1974	16	STL/BTMN	1,450
314	315	200	1974	16	SP STEEL	1,000
317	324	200	1953	37	CST-IRON	1,365
321	328	150	1965	25	CST-IRON	650
320	328	150	1972	18	CST-IRON	1,100
302	328	150	1972	18	CST-IRON	1,150
328	329	150	1951	39	CST-IRON	1,100
301	329	150	1972	18	CST-IRON	550
302	320	150	1979	11	DI/CMNT	1,500
320	318	200	1964	26	CST-IRON	800
326	320	350	1979	11	DI/CMNT	1,200
320	318	350	1979	11	DI/CMNT	1,400
318	327	350	1979	11	DI/CMNT	900
327	319	350	1979	11	DI/CMNT	600
350	351	200	1979	11	uPVC	4,015
350	353	75	1972	18	GVZD-STL	5,000
351	352	150	1953	37	CST-IRON	985
315	316	200	1960	30	CST-IRON	3,600
103	203	700	1976	14	STL/BTMN	60
106	115	450	1963	27	STL/BTMN	20
318	329	150	1952	38	CST-IRON	500
203	236	600	1990	0	STL/BTMN	1,100
236	219	600	1990	0	STL/BTMN	4,100
219	304	600	1990	0	STL/BTMN	2,500
218	219	400	1990	0	FGRP	3,200

KEY

CST-IRON : Cast Iron Pipe
DI/CMNT : Ductile Iron Pipe, Cement Mortar Lining
FGRP : Fibre Glass Reinforced Plastic Pipe
GVZD-STL : Galvanized Steel Pipe
PSCP : Pre-Stressed Concrete Pipe
SP STEEL : Special Steel, Unlined Stainless Submerged Pipe
STL/BTMN : Steel Pipe, Bitumen Lining
uPVC : Unplasticized Poly-Vinyl Chloride Pipe

TABLE C.5.3 SOURCE DATA FOR HYDRAULIC NETWORK ANALYSIS IN 1990

NODE NO.	SOURCE NAME	SUB BRANCH	TYPE OF SOURCE	CAPACITY (m3)	OPERATING LEVELS(m) BOTTOM	TOP
100	UNIVERSITY	KAWE	RESERVOIR	45,400	63.39	70.19
200	KIMARA	MAGOMENI	RESERVOIR	34,000	128.43	135.90
300	MTONI - CITY	TEMEKE	PUMPED	9,000	41.00	41.00
350	MTONI - MBAGALA	TEMEKE	PUMPED	6,500	98.50	98.50

TABLE C.5.4 CONSUMPTION FOR HYDRAULIC NETWORK ANALYSIS IN 1990 (LARGE CONSUMER)

(Unit : cu. m/day)

N A M E	NO.	WARD. NO.	INDUST-RIAL	INSTI-TUTIONAL	COMMER-CIAL	TOTAL
TANZANIA BREWERY LTD	1101	106	410			410
TANZANIA BREWERY LTD	1102	106	213			213
KILIMANJARO HOTEL	1103	118			94	94
USAMBARA HOTEL	1104	112			72	72
RAILWAYS SHAURI MOYO	1105	106		30		30
EMBASSY HOTEL	1106	118			25	25
FIRE BRIGADE STATION	1107	117		13		13
INST. OF FINANCIAL MGNT.	1108	118		12		12
SEGEREA POULTRY FARMS	1109	105			12	12
TIPER OIL REFINERY	1201	201	140			140
MGULANI ARMY CAMP	1202	216		126		126
DAR-ES-SALAAM HARBOUR	1203	216			104	104
PEPSI-COLA FACTORY	1204	213	80			80
KIBASILA STAND PIPE	1205	213			71	71
DAR-ES-SALAAM HARBOUR	1206	216			70	70
GENERAL FOOD COMPANY LTD	1207	215			47	47
COGNAC DISTILLERS	1208	213	30			30
KIOO(GLASS) INDUSTRY LTD	1209	213	26			26
CALICO TEXTILE COMPANY	1210	213	17			17
TANITA CASHEWNUT FACTORY	1211	213	14			14
KIUTA PRINTING WORKS	1212	215			12	12
UNIVERSITY OF DAR'SALAAM	1401	402		559		559
TANGANYIKA PACKERS LTD	1402	402	31			31
JESHI LA KUJENGA TAIFA	1403	402		24		24
JESHI LA KUJENGA TAIFA	1404	402		16		16
FRIENDSHIP TEXTILE MILL	1501	509	783			783
UBUNGO FARM IMPLEMENTS	1502	509	79			79
NATIONAL DAIRY COMPANY	1503	509	40			40
KAJIMA CONSTRUCTION CAMP	1504	501		29		29
INSTITUTE OF TRANSPORT	1505	509		16		16
DARBREW (KIBUKU) BREWERY	1506	509	15			15
UBUNGO SPINNING MILLS	1507	509	14			14
FRUIT & VEGETABLE MARKET	1508	501			13	13
TANZANIA FISHNETS IND.	1509	509	12			12
TOTAL(LARGE CONSUMER)	34		1,904	825	520	3,249

TABLE C.5.5 CONSUMPTION FOR HYDRAULIC NETWORK ANALYSIS IN 1990 (SMALL CONSUMER)

(Unit : person, cu. m/day)

N A M E	WARD No.	POPU-LATION (A)	DOMESTIC (B)	INDUST-RIAL (C)	INSTI-TUTIONAL (D)	COMMER-CIAL (E)	TOTAL
UKONGA	101	49,647	1,202	6	31	10	1,249
PUGU	102		0	0	0	0	0
TABATA	104	20,280	529	6	4	39	578
KINYEREZI	105	536	34	0	0	1	35
ILALA	106	38,493	3,810	15	116	264	4,205
MCHIKICHINI	107	16,518	1,354	0	0	0	1,354
VINGUGUTI	108	37,002	935	0	0	0	935
KIPAWA	109	40,538	1,024	125	140	82	1,371
BUGURUNI	110	52,990	4,837	24	29	113	5,003
KARIAKOO	111	13,805	1,540	24	35	264	1,863
JANGWANI	112	16,826	1,036	11	8	109	1,164
GEREZANI	113	8,223	1,162	41	36	132	1,371
KISUTU	114	9,180	2,180	66	258	1,022	3,526
MCHAFUKOGE	115	9,387	2,230	0	0	0	2,230
UPANGA EAST	116	10,771	4,093	0	217	9	4,319
UPANGA WEST	117	12,103	4,599	0	462	10	5,071
KIVUKONI	118	5,900	1,401	18	622	96	2,137
KIGAMBONI	201	26,064	856	11	22	4	893
VIJIBWENI	202	1,292	43	0	0	0	43
MBAGALA	207	44,883	1,304	4	0	11	1,319
YOMBO VITUKA	209	10,750	0	0	0	0	0
MIBURANI	212	80,058	3,984	0	0	0	3,984
TEMEKE	213	100,104	6,591	1,314	486	314	8,705
MTONI	214	43,292	2,024	0	23	76	2,123
KEKO	215	47,082	3,427	166	248	172	4,013
KURASINI	216	29,408	1,964	59	161	82	2,266
MSASANI	301	56,335	14,985	13	246	287	15,531
KINONDONI	302	46,554	8,496	18	209	552	9,275
MWANANYAMALA	303	79,636	6,419	0	70	448	6,937
KAWE	402	37,767	3,469	213	465	182	4,329
MAGOMENI	501	18,610	1,021	0	5	231	1,257
MAKURUMLA	502	59,299	4,070	0	0	11	4,081
NDUGUMBI	503	35,954	2,811	0	8	77	2,896
TANDALE	504	64,155	3,335	0	0	0	3,335
MZIMUNI	505	26,343	1,872	0	0	0	1,872
KIGOGO	506	23,308	1,281	8	3	38	1,330
MABIBO	507	50,481	2,908	0	1	15	2,924
MANZESE	508	59,856	2,138	0	0	0	2,138
UBUNGO	509	51,598	6,092	74	124	526	6,816
TOTAL(SMALL CONSUMER)		1,335,028	111,056	2,216	4,029	5,177	122,478
TOTAL(SMALL+LARGE)		1,335,028	111,056	4,120	4,854	5,697	125,727

TABLE C.5.6 NODAL DEMAND ALLOCATION FOR HYDRAULIC NETWORK ANALYSIS IN 1990

(Unit : person, cu. m/day)

NODE NO.	CONTRIBUTIONS			POPULATION			DOMESTIC			INDUSTRIAL		
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL B	WARD CNTRBN C	NODE TOTAL D	WARD TOTAL E	WARD CNTRBN F	NODE TOTAL G	WARD TOTAL H	WARD CNTRBN I	NODE TOTAL J
102	MANZESE	508	2	59,856	1,197	4,293	2,138	42.8	408.3	0	0.0	4.4
	UBUNGO	509	6	51,598	3,096		6,092	365.5		74	4.4	
		1401	100	0	0		0	0.0		0	0.0	
103	MANZESE	508	4	59,856	2,394	3,426	2,138	85.5	207.4	0	0.0	1.5
	UBUNGO	509	2	51,598	1,032		6,092	121.8		74	1.5	
105	MSASANI	301	1	56,335	563	3,771	14,985	149.9	316.6	13	0.1	0.1
	TANDALE	504	5	64,155	3,208		3,335	166.8		0	0.0	
107	MAGOMENI	501	87	18,610	16,191	54,071	1,021	888.3	3,568.2	0	0.0	2.0
	NDUGUMBI	503	32	35,954	11,505		2,811	899.5		0	0.0	
	MZIMUNI	505	78	26,343	20,548		1,872	1,460.2		0	0.0	
	KIGOGO	506	25	23,308	5,827		1,281	320.3		8	2.0	
		1508	100	0	0		0	0.0		0	0.0	
108	TANDALE	504	48	64,155	30,794	30,794	3,335	1,600.8	1,600.8	0	0.0	0.0
109	MANZESE	508	51	59,856	30,527	32,591	2,138	1,090.4	1,334.1	0	0.0	3.0
	UBUNGO	509	4	51,598	2,064		6,092	243.7		74	3.0	
		1505	50	0	0		0	0.0		0	0.0	
110	KAWE	402	50	37,767	18,884	22,092	3,469	1,734.5	1,901.3	213	106.5	106.5
	TANDALE	504	5	64,155	3,208		3,335	166.8		0	0.0	
111	KAWE	402	50	37,767	18,884	24,658	3,469	1,734.5	2,034.7	213	106.5	106.5
	TANDALE	504	9	64,155	5,774		3,335	300.2		0	0.0	
112	MANZESE	508	2	59,856	1,197	4,293	2,138	42.8	408.3	0	0.0	4.4
	UBUNGO	509	6	51,598	3,096		6,092	365.5		74	4.4	
113	MANZESE	508	2	59,856	1,197	4,293	2,138	42.8	408.3	0	0.0	4.4
	UBUNGO	509	6	51,598	3,096		6,092	365.5		74	4.4	
114	MANZESE	508	4	59,856	2,394	3,426	2,138	85.5	207.4	0	0.0	1.5
	UBUNGO	509	2	51,598	1,032		6,092	121.8		74	1.5	
115	MSASANI	301	21	56,335	11,830	32,412	14,985	3,146.9	5,280.3	13	2.7	4.5
	KINONDONI	302	10	46,554	4,655		8,496	849.6		18	1.8	
	MWA'YMALA	303	20	79,636	15,927		6,419	1,283.8		0	0.0	
116	MSASANI	301	5	56,335	2,817	2,817	14,985	749.3	749.3	13	0.7	0.7
117	MSASANI	301	1	56,335	563	3,771	14,985	149.9	316.6	13	0.1	31.1
	TANDALE	504	5	64,155	3,208		3,335	166.8		0	0.0	
		1402	100	0	0		0	0.0		31	31.0	
118	MSASANI	301	2	56,335	1,127	1,127	14,985	299.7	299.7	13	0.3	0.3
		1404	100	0	0		0	0.0		0	0.0	
		1403	100	0	0		0	0.0		0	0.0	
120	MSASANI	301	5	56,335	2,817	7,472	14,985	749.3	1,598.9	13	0.7	2.5
	KINONDONI	302	10	46,554	4,655		8,496	849.6		18	1.8	
121	MSASANI	301	28	56,335	15,774	15,774	14,985	4,195.8	4,195.8	13	3.6	3.6
122	MSASANI	301	2	56,335	1,127	1,127	14,985	299.7	299.7	13	0.3	0.3
123	MSASANI	301	6	56,335	3,380	3,380	14,985	899.1	899.1	13	0.8	0.8
124	MSASANI	301	3	56,335	1,690	1,690	14,985	449.6	449.6	13	0.4	0.4
125	MSASANI	301	3	56,335	1,690	1,690	14,985	449.6	449.6	13	0.4	0.4
126	MSASANI	301	2	56,335	1,127	1,127	14,985	299.7	299.7	13	0.3	0.3
127	MSASANI	301	2	56,335	1,127	1,127	14,985	299.7	299.7	13	0.3	0.3
128	MSASANI	301	2	56,335	1,127	5,782	14,985	299.7	1,149.3	13	0.3	2.1
	KINONDONI	302	10	46,554	4,655		8,496	849.6		18	1.8	
129	MSASANI	301	2	56,335	1,127	5,782	14,985	299.7	1,149.3	13	0.3	2.1
	KINONDONI	302	10	46,554	4,655		8,496	849.6		18	1.8	
130	KINONDONI	302	18	46,554	8,380	8,380	8,496	1,529.3	1,529.3	18	3.2	3.2
131	KINONDONI	302	32	46,554	14,897	14,897	8,496	2,718.7	2,718.7	18	5.8	5.8
133	UP'A EAST	116	18	10,771	1,939	6,077	4,093	736.7	1,789.0	0	0.0	7.6
	UP'A WEST	117	7	12,103	847		4,599	321.9		0	0.0	
	KIVUKONI	118	40	5,900	2,360		1,401	560.4		18	7.2	
	KINONDONI	302	2	46,554	931		8,496	169.9		18	0.4	
134	JANGWANI	112	80	16,826	13,461	18,424	1,036	828.8	2,714.8	11	8.8	8.8
	UP'A EAST	116	9	10,771	969		4,093	368.4		0	0.0	
	UP'A WEST	117	33	12,103	3,994		4,599	1,517.7		0	0.0	
		1107	100	0	0		0	0.0		0	0.0	
		1104	35	0	0		0	0.0		0	0.0	

TABLE C.5.6 CONTINUED

(Unit : cu.m/day)

NODE No.	CONTRIBUTIONS			INSTITUTIONAL			COMMERCIAL			NODAL GRAND TOTAL
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL K	WARD CNTRBN L	NODE TOTAL M	WARD TOTAL N	WARD CNTRBN O	NODE TOTAL P	Q
102	MANZESE	508	2	0	0.0	566.4	0	0.0	31.6	1,010.7
	UBUNGO	509	6	124	7.4		526	31.6		
		1401	100	559	559.0		0	0.0		
103	MANZESE	508	4	0	0.0	2.5	0	0.0	10.5	221.8
	UBUNGO	509	2	124	2.5		526	10.5		
105	MSASANI	301	1	246	2.5	2.5	287	2.9	2.9	322.1
	TANDALE	504	5	0	0.0		0	0.0		
107	MAGOMENI	501	87	5	4.4	7.7	231	201.0	248.1	3,826.0
	NDUGUMBI	503	32	8	2.6		77	24.6		
	MZIMUNI	505	78	0	0.0		0	0.0		
	KIGOGO	506	25	3	0.8		38	9.5		
		1508	100	0	0.0		13	13.0		
108	TANDALE	504	48	0	0.0	0.0	0	0.0	0.0	1,600.8
109	MANZESE	508	51	0	0.0	13.0	0	0.0	21.0	1,371.0
	UBUNGO	509	4	124	5.0		526	21.0		
		1505	50	16	8.0		0	0.0		
110	KAWE	402	50	465	232.5	232.5	182	91.0	91.0	2,331.3
	TANDALE	504	5	0	0.0		0	0.0		
111	KAWE	402	50	465	232.5	232.5	182	91.0	91.0	2,464.7
	TANDALE	504	9	0	0.0		0	0.0		
112	MANZESE	508	2	0	0.0	7.4	0	0.0	31.6	451.7
	UBUNGO	509	6	124	7.4		526	31.6		
113	MANZESE	508	2	0	0.0	7.4	0	0.0	31.6	451.7
	UBUNGO	509	6	124	7.4		526	31.6		
114	MANZESE	508	4	0	0.0	2.5	0	0.0	10.5	221.8
	UBUNGO	509	2	124	2.5		526	10.5		
115	MSASANI	301	21	246	51.7	86.6	287	60.3	205.1	5,576.4
	KINONDONI	302	10	209	20.9		552	55.2		
	MWA'YMALA	303	20	70	14.0		448	89.6		
116	MSASANI	301	5	246	12.3	12.3	287	14.4	14.4	776.6
117	MSASANI	301	1	246	2.5	2.5	287	2.9	2.9	353.1
	TANDALE	504	5	0	0.0		0	0.0		
		1402	100	0	0.0		0	0.0		
118	MSASANI	301	2	246	4.9	44.9	287	5.7	5.7	350.6
		1404	100	16	16.0		0	0.0		
		1403	100	24	24.0		0	0.0		
120	MSASANI	301	5	246	12.3	33.2	287	14.4	69.6	1,704.1
	KINONDONI	302	10	209	20.9		552	55.2		
121	MSASANI	301	28	246	68.9	68.9	287	80.4	80.4	4,348.7
122	MSASANI	301	2	246	4.9	4.9	287	5.7	5.7	310.6
123	MSASANI	301	6	246	14.8	14.8	287	17.2	17.2	931.9
124	MSASANI	301	3	246	7.4	7.4	287	8.6	8.6	465.9
125	MSASANI	301	3	246	7.4	7.4	287	8.6	8.6	465.9
126	MSASANI	301	2	246	4.9	4.9	287	5.7	5.7	310.6
127	MSASANI	301	2	246	4.9	4.9	287	5.7	5.7	310.6
128	MSASANI	301	2	246	4.9	25.8	287	5.7	60.9	1,238.1
	KINONDONI	302	10	209	20.9		552	55.2		
129	MSASANI	301	2	246	4.9	25.8	287	5.7	60.9	1,238.1
	KINONDONI	302	10	209	20.9		552	55.2		
130	KINONDONI	302	18	209	37.6	37.6	552	99.4	99.4	1,669.5
131	KINONDONI	302	32	209	66.9	66.9	552	176.6	176.6	2,968.0
133	UP'A EAST	116	18	217	39.1	324.4	9	1.6	51.8	2,172.7
	UP'A WEST	117	7	462	32.3		10	0.7		
	KIVUKONI	118	40	622	248.8		96	38.4		
	KINONDONI	302	2	209	4.2		552	11.0		
134	JANGWANI	112	80	8	6.4	191.4	109	87.2	116.5	3,031.5
	UP'A EAST	116	9	217	19.5		9	0.8		
	UP'A WEST	117	33	462	152.5		10	3.3		
		1107	100	13	13.0		0	0.0		
		1104	35	0	0.0		72	25.2		

TABLE C.5.6 NODAL DEMAND ALLOCATION FOR HYDRAULIC NETWORK ANALYSIS IN 1990

(Unit : person, cu. m/day)

NODE NO.	CONTRIBUTIONS			POPULATION			DOMESTIC			INDUSTRIAL		
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL B	WARD CNTRBN C	NODE TOTAL D	WARD TOTAL E	WARD CNTRBN F	NODE TOTAL G	WARD TOTAL H	WARD CNTRBN I	NODE TOTAL J
135	JANGWANI	112	13	16,826	2,187	8,121	1,036	134.7	1,698.6	11	1.4	24.9
	KARIAKOO	111	7	13,805	966		1,540	107.8		24	1.7	
	KISUTU	114	33	9,180	3,029		2,180	719.4		66	21.8	
	UP'A EAST	116	18	10,771	1,939		4,093	736.7		0	0.0	
136	KISUTU	114	30	9,180	2,754	2,754	2,180	654.0	654.0	66	19.8	19.8
137	KISUTU	114	7	9,180	643	4,090	2,180	152.6	1,462.4	66	4.6	4.6
	UP'A EAST	116	32	10,771	3,447		4,093	1,309.8		0	0.0	
138	KISUTU	114	20	9,180	1,836	2,131	2,180	436.0	506.1	66	13.2	14.1
	KIVUKONI	118	5	5,900	295		1,401	70.1		18	0.9	
		1106	60	0	0		0	0.0		0	0.0	
139	KIVUKONI	118	5	5,900	295	295	1,401	70.1	70.1	18	0.9	0.9
		1106	40	0	0		0	0.0		0	0.0	
		1103	90	0	0		0	0.0		0	0.0	
140	KIVUKONI	118	5	5,900	295	295	1,401	70.1	70.1	18	0.9	0.9
		1108	50	0	0		0	0.0		0	0.0	
		1103	10	0	0		0	0.0		0	0.0	
141	KINONDONI	302	8	46,554	3,724	3,724	8,496	679.7	679.7	18	1.4	1.4
142	UBUNGO	509	12	51,598	6,192	6,192	6,092	731.0	731.0	74	8.9	8.9
143	MAKURUMLA	502	75	59,299	44,474	86,886	4,070	3,052.5	5,897.8	0	0.0	0.0
	NDUGUMBI	503	68	35,954	24,449		2,811	1,911.5		0	0.0	
	TANDALE	504	28	64,155	17,963		3,335	933.8		0	0.0	
144	UP'A EAST	116	23	10,771	2,477	9,739	4,093	941.4	3,700.8	0	0.0	0.0
	UP'A WEST	117	60	12,103	7,262		4,599	2,759.4		0	0.0	
145	KIVUKONI	118	5	5,900	295	295	1,401	70.1	70.1	18	0.9	0.9
		1108	50	0	0		0	0.0		0	0.0	
146	JANGWANI	112	7	16,826	1,178	9,392	1,036	72.5	617.1	11	0.8	0.8
	MAGOMENI	501	13	18,610	2,419		1,021	132.7		0	0.0	
	MZIMUNI	505	22	26,343	5,795		1,872	411.8		0	0.0	
		1504	100	0	0		0	0.0		0	0.0	
147	MWA'YMALA	303	25	79,636	19,909	19,909	6,419	1,604.8	1,604.8	0	0.0	0.0
148	MWA'YMALA	303	30	79,636	23,891	23,891	6,419	1,925.7	1,925.7	0	0.0	0.0
150	MWA'YMALA	303	25	79,636	19,909	19,909	6,419	1,604.8	1,604.8	0	0.0	0.0
153	MSASANI	301	3	56,335	1,690	1,690	14,985	449.6	449.6	13	0.4	0.4
154	MSASANI	301	2	56,335	1,127	1,127	14,985	299.7	299.7	13	0.3	0.3
155	MSASANI	301	7	56,335	3,943	3,943	14,985	1,049.0	1,049.0	13	0.9	0.9
156	KISUTU	114	10	9,180	918	1,508	2,180	218.0	358.1	66	6.6	8.4
	KIVUKONI	118	10	5,900	590		1,401	140.1		18	1.8	
158	KIVUKONI	118	20	5,900	1,180	1,180	1,401	280.2	280.2	18	3.6	3.6
159	KIVUKONI	118	10	5,900	590	590	1,401	140.1	140.1	18	1.8	1.8
162	MSASANI	301	3	56,335	1,690	1,690	14,985	449.6	449.6	13	0.4	0.4
201	UBUNGO	509	17	51,598	8,772	8,772	6,092	1,035.6	1,035.6	74	12.6	12.6
202	UBUNGO	509	13	51,598	6,708	6,708	6,092	792.0	792.0	74	9.6	9.6
203	UBUNGO	509	10	51,598	5,160	5,160	6,092	609.2	609.2	74	7.4	7.4
204	UBUNGO	509	2	51,598	1,032	1,032	6,092	121.8	121.8	74	1.5	1.5
205	UBUNGO	509	2	51,598	1,032	1,032	6,092	121.8	121.8	74	1.5	16.5
		1506	100	0	0		0	0.0		15	15.0	
206	MANZESE	508	35	59,856	20,950	20,950	2,138	748.3	748.3	0	0.0	391.5
		1501	50	0	0		0	0.0		783	391.5	
207	UBUNGO	509	10	51,598	5,160	5,160	6,092	609.2	609.2	74	7.4	37.4
		1503	75	0	0		0	0.0		40	30.0	
208	MABIBO	507	32	50,481	16,154	16,154	2,908	930.6	930.6	0	0.0	14.0
		1505	50	0	0		0	0.0		0	0.0	
		1507	100	0	0		0	0.0		14	14.0	
209	TABATA	104	6	20,280	1,217	3,290	529	31.7	151.5	6	0.4	0.4
	KINYEREZI	105	10	536	54		34	3.4		0	0.0	
	MABIBO	507	4	50,481	2,019		2,908	116.3		0	0.0	
210	TABATA	104	6	20,280	1,217	3,290	529	31.7	151.5	6	0.4	0.4
	KINYEREZI	105	10	536	54		34	3.4		0	0.0	
	MABIBO	507	4	50,481	2,019		2,908	116.3		0	0.0	

TABLE C.5.6 CONTINUED

(Unit : cu.m/day)

NODE No.	CONTRIBUTIONS			INSTITUTIONAL			COMMERCIAL			NODAL GRAND TOTAL
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL K	WARD CNTRBN L	NODE TOTAL M	WARD TOTAL N	WARD CNTRBN O	NODE TOTAL P	Q
135	JANGWANI	112	13	8	1.0	127.7	109	14.2	371.5	2,222.7
	KARIAKOO	111	7	35	2.5		264	18.5		
	KISUTU	114	33	258	85.1		1,022	337.3		
	UP'A EAST	116	18	217	39.1		9	1.6		
136	KISUTU	114	30	258	77.4	77.4	1,022	306.6	306.6	1,057.8
137	KISUTU	114	7	258	18.1	87.5	1,022	71.5	74.4	1,628.9
	UP'A EAST	116	32	217	69.4		9	2.9		
138	KISUTU	114	20	258	51.6	82.7	1,022	204.4	224.2	827.1
	KIVUKONI	118	5	622	31.1		96	4.8		
		1106	60	0	0.0		25	15.0		
139	KIVUKONI	118	5	622	31.1	31.1	96	4.8	99.4	201.5
		1106	40	0	0.0		25	10.0		
		1103	90	0	0.0		94	84.6		
140	KIVUKONI	118	5	622	31.1	37.1	96	4.8	14.2	122.3
		1108	50	12	6.0		0	0.0		
		1103	10	0	0.0		94	9.4		
141	KINONDONI	302	8	209	16.7	16.7	552	44.2	44.2	742.0
142	UBUNGO	509	12	124	14.9	14.9	526	63.1	63.1	817.9
143	MAKURUMLA	502	75	0	0.0	5.4	11	8.3	60.6	5,963.8
	NDUGUMBI	503	68	8	5.4		77	52.4		
	TANDALE	504	28	0	0.0		0	0.0		
144	UP'A EAST	116	23	217	49.9	327.1	9	2.1	8.1	4,036.0
	UP'A WEST	117	60	462	277.2		10	6.0		
145	KIVUKONI	118	5	622	31.1	37.1	96	4.8	4.8	112.9
		1108	50	12	6.0		0	0.0		
146	JANGWANI	112	7	8	0.6	30.2	109	7.6	37.7	685.7
	MAGOMENI	501	13	5	0.7		231	30.0		
	MZIMUNI	505	22	0	0.0		0	0.0		
		1504	100	29	29.0		0	0.0		
147	MWA'YMALA	303	25	70	17.5	17.5	448	112.0	112.0	1,734.3
148	MWA'YMALA	303	30	70	21.0	21.0	448	134.4	134.4	2,081.1
150	MWA'YMALA	303	25	70	17.5	17.5	448	112.0	112.0	1,734.3
153	MSASANI	301	3	246	7.4	7.4	287	8.6	8.6	465.9
154	MSASANI	301	2	246	4.9	4.9	287	5.7	5.7	310.6
155	MSASANI	301	7	246	17.2	17.2	287	20.1	20.1	1,087.2
156	KISUTU	114	10	258	25.8	88.0	1,022	102.2	111.8	566.3
	KIVUKONI	118	10	622	62.2		96	9.6		
158	KIVUKONI	118	20	622	124.4	124.4	96	19.2	19.2	427.4
159	KIVUKONI	118	10	622	62.2	62.2	96	9.6	9.6	213.7
162	MSASANI	301	3	246	7.4	7.4	287	8.6	8.6	465.9
201	UBUNGO	509	17	124	21.1	21.1	526	89.4	89.4	1,158.7
202	UBUNGO	509	13	124	16.1	16.1	526	68.4	68.4	886.1
203	UBUNGO	509	10	124	12.4	12.4	526	52.6	52.6	681.6
204	UBUNGO	509	2	124	2.5	2.5	526	10.5	10.5	136.3
205	UBUNGO	509	2	124	2.5	2.5	526	10.5	10.5	151.3
		1506	100	0	0.0		0	0.0		
206	MANZESE	508	35	0	0.0	0.0	0	0.0	0.0	1,139.8
		1501	50	0	0.0		0	0.0		
207	UBUNGO	509	10	124	12.4	12.4	526	52.6	52.6	711.6
		1503	75	0	0.0		0	0.0		
208	MABIBO	507	32	1	0.3	8.3	15	4.8	4.8	957.7
		1505	50	16	8.0		0	0.0		
		1507	100	0	0.0		0	0.0		
209	TABATA	104	6	4	0.2	0.3	39	2.3	3.0	155.1
	KINYEREZI	105	10	0	0.0		1	0.1		
	MABIBO	507	4	1	0.0		15	0.6		
210	TABATA	104	6	4	0.2	0.3	39	2.3	3.0	155.1
	KINYEREZI	105	10	0	0.0		1	0.1		
	MABIBO	507	4	1	0.0		15	0.6		

TABLE C.5.6 NODAL DEMAND ALLOCATION FOR HYDRAULIC NETWORK ANALYSIS IN 1990

(Unit : person, cu. m/day)

NODE NO.	CONTRIBUTIONS			POPULATION			DOMESTIC			INDUSTRIAL		
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL B	WARD CNTRBN C	NODE TOTAL D	WARD TOTAL E	WARD CNTRBN F	NODE TOTAL G	WARD TOTAL H	WARD CNTRBN I	NODE TOTAL J
211	UKONGA	101	85	49,647	42,200	42,200	1,202	1,021.7	1,021.7	6	5.1	5.1
	PUGU	102	100	0	0		0	0.0		0	0.0	
		1109	100	0	0		0	0.0		0	0.0	
212	UKONGA	101	15	49,647	7,447	9,879	1,202	180.3	241.7	6	0.9	8.4
	KIPAWA	109	6	40,538	2,432		1,024	61.4		125	7.5	
213	KIPAWA	109	6	40,538	2,432	2,432	1,024	61.4	61.4	125	7.5	7.5
214	VINGUGUTI	108	6	37,002	2,220	8,301	935	56.1	209.7	0	0.0	18.8
	KIPAWA	109	15	40,538	6,081		1,024	153.6		125	18.8	
215	VINGUGUTI	108	6	37,002	2,220	8,301	935	56.1	209.7	0	0.0	18.8
	KIPAWA	109	15	40,538	6,081		1,024	153.6		125	18.8	
216	VINGUGUTI	108	66	37,002	24,421	26,853	935	617.1	678.5	0	0.0	15.7
	KIPAWA	109	6	40,538	2,432		1,024	61.4		125	7.5	
		1210	40	0	0		0	0.0		17	6.8	
		1211	10	0	0		0	0.0		14	1.4	
217	VINGUGUTI	108	4	37,002	1,480	14,047	935	37.4	354.8	0	0.0	102.8
	KIPAWA	109	31	40,538	12,567		1,024	317.4		125	38.8	
		1204	80	0	0		0	0.0		80	64.0	
218	TABATA	104	44	20,280	8,923	8,923	529	232.8	232.8	6	2.6	2.6
220	BUGURUNI	110	10	52,990	5,299	5,299	4,837	483.7	483.7	24	2.4	2.4
221	ILALA	106	34	38,493	13,088	23,686	3,810	1,295.4	2,262.8	15	5.1	9.9
	BUGURUNI	110	20	52,990	10,598		4,837	967.4		24	4.8	
222	BUGURUNI	110	10	52,990	5,299	5,299	4,837	483.7	483.7	24	2.4	2.4
223	ILALA	106	42	38,493	16,167	25,417	3,810	1,600.2	2,358.4	15	6.3	317.8
	MCH'CHINI	107	56	16,518	9,250		1,354	758.2		0	0.0	
		1101	50	0	0		0	0.0		410	205.0	
		1102	50	0	0		0	0.0		213	106.5	
224	MCH'CHINI	107	44	16,518	7,268	11,380	1,354	595.8	1,176.8	0	0.0	332.0
	GEREZANI	113	50	8,223	4,112		1,162	581.0		41	20.5	
		1101	50	0	0		0	0.0		410	205.0	
		1104	65	0	0		0	0.0		0	0.0	
		1102	50	0	0		0	0.0		213	106.5	
225	KARIAKOO	111	8	13,805	1,104	11,642	1,540	123.2	2,515.9	24	1.9	7.7
	GEREZANI	113	14	8,223	1,151		1,162	162.7		41	5.7	
	MCHA'KOGE	115	100	9,387	9,387		2,230	2,230.0		0	0.0	
226	GEREZANI	113	22	8,223	1,809	13,543	1,162	255.6	1,564.6	41	9.0	29.4
	KARIAKOO	111	85	13,805	11,734		1,540	1,309.0		24	20.4	
228	BUGURUNI	110	44	52,990	23,316	23,316	4,837	2,128.3	2,128.3	24	10.6	10.6
229	UBUNGO	509	2	51,598	1,032	1,032	6,092	121.8	121.8	74	1.5	484.0
		1501	50	0	0		0	0.0		783	391.5	
		1505	0	0	0		0	0.0		0	0.0	
		1509	100	0	0		0	0.0		12	12.0	
		1502	100	0	0		0	0.0		79	79.0	
230	MABIBO	507	20	50,481	10,096	13,192	2,908	581.6	947.1	0	0.0	14.4
	UBUNGO	509	6	51,598	3,096		6,092	365.5		74	4.4	
		1503	25	0	0		0	0.0		40	10.0	
231	TABATA	104	44	20,280	8,923	61,421	529	232.8	3,374.2	6	2.6	8.6
	MAKURUMLA	502	25	59,299	14,825		4,070	1,017.5		0	0.0	
	KIGOGO	506	75	23,308	17,481		1,281	960.8		8	6.0	
	MABIBO	507	40	50,481	20,192		2,908	1,163.2		0	0.0	
232	YOMBO VIT	209	50	10,750	5,375	13,676	0	0.0	209.7	0	0.0	18.8
	VINGUGUTI	108	6	37,002	2,220		935	56.1		0	0.0	
	KIPAWA	109	15	40,538	6,081		1,024	153.6		125	18.8	
233	KINYEREZI	105	80	536	429	429	34	27.2	27.2	0	0.0	0.0
234	ILALA	106	8	38,493	3,079	5,199	3,810	304.8	498.3	15	1.2	2.2
	BUGURUNI	110	4	52,990	2,120		4,837	193.5		24	1.0	
240	GEREZANI	113	14	8,223	1,151	1,151	1,162	162.7	162.7	41	5.7	5.7
301	MIBURANI	212	13	80,058	10,408	30,322	3,984	517.9	1,449.0	0	0.0	0.0
	MTONI	214	46	43,292	19,914		2,024	931.0		0	0.0	
302	TEMEKE	213	5	100,104	5,005	6,888	6,591	329.6	466.6	1,314	65.7	72.3
	KEKO	215	4	47,082	1,883		3,427	137.1		166	6.6	

TABLE C.5.6 CONTINUED

(Unit : cu.m/day)

NODE No.	CONTRIBUTIONS			INSTITUTIONAL			COMMERCIAL			NODAL GRAND TOTAL
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL K	WARD CNTRBN L	NODE TOTAL M	WARD TOTAL N	WARD CNTRBN O	NODE TOTAL P	Q
211	UKONGA	101	85	31	26.4	26.4	10	8.5	20.5	1,073.7
	PUGU	102	100	0	0.0		0	0.0		
		1109	100	0	0.0		12	12.0		
212	UKONGA	101	15	31	4.7	13.1	10	1.5	6.4	269.6
	KIPAWA	109	6	140	8.4		82	4.9		
213	KIPAWA	109	6	140	8.4	8.4	82	4.9	4.9	82.3
214	VINGUGUTI	108	6	0	0.0	21.0	0	0.0	12.3	261.8
	KIPAWA	109	15	140	21.0		82	12.3		
215	VINGUGUTI	108	6	0	0.0	21.0	0	0.0	12.3	261.8
	KIPAWA	109	15	140	21.0		82	12.3		
216	VINGUGUTI	108	66	0	0.0	8.4	0	0.0	4.9	707.6
	KIPAWA	109	6	140	8.4		82	4.9		
		1210	40	0	0.0		0	0.0		
		1211	10	0	0.0		0	0.0		
217	VINGUGUTI	108	4	0	0.0	43.4	0	0.0	25.4	526.4
	KIPAWA	109	31	140	43.4		82	25.4		
		1204	80	0	0.0		0	0.0		
218	TABATA	104	44	4	1.8	1.8	39	17.2	17.2	254.3
220	BUGURUNI	110	10	29	2.9	2.9	113	11.3	11.3	500.3
221	ILALA	106	34	116	39.4	45.2	264	89.8	112.4	2,430.3
	BUGURUNI	110	20	29	5.8		113	22.6		
222	BUGURUNI	110	10	29	2.9	2.9	113	11.3	11.3	500.3
223	ILALA	106	42	116	48.7	48.7	264	110.9	110.9	2,835.8
	MCH'CHINI	107	56	0	0.0		0	0.0		
		1101	50	0	0.0		0	0.0		
		1102	50	0	0.0		0	0.0		
224	MCH'CHINI	107	44	0	0.0	18.0	0	0.0	112.8	1,639.6
	GEREZANI	113	50	36	18.0		132	66.0		
		1101	50	0	0.0		0	0.0		
		1104	65	0	0.0		72	46.8		
		1102	50	0	0.0		0	0.0		
225	KARIAKOO	111	8	35	2.8	7.8	264	21.1	39.6	2,571.0
	GEREZANI	113	14	36	5.0		132	18.5		
	MCHA'KOGE	115	100	0	0.0		0	0.0		
226	GEREZANI	113	22	36	7.9	37.7	132	29.0	253.4	1,885.2
	KARIAKOO	111	85	35	29.8		264	224.4		
228	BUGURUNI	110	44	29	12.8	12.8	113	49.7	49.7	2,201.3
229	UBUNGO	509	2	124	2.5	2.5	526	10.5	10.5	618.8
		1501	50	0	0.0		0	0.0		
		1505	0	16	0.0		0	0.0		
		1509	100	0	0.0		0	0.0		
		1502	100	0	0.0		0	0.0		
230	MABIBO	507	20	1	0.2	7.6	15	3.0	34.6	1,003.8
	UBUNGO	509	6	124	7.4		526	31.6		
		1503	25	0	0.0		0	0.0		
231	TABATA	104	44	4	1.8	4.4	39	17.2	54.4	3,441.7
	MAKURUMLA	502	25	0	0.0		11	2.8		
	KIGOGO	506	75	3	2.3		38	28.5		
	MABIBO	507	40	1	0.4		15	6.0		
232	YOMBO VIT	209	50	0	0.0	21.0	0	0.0	12.3	261.8
	VINGUGUTI	108	6	0	0.0		0	0.0		
	KIPAWA	109	15	140	21.0		82	12.3		
233	KINYEREZI	105	80	0	0.0	0.0	1	0.8	0.8	28.0
234	ILALA	106	8	116	9.3	10.4	264	21.1	25.6	536.5
	BUGURUNI	110	4	29	1.2		113	4.5		
240	GEREZANI	113	14	36	5.0	5.0	132	18.5	18.5	191.9
301	MIBURANI	212	13	0	0.0	10.6	0	0.0	35.0	1,494.5
	MTONI	214	46	23	10.6		76	35.0		
302	TEMEKE	213	5	486	24.3	34.2	314	15.7	22.6	595.8
	KEKO	215	4	248	9.9		172	6.9		

TABLE C.5.6 NODAL DEMAND ALLOCATION FOR HYDRAULIC NETWORK ANALYSIS IN 1990

(Unit : person, cu.m/day)

NODE NO.	CONTRIBUTIONS			POPULATION			DOMESTIC			INDUSTRIAL		
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL B	WARD CNTRBN C	NODE TOTAL D	WARD TOTAL E	WARD CNTRBN F	NODE TOTAL G	WARD TOTAL H	WARD CNTRBN I	NODE TOTAL J
303	TEMEKE	213	8	100,104	8,008	8,008	6,591	527.3	527.3	1,314	105.1	130.6
		1208	20	0	0		0	0.0		30	6.0	
		1209	75	0	0		0	0.0		26	19.5	
304	VINGUGUTI	108	4	37,002	1,480	3,600	935	37.4	230.9	0	0.0	39.8
	BUGURUNI	110	4	52,990	2,120		4,837	193.5		24	1.0	
		1204	20	0	0		0	0.0		80	16.0	
		1210	60	0	0		0	0.0		17	10.2	
		1211	90	0	0		0	0.0		14	12.6	
305	MIBURANI	212	4	80,058	3,202	19,210	3,984	159.4	1,324.5	0	0.0	56.4
	KEKO	215	34	47,082	16,008		3,427	1,165.2		166	56.4	
306	KEKO	215	17	47,082	8,004	8,004	3,427	582.6	582.6	166	28.2	28.2
		1207	50	0	0		0	0.0		0	0.0	
307	ILALA	106	8	38,493	3,079	3,079	3,810	304.8	304.8	15	1.2	1.2
		1105	100	0	0		0	0.0		0	0.0	
308	VINGUGUTI	108	4	37,002	1,480	3,600	935	37.4	230.9	0	0.0	1.0
	BUGURUNI	110	4	52,990	2,120		4,837	193.5		24	1.0	
309	VINGUGUTI	108	4	37,002	1,480	3,600	935	37.4	230.9	0	0.0	1.0
	BUGURUNI	110	4	52,990	2,120		4,837	193.5		24	1.0	
		1212	60	0	0		0	0.0		0	0.0	
310	MIBURANI	212	4	80,058	3,202	10,578	3,984	159.4	521.9	0	0.0	1.8
	MTONI	214	15	43,292	6,494		2,024	303.6		0	0.0	
	KURASINI	216	3	29,408	882		1,964	58.9		59	1.8	
311	MIBURANI	212	4	80,058	3,202	5,261	3,984	159.4	296.8	0	0.0	4.1
	KURASINI	216	7	29,408	2,059		1,964	137.5		59	4.1	
		1202	100	0	0		0	0.0		0	0.0	
312	KURASINI	216	23	29,408	6,764	6,764	1,964	451.7	451.7	59	13.6	13.6
313	KURASINI	216	3	29,408	882	882	1,964	58.9	58.9	59	1.8	1.8
314	MTONI	214	15	43,292	6,494	6,494	2,024	303.6	303.6	0	0.0	0.0
315	VIJIBWENI	202	100	1,292	1,292	1,292	43	43.0	43.0	0	0.0	0.0
316	KIGAMBONI	201	100	26,064	26,064	26,064	856	856.0	856.0	11	11.0	151.0
		1201	100	0	0		0	0.0		140	140.0	
317	KURASINI	216	13	29,408	3,823	3,823	1,964	255.3	255.3	59	7.7	7.7
318	MIBURANI	212	11	80,058	8,806	26,825	3,984	438.2	1,624.6	0	0.0	236.5
	TEMEKE	213	18	100,104	18,019		6,591	1,186.4		1,314	236.5	
319	MIBURANI	212	3	80,058	2,402	2,402	3,984	119.5	119.5	0	0.0	0.0
320	KIPAWA	109	6	40,538	2,432	47,849	1,024	61.4	2,697.8	125	7.5	533.1
	TEMEKE	213	40	100,104	40,042		6,591	2,636.4		1,314	525.6	
	YOMBO VIT	209	50	10,750	5,375		0	0.0		0	0.0	
321	MIBURANI	212	9	80,058	7,205	12,855	3,984	358.6	769.8	0	0.0	19.9
	KEKO	215	12	47,082	5,650		3,427	411.2		166	19.9	
		1205	100	0	0		0	0.0		0	0.0	
322	KEKO	215	12	47,082	5,650	5,650	3,427	411.2	411.2	166	19.9	50.4
		1209	25	0	0		0	0.0		26	6.5	
		1207	50	0	0		0	0.0		0	0.0	
		1208	80	0	0		0	0.0		30	24.0	
323	MIBURANI	212	10	80,058	8,006	13,888	3,984	398.4	791.2	0	0.0	11.8
	KURASINI	216	20	29,408	5,882		1,964	392.8		59	11.8	
324	KURASINI	216	31	29,408	9,116	9,116	1,964	608.8	608.8	59	18.3	18.3
		1206	100	0	0		0	0.0		0	0.0	
		1203	100	0	0		0	0.0		0	0.0	
325	ILALA	106	8	38,493	3,079	12,966	3,810	304.8	1,024.5	15	1.2	36.1
	KEKO	215	21	47,082	9,887		3,427	719.7		166	34.9	
		1212	40	0	0		0	0.0		0	0.0	
326	TEMEKE	213	14	100,104	14,015	14,015	6,591	922.7	922.7	1,314	184.0	184.0
327	MIBURANI	212	22	80,058	17,613	17,613	3,984	876.5	876.5	0	0.0	0.0
328	MIBURANI	212	4	80,058	3,202	13,212	3,984	159.4	818.5	0	0.0	131.4
	TEMEKE	213	10	100,104	10,010		6,591	659.1		1,314	131.4	
329	MIBURANI	212	13	80,058	10,408	15,413	3,984	517.9	847.5	0	0.0	65.7
	TEMEKE	213	5	100,104	5,005		6,591	329.6		1,314	65.7	

TABLE C.5.6 CONTINUED

(Unit : cu.m/day)

NODE No.	CONTRIBUTIONS			INSTITUTIONAL			COMMERCIAL			NODAL GRAND TOTAL
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL K	WARD CNTRBN L	NODE TOTAL M	WARD TOTAL N	WARD CNTRBN O	NODE TOTAL P	Q
303	TEMEKE	213	8	486	38.9	38.9	314	25.1	25.1	721.9
		1208	20	0	0.0		0	0.0		
		1209	75	0	0.0		0	0.0		
304	VINGUGUTI	108	4	0	0.0	1.2	0	0.0	4.5	276.3
	BUGURUNI	110	4	29	1.2		113	4.5		
		1204	20	0	0.0		0	0.0		
		1210	60	0	0.0		0	0.0		
		1211	90	0	0.0		0	0.0		
305	MIBURANI	212	4	0	0.0	84.3	0	0.0	58.5	1,523.8
	KEKO	215	34	248	84.3		172	58.5		
306	KEKO	215	17	248	42.2	42.2	172	29.2	52.7	705.7
		1207	50	0	0.0		47	23.5		
307	ILALA	106	8	116	9.3	39.3	264	21.1	21.1	366.4
		1105	100	30	30.0		0	0.0		
308	VINGUGUTI	108	4	0	0.0	1.2	0	0.0	4.5	237.5
	BUGURUNI	110	4	29	1.2		113	4.5		
309	VINGUGUTI	108	4	0	0.0	1.2	0	0.0	11.7	244.7
	BUGURUNI	110	4	29	1.2		113	4.5		
		1212	60	0	0.0		12	7.2		
310	MIBURANI	212	4	0	0.0	8.3	0	0.0	13.9	545.8
	MTONI	214	15	23	3.5		76	11.4		
	KURASINI	216	3	161	4.8		82	2.5		
311	MIBURANI	212	4	0	0.0	137.3	0	0.0	5.7	444.0
	KURASINI	216	7	161	11.3		82	5.7		
		1202	100	126	126.0		0	0.0		
312	KURASINI	216	23	161	37.0	37.0	82	18.9	18.9	521.2
313	KURASINI	216	3	161	4.8	4.8	82	2.5	2.5	68.0
314	MTONI	214	15	23	3.5	3.5	76	11.4	11.4	318.5
315	VIJIBWENI	202	100	0	0.0	0.0	0	0.0	0.0	43.0
316	KIGAMBONI	201	100	22	22.0	22.0	4	4.0	4.0	1,033.0
		1201	100	0	0.0		0	0.0		
317	KURASINI	216	13	161	20.9	20.9	82	10.7	10.7	294.6
318	MIBURANI	212	11	0	0.0	87.5	0	0.0	56.5	2,005.1
	TEMEKE	213	18	486	87.5		314	56.5		
319	MIBURANI	212	3	0	0.0	0.0	0	0.0	0.0	119.5
320	KIPAWA	109	6	140	8.4	202.8	82	4.9	130.5	3,564.3
	TEMEKE	213	40	486	194.4		314	125.6		
	YOMBO VIT	209	50	0	0.0		0	0.0		
321	MIBURANI	212	9	0	0.0	29.8	0	0.0	91.6	911.1
	KEKO	215	12	248	29.8		172	20.6		
		1205	100	0	0.0		71	71.0		
322	KEKO	215	12	248	29.8	29.8	172	20.6	44.1	535.6
		1209	25	0	0.0		0	0.0		
		1207	50	0	0.0		47	23.5		
		1208	80	0	0.0		0	0.0		
323	MIBURANI	212	10	0	0.0	32.2	0	0.0	16.4	851.6
	KURASINI	216	20	161	32.2		82	16.4		
324	KURASINI	216	31	161	49.9	49.9	82	25.4	199.4	876.5
		1206	100	0	0.0		70	70.0		
		1203	100	0	0.0		104	104.0		
325	ILALA	106	8	116	9.3	61.4	264	21.1	62.0	1,183.9
	KEKO	215	21	248	52.1		172	36.1		
		1212	40	0	0.0		12	4.8		
326	TEMEKE	213	14	486	68.0	68.0	314	44.0	44.0	1,218.7
327	MIBURANI	212	22	0	0.0	0.0	0	0.0	0.0	876.5
328	MIBURANI	212	4	0	0.0	48.6	0	0.0	31.4	1,029.9
	TEMEKE	213	10	486	48.6		314	31.4		
329	MIBURANI	212	13	0	0.0	24.3	0	0.0	15.7	953.2
	TEMEKE	213	5	486	24.3		314	15.7		

TABLE C.5.6 NODAL DEMAND ALLOCATION FOR HYDRAULIC NETWORK ANALYSIS IN 1990

(Unit : person, cu.m/day)

NODE NO.	CONTRIBUTIONS			POPULATION			DOMESTIC			INDUSTRIAL		
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL B	WARD CNTRBN C	NODE TOTAL D	WARD TOTAL E	WARD CNTRBN F	NODE TOTAL G	WARD TOTAL H	WARD CNTRBN I	NODE TOTAL J
331	MTONI	214	24	43,292	10,390	12,792	2,024	485.8	605.3	0	0.0	0.0
	MIBURANI	212	3	80,058	2,402		3,984	119.5		0	0.0	
351	MBAGALA	207	70	44,883	31,418	31,418	1,304	912.8	912.8	4	2.8	2.8
352	MBAGALA	207	24	44,883	10,772	10,772	1,304	313.0	313.0	4	1.0	1.0
353	MBAGALA	207	6	44,883	2,693	2,693	1,304	78.2	78.2	4	0.2	0.2
	T O T A L					1,335,028			111,056			4,120

TABLE C.5.6 CONTINUED

(Unit : cu.m/day)

NODE No.	CONTRIBUTIONS			INSTITUTIONAL			COMMERCIAL			NODAL GRAND TOTAL
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL K	WARD CNTRBN L	NODE TOTAL M	WARD TOTAL N	WARD CNTRBN O	NODE TOTAL P	Q
331	MTONI	214	24	23	5.5	5.5	76	18.2	18.2	629.0
	MIBURANI	212	3	0	0.0		0	0.0		
351	MBAGALA	207	70	0	0.0	0.0	11	7.7	7.7	923.3
352	MBAGALA	207	24	0	0.0	0.0	11	2.6	2.6	316.6
353	MBAGALA	207	6	0	0.0	0.0	11	0.7	0.7	79.1
	T O T A L					4,854			5,697	125,727

TABLE C.5.7 PEAKING FACTOR IN 1990

Total Consumption at each Node ① (m3/day)	Daily Average Demand (m3/day)	Ratio of Hourly Maximum Demand to Daily Average Demand	Hourly Maximum Demand ② (m3/day)	Peaking Factor ②/①
125,727	182,000	1.47	268,400	2.13

TABLE C.5.8

DAR-ES-SALAAM NETWORK ANALYSIS - MAXIMUM DEMAND IN 1990

CONNECTOR RESULTS.

NODE	NODE	TYP	DIAM	CVALUE	LENGTH	FLOW.	VEL.	GRA.	LOSS
			=MM=		==M==	=CUM/D=	=M/S=	=1/1000=	==M=
100	101	H 2	1350.	110.	1820.	191248.3	1.55	1.80	3.27
100	102	H 2	800.	110.	1820.	-93.2	.00	.00	.00
101	104	H 2	1350.	110.	1030.	191248.1	1.55	1.80	1.85
102	103	H 2	700.	110.	2700.	-2250.6	-.07	-.01	-.03
104	105	H 2	1350.	110.	1900.	188343.7	1.52	1.75	3.32
105	106	H 2	1200.	105.	2500.	144206.1	1.48	2.06	5.16
105	108	H 2	750.	110.	1440.	9644.5	.25	.13	.18
105	110	H 2	525.	110.	35.	13193.2	.71	1.27	.04
105	150	H 2	450.	110.	1200.	20610.6	1.50	6.15	7.38
150	115	H 2	450.	110.	1300.	10557.4	.77	1.78	2.32
106	107	H 2	1200.	105.	3420.	94538.1	.97	.95	3.23
107	143	H 2	375.	80.	1435.	4762.8	.50	1.79	2.57
107	146	H 2	375.	80.	825.	16605.0	1.74	18.06	14.90
107	237	H 2	1050.	100.	2400.	65002.1	.87	.99	2.38
237	307	H 2	1050.	100.	1600.	65001.9	.87	.99	1.59
108	109	H 2	750.	115.	1810.	5263.6	.14	.04	.07
108	113	H 2	800.	115.	2280.	964.2	.02	.00	.00
109	142	H 2	375.	80.	900.	1885.7	.20	.32	.29
109	143	H 2	375.	80.	2315.	7968.7	.84	4.64	10.75
109	208	H 2	600.	115.	1530.	-7517.9	-.31	-.22	-.33
110	111	H 2	525.	115.	1535.	6559.8	.35	.32	.49
110	117	H 2	150.	95.	55.	1655.2	1.08	15.99	.88
111	112	H 2	825.	115.	940.	964.0	.02	.00	.00
111	114	H 2	525.	115.	3000.	333.7	.02	.00	.00
114	142	H 2	375.	80.	1220.	-139.7	-.01	-.00	-.00
115	116	H 2	150.	65.	2000.	803.5	.53	8.48	16.95
104	118	H 2	200.	115.	200.	2904.2	1.07	7.83	1.57
118	161	H 2	200.	115.	1600.	1848.9	.68	3.40	5.43
161	162	H 2	150.	115.	500.	1848.9	1.21	13.78	6.89
116	162	H 2	150.	65.	1700.	-854.4	-.56	-9.50	-16.14
115	117	H 2	200.	70.	2275.	-1208.3	-.45	-3.87	-8.81
115	120	H 2	450.	120.	1000.	39311.9	2.86	17.29	17.29
115	128	H 2	200.	70.	1370.	2431.4	.90	14.12	19.34
115	141	H 2	200.	70.	700.	6981.8	2.57	99.39	69.57
117	118	H 2	150.	65.	1900.	-306.8	-.20	-1.43	-2.71
120	121	H 2	250.	115.	1120.	10207.8	2.41	27.02	30.26
120	121	H 2	200.	110.	1120.	5429.4	2.00	27.05	30.29
121	124	H 2	200.	110.	1600.	2672.4	.98	7.29	11.66
120	128	H 2	450.	120.	400.	20037.6	1.46	4.97	1.99
121	122	H 2	200.	100.	1255.	3681.5	1.36	15.72	19.73
122	151	H 2	200.	110.	500.	3018.5	1.11	9.13	4.57
151	152	H 2	200.	110.	300.	1536.1	.57	2.62	.78
152	153	H 2	200.	110.	500.	2686.2	.99	7.36	3.68
153	123	H 2	150.	95.	1300.	1248.9	.82	9.50	12.35
151	154	H 2	150.	110.	800.	1482.4	.97	9.94	7.96
153	154	H 2	125.	80.	750.	442.8	.42	4.66	3.49
123	154	H 2	150.	110.	1200.	-1262.2	-.83	-7.39	-8.86
152	124	H 2	150.	80.	1200.	-1150.1	-.75	-11.21	-13.45
123	155	H 2	150.	80.	1500.	521.7	.34	2.60	3.89
155	124	H 2	150.	80.	1300.	-1799.1	-1.18	-25.65	-33.34

TABLE C.5.8

DAR-ES-SALAAM NETWORK ANALYSIS - MAXIMUM DEMAND IN 1990

CONNECTOR RESULTS.

NODE	NODE	TYP	DIAM	CVALUE	LENGTH	FLOW.	VEL.	GRA.	LOSS
			=MM=		===M==	=CUM/D=	=M/S=	=1/1000=	==M=
124	125	H 2	100.	75.	545.	-65.2	-.10	-.45	-.25
124	127	H 2	150.	80.	1800.	-1206.0	-.79	-12.24	-22.03
125	126	H 2	150.	80.	1040.	-1059.8	-.69	-9.63	-10.02
126	127	H 2	150.	80.	650.	-1489.9	-.98	-18.09	-11.76
127	128	H 2	200.	70.	700.	-3358.9	-1.24	-25.67	-17.97
128	129	H 2	300.	70.	950.	6308.1	1.03	11.44	10.86
128	131	H 2	150.	65.	1050.	2933.4	1.92	93.03	97.68
128	132	H 2	300.	100.	1430.	7225.9	1.18	7.60	10.87
129	126	H 2	100.	60.	2640.	232.9	.34	7.16	18.91
129	132	H 2	400.	110.	480.	70.7	.01	.00	.00
130	131	H 2	150.	65.	850.	40.7	.03	.03	.03
130	147	H 2	200.	70.	350.	-3604.3	-1.33	-29.25	-10.24
147	141	H 2	200.	70.	600.	-5397.9	-1.99	-61.75	-37.05
147	148	H 2	150.	115.	1600.	-1908.5	-1.25	-14.62	-23.39
148	149	H 2	150.	115.	400.	-6351.1	-4.16	-135.17	-54.07
149	150	H 2	200.	115.	950.	-6351.0	-2.34	-33.30	-31.63
131	129	H 2	150.	65.	725.	-3361.7	-2.20	-119.71	-86.79
132	133	H 2	400.	110.	200.	7297.2	.67	1.60	.32
133	144	H 2	300.	70.	1020.	2155.6	.35	1.57	1.60
133	137	H 2	150.	65.	1540.	187.4	.12	.57	.88
133	145	H 2	150.	65.	1740.	316.1	.21	1.51	2.63
134	160	H 2	400.	110.	500.	1978.7	.18	.14	.07
160	135	H 2	400.	110.	330.	6570.3	.61	1.32	.43
156	225	H 2	150.	75.	850.	-1578.5	-1.03	-22.69	-19.28
137	158	H 2	200.	75.	750.	828.5	.31	1.70	1.27
157	158	H 2	200.	75.	600.	326.5	.12	.30	.18
158	159	H 2	150.	75.	750.	242.6	.16	.71	.53
134	144	H 2	300.	70.	1025.	6460.2	1.06	11.95	12.25
134	146	H 2	400.	110.	1005.	-15141.2	-1.39	-6.17	-6.20
134	224	H 2	200.	90.	1160.	230.8	.09	.11	.13
135	136	H 2	150.	75.	640.	1085.7	.71	11.35	7.27
135	137	H 2	250.	80.	940.	4524.9	1.07	11.74	11.03
136	138	H 2	150.	65.	600.	779.1	.51	8.01	4.80
136	225	H 2	150.	65.	340.	-1951.5	-1.28	-43.77	-14.88
137	138	H 2	150.	65.	420.	406.5	.27	2.40	1.01
138	156	H 2	200.	70.	410.	-580.0	-.21	-1.00	-.41
139	156	H 2	200.	70.	250.	210.4	.08	.15	.04
139	157	H 2	200.	70.	350.	726.1	.27	1.51	.53
140	157	H 2	200.	70.	680.	-399.6	-.15	-.50	-.34
139	225	H 2	150.	65.	850.	-1366.6	-.90	-22.64	-19.25
140	159	H 2	150.	65.	1140.	138.5	.09	.33	.37
145	159	H 2	150.	65.	600.	75.1	.05	.11	.06
200	201	H 2	525.	115.	3650.	49381.5	2.64	13.46	49.13
200	202	H 2	525.	115.	3650.	2182.7	.12	.04	.15
200	210	H 2	600.	115.	5000.	12286.9	.50	.54	2.68
201	203	H 2	525.	115.	900.	46907.9	2.51	12.24	11.02
202	204	H 2	525.	115.	970.	290.0	.02	.00	.00
203	205	H 2	525.	115.	100.	42728.6	2.28	10.30	1.03
205	229	H 2	400.	115.	990.	3754.1	.35	.43	.43
205	207	H 2	525.	115.	460.	38651.3	2.07	8.56	3.94

TABLE C.5.8
DAR-ES-SALAAM NETWORK ANALYSIS - MAXIMUM DEMAND IN 1990

CONNECTOR RESULTS.

NODE	NODE	TYP	DIAM	CVALUE	LENGTH	FLOW.	VEL.	GRA.	LOSS
			=MM=		===M==	=CUM/D=	=M/S=	=1/1000=	==M=
206	229	H 2	400.	115.	985.	-2433.2	-.22	-.19	-.19
207	230	H 2	525.	115.	1125.	36800.6	1.97	7.81	8.79
207	236	H 2	600.	115.	800.	331.7	.01	.00	.00
236	209	H 2	600.	115.	3000.	330.8	.01	.00	.00
208	231	H 2	525.	115.	1970.	25094.3	1.34	3.85	7.58
208	230	H 2	525.	115.	1125.	-34657.5	-1.85	-6.99	-7.87
210	218	H 2	450.	110.	2700.	8735.6	.64	1.26	3.39
210	233	H 2	300.	95.	2920.	3220.2	.53	1.87	5.47
211	212	H 2	400.	110.	1890.	868.3	.08	.03	.06
211	233	H 2	300.	95.	2925.	-3160.4	-.52	-1.81	-5.29
212	213	H 2	150.	100.	1145.	175.7	.12	.23	.26
212	214	H 2	400.	110.	1875.	-7633.8	-.70	-1.74	-3.26
212	232	H 2	250.	100.	1895.	7750.8	1.83	21.03	39.85
215	216	H 2	400.	110.	1435.	-558.8	-.05	-.01	-.02
216	304	H 2	300.	100.	2385.	-2069.4	-.34	-.75	-1.79
217	232	H 2	250.	100.	1990.	-7191.9	-1.70	-18.31	-36.43
217	304	H 2	300.	100.	1655.	6068.2	.99	5.50	9.11
218	214	H 2	400.	110.	2100.	8192.7	.75	1.98	4.16
220	228	H 2	450.	110.	1025.	16678.9	1.21	4.16	4.26
220	231	H 2	525.	115.	1970.	-17746.9	-.95	-2.03	-3.99
221	222	H 2	300.	90.	645.	1068.0	.17	.27	.17
221	223	H 2	300.	90.	1625.	2639.5	.43	1.43	2.33
221	228	H 2	300.	100.	1270.	-8895.7	-1.46	-11.16	-14.18
223	224	H 2	300.	90.	1125.	-3414.3	-.56	-2.31	-2.60
224	241	H 2	300.	90.	900.	-4662.4	-.76	-4.11	-3.70
224	226	H 2	200.	90.	435.	-2021.2	-.74	-6.30	-2.74
225	240	H 2	250.	95.	400.	-1428.9	-.34	-1.01	-.41
226	240	H 2	250.	95.	675.	-4150.1	-.98	-7.28	-4.91
225	240	H 2	550.	115.	400.	-13758.1	-.67	-1.01	-.40
240	307	H 2	550.	115.	1675.	-35207.1	-1.72	-5.74	-9.61
225	240	H 2	300.	100.	400.	-2429.6	-.40	-1.01	-.40
240	325	H 2	300.	100.	1600.	-7.9	.00	.00	.00
240	241	H 2	300.	90.	350.	8053.3	1.32	11.29	3.95
240	241	H 2	250.	90.	350.	4985.7	1.18	11.30	3.95
135	241	H 2	250.	90.	600.	-3785.2	-.89	-6.79	-4.07
160	241	H 2	250.	90.	850.	-2950.7	-.70	-4.28	-3.64
160	241	H 2	200.	90.	850.	-1640.8	-.60	-4.28	-3.64
225	312	H 2	400.	110.	1245.	7231.4	.67	1.57	1.96
226	234	H 2	250.	100.	1775.	-1895.6	-.45	-1.55	-2.76
228	304	H 2	300.	100.	645.	3083.7	.50	1.57	1.01
234	304	H 2	250.	100.	1995.	-3040.8	-.72	-3.72	-7.43
300	331	H 2	375.	75.	50.	10578.7	1.11	8.84	.44
331	301	H 2	375.	75.	1515.	6917.9	.72	4.03	6.10
331	310	H 2	250.	70.	2415.	2318.2	.55	4.36	10.53
301	321	H 2	375.	75.	1895.	1404.0	.15	.21	.40
302	303	H 2	200.	75.	700.	-1623.7	-.60	-5.89	-4.12
303	309	H 2	200.	75.	800.	-3164.8	-1.17	-20.24	-16.19
302	322	H 2	150.	65.	1100.	-271.5	-.18	-1.14	-1.25
304	308	H 2	550.	115.	275.	-2770.0	-.13	-.05	-.01
304	309	H 2	300.	100.	420.	6221.8	1.02	5.76	2.42

TABLE C.5.8

DAR-ES-SALAAM NETWORK ANALYSIS - MAXIMUM DEMAND IN 1990

CONNECTOR RESULTS.

NODE	NODE	TYP	DIAM	CVALUE	LENGTH	FLOW.	VEL.	GRA.	LOSS
			=MM=		===M==	=CUM/D=	=M/S=	=1/1000=	==M=
305	306	H 2	375.	75.	600.	-6864.5	-.72	-3.97	-2.38
305	311	H 2	200.	70.	1415.	1116.4	.41	3.35	4.73
305	321	H 2	375.	75.	1475.	2495.0	.26	.61	.90
306	307	H 2	375.	75.	700.	-9785.9	-1.03	-7.65	-5.36
306	322	H 2	150.	65.	850.	1414.9	.93	24.15	20.52
308	307	H 2	550.	115.	2325.	-19226.7	-.94	-1.87	-4.36
308	326	H 2	350.	115.	1100.	15949.5	1.92	11.98	13.18
309	325	H 2	300.	100.	2600.	2534.7	.42	1.09	2.85
310	311	H 2	250.	70.	1125.	-404.7	-.10	-.17	-.19
310	314	H 2	250.	80.	1600.	1557.8	.37	1.63	2.61
311	312	H 2	200.	70.	2485.	-236.2	-.09	-.19	-.47
312	323	H 2	400.	110.	1050.	3382.5	.31	.39	.40
312	324	H 2	200.	70.	1600.	2499.9	.92	14.86	23.78
313	314	H 2	200.	100.	950.	1419.2	.52	2.70	2.56
313	330	H 2	400.	110.	1900.	-1564.4	-.14	-.09	-.18
330	323	H 2	400.	110.	1450.	-1564.4	-.14	-.09	-.13
314	315	H 2	200.	100.	1000.	2296.9	.85	6.57	6.57
317	324	H 2	200.	70.	1365.	-628.8	-.23	-1.16	-1.58
321	328	H 2	150.	80.	650.	1954.1	1.28	29.88	19.42
320	328	H 2	150.	85.	1100.	98.5	.06	.11	.12
302	328	H 2	150.	85.	1150.	298.0	.20	.82	.95
328	329	H 2	150.	65.	1100.	151.9	.10	.39	.43
301	329	H 2	150.	85.	550.	2323.8	1.52	36.81	20.24
302	320	H 2	150.	115.	1500.	325.4	.21	.55	.83
320	318	H 2	200.	75.	800.	1004.6	.37	2.42	1.94
326	320	H 2	350.	115.	1200.	13347.9	1.61	8.62	10.35
320	318	H 2	350.	115.	1400.	4961.2	.60	1.38	1.93
318	327	H 2	350.	115.	900.	2126.3	.26	.29	.26
327	319	H 2	350.	115.	600.	255.0	.03	.01	.00
350	351	H 2	200.	115.	4015.	2646.8	.98	6.59	26.48
350	353	H 2	75.	115.	5000.	168.9	.44	4.82	24.08
351	352	H 2	150.	65.	985.	675.8	.44	6.15	6.06
315	316	H 2	200.	75.	3600.	2205.2	.81	10.37	37.35
103	203	H 2	100.	110.	60.	-2724.2	-4.01	-220.83	-13.25
106	115	H 2	300.	110.	20.	49667.3	8.13	225.44	4.51
318	329	H 2	150.	65.	500.	-440.9	-.29	-2.79	-1.40

TABLE C.5.8
DAR-ES-SALAAM NETWORK ANALYSIS - MAXIMUM DEMAND IN 1990

NODE RESULTS.

NODE	REL. HEAD(M.)	HEAD(M.)	SUPPLY(CUM./DAY.-VE IN)
100	.800	63.300	-191155.100
200	9.400	135.900	-63851.050
300	2.500	41.000	-10578.750
350	60.000	98.500	-2815.680
101	22.052	60.052	.141
102	25.300	63.300	2157.367
103	5.332	63.332	473.658
104	35.214	58.214	.219
105	34.919	54.919	689.320
106	34.803	49.803	.676
107	29.601	46.601	8168.302
108	28.140	54.740	3416.767
109	16.673	54.673	2927.043
110	34.875	54.875	4978.207
111	21.088	54.388	5262.032
112	16.387	54.387	964.026
113	16.738	54.738	964.183
114	-3.616	54.384	473.423
115	30.340	45.340	11904.150
116	25.666	28.666	1657.850
117	34.009	54.009	753.787
118	33.672	56.672	748.448
120	15.742	28.242	3637.238
121	-9.626	-1.626	9283.252
122	-25.072	-21.072	662.978
123	-51.108	-42.108	1989.311
124	-17.108	-13.108	994.460
125	-16.868	-12.868	994.556
126	-7.512	-3.012	663.024
127	.562	8.562	663.018
128	12.279	26.279	2642.684
129	9.558	15.558	2642.814
130	-85.996	-69.996	3563.623
131	-78.524	-70.024	6335.742
132	12.558	15.558	-.561
133	9.243	15.243	4638.086
134	13.256	25.756	6471.483
135	15.257	25.257	4744.906
136	7.609	18.109	2258.143
137	8.376	14.376	3477.260
138	6.385	13.385	1765.612
139	7.323	13.823	430.121
140	7.970	12.970	261.078
141	-38.844	-23.344	1583.925
142	6.387	54.387	1746.005
143	18.065	44.065	12731.500
144	3.167	13.667	8615.832
145	9.165	12.665	241.014
146	25.878	31.878	1463.736
147	-75.902	-59.902	3702.136

TABLE C.5.8

DAR-ES-SALAAM NETWORK ANALYSIS - MAXIMUM DEMAND IN 1990

NODE RESULTS.

NODE	REL. HEAD(M.)	HEAD(M.)	SUPPLY(CUM./DAY.-VE IN)
148	-59.887	-36.887	4442.548
149	-4.565	16.435	-.093
150	35.628	47.628	3702.239
151	-28.567	-25.567	-.037
152	-31.340	-26.340	-.032
153	-35.962	-29.962	994.556
154	-39.393	-33.393	663.030
155	-51.935	-45.935	2320.864
156	7.286	13.786	1208.876
157	6.804	13.304	-.017
158	6.626	13.126	912.358
159	7.603	12.603	456.196
160	15.686	25.686	-.091
161	42.327	51.327	-.020
162	41.545	44.545	994.564
201	-1.218	87.282	2473.596
202	47.249	135.749	1892.750
203	18.382	76.382	1455.080
204	77.748	135.748	289.968
205	22.863	75.363	323.155
206	40.756	74.756	2433.151
207	18.971	71.471	1519.061
208	19.499	54.999	2045.353
209	21.468	71.468	330.802
210	62.756	133.256	331.110
211	66.152	122.652	2292.098
212	69.595	122.595	575.579
213	68.337	122.337	175.691
214	77.108	125.808	558.886
215	-12.128	36.572	558.841
216	-1.108	36.592	1510.534
217	12.037	47.337	1123.757
218	86.909	129.909	542.878
220	23.564	43.564	1068.050
221	-.637	25.363	5188.170
222	5.192	25.192	1068.016
223	3.069	23.069	6053.813
224	9.627	25.627	3500.137
225	21.270	32.770	5488.709
226	11.825	28.325	4024.478
228	5.356	39.356	4699.409
229	26.943	74.943	1320.948
230	17.778	62.778	2143.056
231	19.508	47.508	7347.401
232	34.280	83.280	558.889
233	47.867	127.867	59.775
234	9.539	31.039	1145.245
236	21.470	71.470	.866
237	22.245	44.245	.172
240	20.169	33.169	409.240

TABLE C.5.8
DAR-ES-SALAAM NETWORK ANALYSIS - MAXIMUM DEMAND IN 1990

NODE RESULTS.

NODE	REL. HEAD(M.)	HEAD(M.)	SUPPLY(CUM./DAY.-VE IN)
241	16.270	29.270	.014
301	2.043	34.543	3190.107
302	-10.048	15.952	1271.883
303	-9.990	20.010	1541.089
304	5.057	38.357	589.941
305	17.537	35.037	3253.122
306	18.887	37.387	1506.562
307	23.675	42.675	782.185
308	3.771	38.371	507.158
309	1.170	35.970	522.279
310	7.688	30.188	1165.187
311	13.879	30.379	947.830
312	22.840	30.840	1112.757
313	14.637	30.137	145.210
314	19.618	27.618	680.031
315	61.149	71.149	91.754
316	21.864	34.364	2205.180
317	-9.647	5.853	628.845
318	-27.269	13.231	4280.503
319	-25.528	12.972	255.046
320	-18.863	15.137	7608.973
321	13.150	34.150	1944.875
322	-6.318	17.182	1143.387
323	17.942	30.442	1818.070
324	-9.095	7.405	1871.072
325	14.169	33.169	2526.767
326	-9.649	25.351	2601.623
327	-27.024	12.976	1871.209
328	-10.977	15.023	2198.569
329	-17.397	14.603	2034.820
330	13.310	30.310	.018
331	3.564	40.564	1342.601
351	13.932	72.432	1970.989
352	4.972	66.472	675.831
353	13.413	74.913	168.860

TABLE C.5.9 NETWORK MODEL CALIBRATION FOR 3 AUG 1990

NODE NUMBER	MEASURED TOTAL HEAD (m) A	MODELLED TOTAL HEAD (m) B	TOTAL %age ERROR C	ACTUAL %age ERROR
101	44.00	60.05	36.5	
102	61.00	63.30	3.8	3.8
105	51.00	54.92	7.7	7.7
107	47.00	46.60	0.9	0.9
108	42.50	54.74	28.8	
109	38.90	54.67	40.5	
111	34.00	54.38	59.9	
115	33.00	45.34	37.4	37.4
128	33.00	26.28	20.4	20.4
133	17.00	15.24	10.4	10.4
134	26.00	25.76	0.9	0.9
135	27.00	25.26	6.4	6.4
137	17.00	14.38	15.4	15.4
142	56.00	54.39	2.9	2.9
143	35.00	44.07	25.9	25.9
146	30.00	31.88	6.3	6.3
208	30.00	55.00	83.3	
220	46.00	43.56	5.3	5.3
223	23.00	23.07	0.3	0.3
224	18.00	25.63	42.4	
305	36.00	35.04	2.7	2.7
307	40.00	42.68	6.7	6.7
308	38.00	38.38	1.0	1.0
325	36.00	33.17	7.9	7.9
	N U M B E R		24	18
	M I N I M U M		0.3	0.3
	M A X I M U M		83.3	37.4
	A V E R A G E		18.9	9.0

C=ABS((A-B)/A)*100

D.

APPENDIX TO CHAPTER 5

D. APPENDIX TO CHAPTER 5 *

1 1995 WATER DEMAND

1.1 1995 PROJECTED POPULATION

The future population levels in DSM are estimated so as to determine the water demand in 1995, when the rehabilitation of the water supply system will be complete and the system is fully functional.

The Tanzanian government has conducted the national population survey once a decade since independence. The results of this survey are tabulated by regions and published in the Census report. To date, 3 census have been conducted and the results published in 1967, 1978 and 1988. Prior to this, the population levels of Dar-es-Salaam were estimated and published in 1957. The salient features of the census reports are listed below :

Year	Population	Intercensual Growth Rate	Decrease in Growth Rate
1967	325,628		
1978	843,090	8.15 %	
1988	1,360,850	4.90 %	3.25 %

Future projections of population levels is usually estimated from the past trend of population growth. In Dar-es-Salaam, as well as in the rest of Tanzania, only three population survey results are available, and this is insufficient for full-fledged statistical analysis for the determination of the population growth pattern, whereby the population and growth rate data is tested for best fit with different kinds of mathematical functions - linear, exponential, logarithmic, polynomial, etc.

In the tabulation given above, it can be seen that the growth rate is decreasing in the intervening, intercensual period, with the annual average growth rate for the decade being 8.15 % for the period 1967-1978 and 4.9 % for the period 1978-1988. This trend is commonly the case for most cities in the world. The difference in the percentage growth rate between the two intervening periods is 3.25 %.

To project the population of DSM, it is assumed that the decrease in the population growth rate between any two census periods halves itself, i.e., the decrease in the population growth rate in a subsequent period is half the decrease experienced during the preceding period.

---

* The contents of this section is summarized in section 5.3.2 "1995 water demand", Main Report. They are also used for "hydraulic analysis", the following section.

The population levels and growth rates in the future, based on this assumption, are given in the tabulation below :

Year	Population	Intercensus growth rate	Decrease in growth rate
1967	325,628		
1978	843,090	8.15 %	
1988	1,360,850	4.90 %	3.25 %
1998	1,877,500	3.27 %	1.63 %
2008	2,392,800	2.45 %	0.81 %
2018	2,929,800	2.05 %	0.41 %

Figure D.1.1 gives the graphic description of the current and the future projected population levels and growth rates in the intervening, intercensual period, based on the analysis described above. It can be seen in Figure D.1.1 that while the population levels show a linear increase, the growth rate curve is an exponentially declining one.

It was derived above that the population growth rate in DSM is 3.27 % for the decade 1988-1998. To provide a margin of safety, a population growth rate of 3.50 % is assumed to be the annual average growth rate from 1990 to 1995. The total population of Dar-es-Salaam in 1995 is calculated to be 1,731,381.

WARD-WISE POPULATION

The population density in the different areas and wards of DSM is not even, with large differences apparent between the wards in the city center on the one hand and the outlying areas on the other. To take this into account in apportioning the increase in population levels in the wards, the overall growth rate of 3.5 % for Dar-es-Salaam has been utilized.

On a ward-by-ward basis, the growth rate has been derived in such a way as to ensure that the total population estimated by these ward-by-ward growth rates matches with the total population calculated for Dar-es-Salaam overall. Table D.1.1 gives the projected ward population and the type of water connection in the year 1995.

Growth rate in wards having

Population Density (persons per km^2) > 10,000 - 1.4645896 %

5,000 < Population Density (persons per km^2) < 10,000 - 2.9291792 %

1,000 < Population Density (persons per km^2) < 5,000 - 4.3937688 %

Population Density (persons per km^2) < 1,000 - 5.8583584 %

1.2 WATER DEMAND

PER CAPITA CONSUMPTION

In general, per capita consumption is found to be higher depending upon the reliability of the supply, social and economic conditions, and whether there is a sewerage system. In Dar-es-Salaam, economic conditions seem to have hit the bottom and to have started rebounding, stimulated by the change in policy of the Government. This will certainly increase per capita consumption.

On the other hand, the reliability of the water supply and the sewerage system will remain at current levels, in terms of extent provided to customers, even though this rehabilitation project will result in higher reliability. This will restrain per capita consumption from increasing. Under these restrained conditions, increase in per capita consumption is not foreseeable, at least by the target year, 1995.

The per capita water consumption is, therefore, considered to remain at 1990 levels;

- house connection (high) 400 liters per capita per day
- house connection (middle) 250 " " " " "
- house connection (low) 160 " " " " "
- yard connection 85 " " " " "
- no connection 22 " " " " "

However, higher per capita consumption, especially for house connections, could be adopted for planning purposes, for example in the formulation of a master plan.

SERVICE LEVEL IMPROVEMENT

It is assumed that the proportion of house to yard to no connections within each ward in Dar-es-Salaam would not change between 1990 and 1995. The basis for this is that while there is upgrading of the water service level with time, a large portion of the increase in the population in Dar-es-Salaam would be due to migration (the other factor is natural : birth - death). A large majority of the migrants from the countryside to the urban areas start city life without connections, relying on kiosks and standpipes. It is assumed that this would largely balance out to result in an unchanged house to yard to no connection proportion. It is also assumed that the served area will not be extended since currently densely populated urban areas are mostly served with NUWA's distribution system. Costly distribution network extension work can be conducted under the overall water supply expansion programme.

INDUSTRIAL, COMMERCIAL AND INSTITUTIONAL WATER CONSUMPTION

Industrial, commercial and institutional water consumption in 1995 are assumed to increase by the GDP growth rate of the last 5 years.

WATER CONSUMPTION

Based on factors discussed above, the ward-wise domestic, industrial, commercial and institutional water consumption in 1995 is given in Table D.1.4. Total consumption in DSM will be 164,338 m^3/day (36 mgd) in 1995 on a daily average basis.

WATER DEMAND

Water demand in 1995 will vary depending upon leakage (and wastage) level of that year. If the leakage level in 1995 is maintained at the present level of 35 %, demand in 1995 will be (164,338 m^3/day)/(1-0.35) = 252,800 m^3/day. With this leakage level, water demand is larger than the projected supply to the city of 206,000 m^3/day on a daily average base.

Experience shows that leakage level rises with time. If leakage level deteriorate to 50 %, which is quite reasonable, water demand will be more than 1.5 times as high as the supply to the city, as shown in Table D.1.5. On the other hand, if leakage is controllable, the projected supply can meet the projected demand on a daily average basis. This controlled level, or the so-called break-even leakage level is 25%.

TABLE D.1.1 WARD POPULATION AND POPULATION ACCORDING TO SERVICE LEVEL BY WARD IN 1995

Sr. No.	Ward Name	Population	SERVED Population	Population Distribution by Service Level House Connection Class People(%)	Yard Connection People(%)	Kiosk/ Standpipe People(%)
ILALA Sub-branch						
101	Ukonga	67,335	67,335	L 6,734(10)	13,467(20)	47,134(70)
102	Pugu	9,274	-			
103	Msongola	19,888	-			
104	Tabata	24,950	24,950	L 3,743(15)	3,743(15)	17,464(70)
105	Kinyerezi	4,540	726	L 509(70)	73(10)	144(20)
106	Ilala	38,803	38,803	L 23,282(60)	11,641(30)	3,880(10)
107	Mchikichini	16,651	16,651	L 6,661(40)	6,661(40)	3,329(20)
108	Vingunguti	50,185	50,185	L 5,019(10)	5,019(10)	40,147(80)
109	Kipawa	49,873	49,873	L 4,987(10)	4,987(10)	39,899(80)
110	Buguruni	53,416	53,416	L 21,366(40)	16,025(30)	16,025(30)
111	Kariakoo	13,916	13,916	L 8,349(60)	2,783(20)	2,784(20)
112	Jangwani	16,961	16,961	L 2,544(15)	5,936(35)	8,481(50)
113	Gerezani	9,164	9,164	L 7,789(85)	1,375(15)	0(--)

TABLE D.1.1 CONTINUED

Sr. No.	Ward Name	Population	SERVED Population	Population Distribution by Service Level House Connection Class People(%)	Yard Connection People(%)	Kiosk/ Standpipe People(%)
114	Kisutu	9,253	9,253	M 9,253(100)	0(--)	0(--)
115	Mchafukoge	9,463	9,463	M 9,463(100)	0(--)	0(--)
116	Upanga East	12,003	12,003	H 12,003(100)	0(--)	0(--)
117	Upanga West	13,488	13,488	H 13,488(100)	0(--)	0(--)
118	Kivukoni	7,259	7,259	M 7,259(100)	0(--)	0(--)
	SUB-TOTAL	426,424	393,448	L 90,983(23) M 25,975(7) H 25,491(6)	71,710(18)	179,289(46)
TEMEKE SUB BRANCH						
201	Kigamboni	38,846	35,350	L 3,535(10)	10,605(30)	21,210(60)
202	Vijibweni	3,809	1,752	L 175(10)	526(30)	1,051(60)
203	Kibada	4,473	-			
204	Kisarawe 11	4,202	-			
205	Somangira	10,025	-			
206	Kimbiji	9,630	-			
207	Mbagala	55,218	55,218	L 2,761(5)	11,044(20)	41,413(75)
208	Chamazi	8,121	-			
209	Yombo Vituka	18,117	13,225	L 661(5)	2,645(20)	9,919(75)
210	Charambe	25,165	-			
211	Toangoma	9,909	-			
212	Miburani	98,492	98,492	L 19,698(20)	19,698(20)	59,096(60)
213	Temeke 14	123,154	123,154	L 36,946(30)	36,946(30)	49,262(40)
214	Mtoni	43,640	43,640	L 6,546(15)	10,910(25)	26,184(60)
215	Keko	63,857	63,857	L 22,350(35)	6,386(10)	35,121(55)
216	Kurasini	39,886	39,886	L 15,954(40)	3,989(10)	19,943(50)
	SUB-TOTAL	**556,547**	**474,576**	**L 108,626(23)**	**102,749(22)**	**263,201(55)**
KINONDONI SUB BRANCH						
301	Msasani	69,307	69,307	L 34,654(50) H 34,653(50)	0(--)	0(--)
302	Kinondoni	46,928	46,928	H 18,771(40)	14,078(30)	14,079(30)
303	Mwananyamala	80,276	80,276	L 20,069(25)	36,124(45)	24,083(30)
	SUB-TOTAL	**196,512**	**196,512**	**L 54,723(28)** **H 53,424(27)**	**50,202(26)**	**38,163(19)**
KAWE SUB BRANCH						
401	Goba	7,080	-			
402	Kawe	59,568	46,463	L 20,908(45)	9,293(20)	16,262(35)
403	Kunduchi	33,878	-			
404	Mbweni	3,216	-			
405	Bunju	14,862	-			
	SUB-TOTAL	**118,605**	**46,463**	**L 20,908(45)**	**9,293(20)**	**16,262(35)**
MAGOMENI SUB BRANCH						
501	Magomeni	22,895	22,895	L 4,579(20)	6,868(30)	11,448(50)
502	Makurumla	59,775	59,775	L 14,944(25)	14,944(25)	29,887(50)
503	Ndugumbi	36,243	36,243	L 10,873(30)	10,873(30)	14,497(40)
504	Tandale	64,671	64,671	L 6,467(10)	19,401(30)	38,803(60)
505	Mzumuni	26,555	26,555	L 5,311(20)	10,622(40)	10,622(40)
506	Kigogo	23,496	23,496	L 5,874(25)	8,223(35)	9,399(40)
507	Mabibo	50,887	50,887	L 15,266(30)	15,266(30)	20,355(40)
508	Manzese	60,338	60,338	L 3,017(5)	15,084(25)	42,237(70)
509	Ubungo	63,480	63,480	L 41,262(65)	12,696(20)	9,522(15)
510	Kibamba	24,953	-			
	SUB-TOTAL	**433,293**	**408,340**	**L 107,593(26)**	**113,977(28)**	**186,770(46)**
DAR ES SALAAM		**1,731,381**	**1,519,339**	**L 382,833(25)** **M 25,975(2)** **H 78,915(5)**	**347,931(23)**	**683,685(45)**

Note: Class L = Low, M = Middle, H = High

TABLE D.1.2 HOUSEHOLD ACCORDING TO SERVICE LEVEL BY WARD IN 1995

Sr.No. Ward	NUWA TOTAL Number class (%)	House Connection Number (%)	Yard Connection Number (%)	Kiosk/ Standpipe
ILALA Sub-branch				
101 Ukonga	15,085	1,509 L (10)	3,017 (20)	10,559 (70)
102 Pugu				
104 Tabata	5,108	766 L (15)	766 (15)	3,576 (70)
105 Kinyerezi	174	122 L (70)	17 (10)	35 (20)
106 Ilala	9,124	5,474 L (60)	2,737 (30)	913 (10)
107 Mchikichini	3,733	1,493 L (40)	1,493 (40)	747 (20)
108 Vingunguti	13,006	1,301 L (10)	1,301 (10)	10,404 (80)
109 Kipawa	12,542	1,254 L (10)	1,254 (10)	10,034 (80)
110 Buguruni	14,612	5,845 L (40)	4,384 (30)	4,383 (30)
111 Kariakoo	2,767	1,660 L (60)	553 (20)	554 (20)
112 Jangwani	3,220	483 L (15)	1,127 (35)	1,610 (50)
113 Gerezani	1,906	1,620 L (85)	286 (15)	0 (-)
114 Kisutu	1,881	1,881 M (100)	0 (-)	0 (-)
115 Mchafukoge	1,776	1,776 M (100)	0 (-)	0 (-)
116 Upanga East	920	920 H (100)	0 (-)	0 (-)
117 Upanga West	1,999	1,999 H (100)	0 (-)	0 (-)
118 Kivukoni	1,055	1,055 M (100)	0 (-)	0 (-)
SUB-TOTAL	88,908	21,527 L (24) 4,712 M (5) 2,919 H (3)	16,935 (19)	42,815 (48)
TEMEKE Sub-branch				
201 Kigamboni	8,400	840 L (10)	2,520 (30)	5,040 (60)
202 Vijibweni	356	36 L (10)	107 (30)	213 (60)
207 Mbagala	12,889	644 L (5)	2,578 (20)	9,667 (75)
209 Yombo Vituka	2,837	142 L (5)	567 (20)	2,128 (75)
212 Miburani	22,691	4,538 L (20)	4,538 (20)	13,615 (60)
213 Temeke 14	30,093	9,028 L (30)	9,028 (30)	12,037 (40)
214 Mtoni	10,789	1,618 L (15)	2,697 (25)	6,474 (60)
215 Keko	15,631	5,471 L (35)	1,563 (10)	8,597 (55)
216 Kurasini	8,612	3,445 L (40)	861 (10)	4,306 (50)
SUB-TOTAL	112,298	25,762 L (23)	24,459 (22)	62,077 (55)
KINONDONI Sub-branch				
301 Msasani	14,646	7,323 L (50) 7,323 H (50)	0 (-)	0 (-)
302 Kinondoni	10,547	4,219 H (40)	3,164 (30)	3,164 (30)
303 Mwananyamala	18,758	4,690 L (25)	8,441 (45)	5,627 (30)
SUB-TOTAL	43,951 11,542	12,013 L (27) H (26)	11,605 (26)	8,791 (20)
KAWE Sub-branch				
402 Kawe	11,095	4,993 L (45)	2,219 (20)	3,883 (35)
SUB-TOTAL	11,095	4,993 L (45)	2,219 (20)	3,883 (35)
MAGOMENI Sub-branch				
501 Magomeni	5,893	1,179 L (20)	1,768 (30)	2,946 (50)
502 Makurumla	14,378	3,595 L (25)	3,595 (25)	7,188 (50)
503 Ndugumbi	8,783	2,635 L (30)	2,635 (30)	3,513 (40)
504 Tandale	14,813	1,481 L (10)	4,444 (30)	8,888 (60)
505 Mzimuni	6,429	1,286 L (20)	2,572 (40)	2,571 (40)
506 Kigogo	5,196	1,299 L (25)	1,819 (35)	2,078 (40)
507 Mabibo	11,914	3,574 L (30)	3,574 (30)	4,766 (40)
508 Manzese	14,209	710 L (5)	3,552 (25)	9,947 (70)
509 Ubungo	12,865	8,362 L (65)	2,573 (20)	1,930 (15)
SUB-TOTAL	94,480	24,121 L (26)	26,532 (28)	43,827 (46)
DAR-ES-SALAAM	350,732	88,416 L (25) 4,712 M (1) 14,461 H (4)	81,750 (23)	161,393 (46)

Note: Class L = Low, M = Middle, H = High

TABLE D.1.3 DOMESTIC WATER CONSUMPTION BY WARD IN 1995

(Unit : m^3/day)

Sr. No.	Ward	House Connection	Class	Yard Connection	Kiosk/ Standpipe	TOTAL
ILALA Sub-branch						
101	Ukonga	1,077	L	1,145	1,037	3,259
102	Pugu					1,101
104	Tabata	599	L	318	384	1,301
105	Kinyerezi	81	L	6	3	90
106	Ilala	3,725	L	989	85	4,799
107	Mchikichini	1,066	L	566	73	1,705
108	Vingunguti	803	L	427	883	2,113
109	Kipawa	798	L	424	878	2,100
110	Buguruni	3,419	L	1,362	353	5,134
111	Kariakoo	1,336	L	237	61	1,634
112	Jangwani	407	L	505	187	1,099
113	Gerezani	1,246	L	117	0	1,363
114	Kisutu	2,313	M	0	0	2,313
115	Mchafukoge	2,366	M	0	0	2,366
116	Upanga East	4,801	H	0	0	4,801
117	Upanga West	5,395	H	0	0	5,395
118	Kivukoni	1,815	M	0	0	1,815
SUB-TOTAL		14,557	L	6,096	3,944	42,388
		6,494	M			
		10,196	H			
TEMEKE Sub-branch						
201	Kigamboni	566	L	901	467	1,934
202	Vijibweni	28	L	45	23	96
207	Mbagala	442	L	939	911	2,292
209	Yombo Vituka	106	L	225	218	549
212	Miburani	3,152	L	1,674	1,300	6,126
213	Temeke 14	5,911	L	3,140	1,084	10,135
214	Mtoni	1,047	L	927	576	2,550
215	Keko	3,576	L	543	773	4,892
216	Kurasini	2,553	L	339	439	3,331
SUB-TOTAL		17,381	L	8,733	5,791	31,905
KINONDONI Sub-branch						
301	Msasani	5,545	L	0	0	19,406
		13,861	H			
302	Kinondoni	7,508	H	1,197	310	9,015
303	Mwananyamala	3,211	L	3,071	530	6,812
SUB-TOTAL		8,756	L	4,268	840	35,233
		21,369	H			
KAWE Sub-branch						
402	Kawe	3,345	L	790	358	4,493
SUB-TOTAL		3,345	L	790	358	4,493
MAGOMENI Sub-branch						
501	Magomeni	733	L	584	252	1,569
502	Makurumla	2,391	L	1,270	658	4,319
503	Ndugumbi	1,740	L	924	319	2,983
504	Tandale	1,035	L	1,649	854	3,538
505	Mzimuni	850	L	903	234	1,987
506	Kigogo	940	L	699	207	1,846
507	Mabibo	2,443	L	1,298	448	4,189
508	Manzese	483	L	1,282	929	2,694
509	Ubungo	6,602	L	1,079	209	7,890
SUB-TOTAL		17,217	L	9,688	4,110	31,015
DAR-ES-SALAAM		61,256	L	29,575	15,043	145,034
		6,494	M			
		31,565	H			

Note: Class L = Low, M = Middle, H = High

TABLE D.1.4 WATER CONSUMPTION IN 1995

(Unit: m^3/day)

Sr. No.	Ward	NUWA	Connected to Domestic Dist.Sys.	Ind'rial	Com'cial	Ins'tional	Total
ILALA SUB BRANCH							
101	Ukonga	C	3,259	14	23	74	3,370
102	Pugu		1,101	0	0	0	1,101
103	Msongola		0	0	0	0	0
104	Tabata	C	1,301	14	93	10	1,418
105	Kinyerezi	C	90	0	15	0	105
106	Ilala	C	4,799	762	392	208	6,161
107	Mchikichini	C	1,705	0	0	0	1,705
108	Vingunguti	C	2,113	0	0	0	2,113
109	Kipawa	C	2,100	248	162	278	2,788
110	Buguruni	C	5,134	30	141	36	5,341
111	Kariakoo	C	1,634	30	330	44	2,038
112	Jangwani	C	1,099	14	222	10	1,345
113	Gerezani	C	1,363	51	165	45	1,624
114	Kisutu	C	2,313	82	1,278	323	3,996
115	Mchafukoge	C	2,366	0	0	0	2,366
116	Upanga East	C	4,801	0	11	271	5,083
117	Upanga West	C	5,395	0	13	593	6,001
118	Kivukoni	C	1,815	23	261	792	2,891
	SUB-TOTAL		**42,388**	**1,268**	**3,106**	**2,684**	**49,446**
TEMEKE SUB BRANCH							
201	Kigamboni	C	1,934	189	7	44	2,174
202	Vijibweni	C	96	0	0	0	96
203	Kibada		0	0	0	0	0
204	Kisarawe 11		0	0	0	0	0
205	Somangira		0	0	0	0	0
206	Kimbiji		0	0	0	0	0
207	Mbagala	C	2,292	7	18	0	2,317
208	Chamazi		0	0	0	0	0
209	Yombo Vituka	C	549	0	0	0	549
210	Charambe		0	0	0	0	0
211	Toangoma		0	0	0	0	0
212	Miburani	C	6,126	0	0	0	6,126
213	Temeke 14	C	10,135	2,149	550	721	13,555
214	Mtoni	C	2,550	0	113	34	2,697
215	Keko	C	4,892	208	285	310	5,695
216	Kurasini	C	3,331	88	328	388	4,135
	SUB-TOTAL		**31,905**	**2,641**	**1,301**	**1,497**	**37,344**
KINONDONI SUB BRANCH							
301	Msasani	C	19,406	17	359	308	20,090
302	Kinondoni	C	9,015	23	690	261	9,989
303	Mwananyamala	C	6,812	0	561	88	7,461
	SUB-TOTAL		**35,233**	**40**	**1,610**	**657**	**37,540**
KAWE SUB BRANCH							
401	Goba		0	0	0	0	0
402	Kawe	C	4,493	303	228	1,292	6,316
403	Kunduchi		0	0	0	0	0
404	Mbweni		0	0	0	0	0
405	Bunju		0	0	0	0	0
	SUB-TOTAL		**4,493**	**303**	**228**	**1,292**	**6,316**
MAGOMENI SUB BRANCH							
501	Magomeni	C	1,569	0	359	42	1,970
502	Makurumla	C	4,319	0	14	0	4,333
503	Ndugumbi	C	2,983	0	96	10	3,089
504	Tandale	C	3,538	0	0	0	3,538
505	Mzumuni	C	1,987	0	0	0	1,987
506	Kigogo	C	1,846	14	64	5	1,929
507	Mabibo	C	4,189	0	26	1	4,216
508	Manzese	C	2,694	0	0	0	2,694
509	Ubungo	C	7,890	1,213	658	175	9,936
510	Kibamba		0	0	0	0	0
	SUB-TOTAL		**31,015**	**1,227**	**1,217**	**233**	**33,692**
DAR ES SALAAM TOTAL			**145,034**	**5,479**	**7,462**	**6,363**	**164,338**

TABLE D.1.5 WATER DEMAND VS. LEAKAGE AND WASTAGE LEVELS IN 1995

(m^3/day)

leakage level	daily average consumption total	net	wastage (level)	daily average demand	daily minimum demand	hourly maximum demand
50%	164,338	= 154,478	+ 9,860 (6%)	329,000	411,000	617,000
40%	164,338	= 154,478	+ 9,860 (6%)	273,000	343,000	515,000
35%	164,338	= 154,478	+ 9,860 (6%)	253,000	316,000	474,000
35%	164,338	= 164,338	+ 0 (0%)	234,000	293,000	440,000
30%	164,338	= 164,338	+ 0 (0%)	218,000	273,000	410,000
25%	164,338	= 164,338	+ 0 (0%)	203,000	254,000	381,000
20%	164,338	= 164,338	+ 0 (0%)	191,000	239,000	359,000
10%	164,338	= 164,338	+ 0 (0%)	169,000	211,000	317,000

Note : Ratio of daily maximum demand to daily average demand is 1.25.
Ratio of hourly maximum demand to daily maximum demand is 1.5.
Supply to DSM is 206,000 m^3/day.

2. HYDRAULIC ANALYSIS

Following model construction and calibration, hydraulic analyses of the present system (shown in section 5, Appendix C) and the rehabilitated system were performed. The hydraulic analyses were carried out for each measure of the rehabilitation project as follows;

- 1995 case A (max): Current system (without measures)
- 1995 case A (min): Current system (without measures)
- 1995 case C (max): Separating High and Low Zone
- 1995 case C (min): Separating High and Low Zone
- 1995 case D (max): Main Pipe Laying (primary and secondary)
- 1995 case D (min): Main Pipe Laying (primary and secondary)
- 1995 case E (max): Middle zone creation
- 1995 case E (min): Middle zone creation

2.1 PIPE CLEANING AND EXISTING PIPES CONNECTIONS

The hydraulic analysis for the rehabilitated system was carried out, based on the calibrated model of the water network with the following changes.

(i) Demands for major consumers and each ward increased appropriately to account for increased industrial growth and productivity and an increase in the population, using a growth rate of 3.5% per annum to obtain demand estimates for 1995. The demands for major consumers in 1995 are given in Table D.2.1 and the corresponding increased domestic and minor industrial, institutional and commercial consumption in Table D.2.2. Since the hydraulic analyses are conducted for an hourly maximum demand and an hourly minimum demand, the above demand is multiplied by peaking factor which is shown below.

TABLE D.2.3 WATER DEMAND IN 1995

Case	(1) Total Consumption at node (m^3/day)	Daily Average Demand (m^3/day)	Ratio of Hourly Demand to Average Demand	(2) Hourly Demand (m^3/day)	Peaking Factor (2)/(1)
1995 Hourly max.	164,338	203,200	1.5	304,800	1.85
1995 Hourly min.	164,338	203,200	0.4	81,300	0.49

(ii) An appropriate increase in the C-value of the pipes based on figures for rehabilitated cast iron pipes and newly brushed mains.

(iii) Kimara and University reservoirs operating at their respective bottom water levels.

TABLE D.2.1 CONSUMPTION FOR HYDRAULIC NETWORK ANALYSIS IN 1995 (LARGE CONSUMER)

(Unit : m^3/day)

N A M E	NO.	WARD. NO.	INDUST-RIAL	INSTI-TUTIONAL	COMMER-CIAL	TOTAL
TANZANIA BREWERY LTD	1101	106	487			487
TANZANIA BREWERY LTD	1102	106	253			253
KILIMANJARO HOTEL	1103	118			112	112
USAMBARA HOTEL	1104	112			86	86
RAILWAYS SHAURI MOYO	1105	106		35		35
EMBASSY HOTEL	1106	118			30	30
FIRE BRIGADE STATION	1107	117		15		15
INST. OF FINANCIAL MGNT.	1108	118		14		14
SEGEREA POULTRY FARMS	1109	105			14	14
TIPER OIL REFINERY	1201	201	167			167
MGULANI ARMY CAMP	1202	216		150		150
DAR-ES-SALAAM HARBOUR	1203	216			123	123
PEPSI-COLA FACTORY	1204	213	95			95
KIBASILA STAND PIPE	1205	213			84	84
DAR-ES-SALAAM HARBOUR	1206	216			83	83
GENERAL FOOD COMPANY LTD	1207	215			56	56
COGNAC DISTILLERS	1208	213	36			36
KIOO(GLASS) INDUSTRY LTD	1209	213	31			31
CALICO TEXTILE COMPANY	1210	213	20			20
TANITA CASHEWNUT FACTORY	1211	213	17			17
KIUTA PRINTING WORKS	1212	215			15	15
UNIVERSITY OF DAR'SALAAM	1401	402		664		664
TANGANYIKA PACKERS LTD	1402	402	37			37
JESHI LA KUJENGA TAIFA	1403	402		29		29
JESHI LA KUJENGA TAIFA	1404	402		19		19
FRIENDSHIP TEXTILE MILL	1501	509	930			930
UBUNGO FARM IMPLEMENTS	1502	509	94			94
NATIONAL DAIRY COMPANY	1503	509	47			47
KAJIMA CONSTRUCTION CAMP	1504	501		35		35
INSTITUTE OF TRANSPORT	1505	509		19		19
DARBREW (KIBUKU) BREWERY	1506	509	18			18
UBUNGO SPINNING MILLS	1507	509	17			17
FRUIT & VEGETABLE MARKET	1508	501			15	15
TANZANIA FISHNETS IND.	1509	509	14			14
TOTAL(LARGE CONSUMER)	34		2,261	979	617	3,857

TABLE D.2.2 CONSUMPTION FOR HYDRAULIC NETWORK ANALYSIS IN 1995 (SMALL CONSUMER)

(Unit: person, m^3/day)

N A M E	WARD No.	POPU-LATION (A)	DOMESTIC (B)	INDUST-RIAL (C)	INSTI-TUTIONAL (D)	COMMER-CIAL (E)	TOTAL
UKONGA	101	67,335	3,259	14	74	23	3,370
PUGU	102		1,101	0	0	0	1,101
TABATA	104	24,950	1,301	14	10	93	1,418
KINYEREZI	105	726	90	0	0	1	91
ILALA	106	38,803	4,799	22	172	392	5,385
MCHIKICHINI	107	16,651	1,705	0	0	0	1,705
VINGUGUTI	108	50,185	2,113	0	0	0	2,113
KIPAWA	109	49,873	2,100	248	278	162	2,788
BUGURUNI	110	53,416	5,134	30	36	141	5,341
KARIAKOO	111	13,916	1,634	30	44	330	2,038
JANGWANI	112	16,961	1,099	14	10	136	1,259
GEREZANI	113	9,164	1,363	51	45	165	1,624
KISUTU	114	9,253	2,313	82	323	1,278	3,996
MCHAFUKOGE	115	9,463	2,366	0	0	0	2,366
UPANGA EAST	116	12,003	4,801	0	271	11	5,083
UPANGA WEST	117	13,488	5,395	0	578	13	5,986
KIVUKONI	118	7,259	1,815	23	778	120	2,736
KIGAMBONI	201	35,350	1,934	23	44	7	2,008
VIJIBWENI	202	1,752	96	0	0	0	96
MBAGALA	207	55,218	2,292	7	0	18	2,317
YOMBO VITUKA	209	13,225	549	0	0	0	549
MIBURANI	212	98,492	6,126	0	0	0	6,126
TEMEKE	213	123,154	10,135	1,951	721	466	13,273
MTONI	214	43,640	2,550	0	34	113	2,697
KEKO	215	63,857	4,892	208	310	215	5,625
KURASINI	216	39,886	3,331	88	238	121	3,778
MSASANI	301	69,307	19,406	17	308	359	20,090
KINONDONI	302	46,928	9,015	23	261	690	9,989
MWANANYAMALA	303	80,276	6,812	0	88	561	7,461
KAWE	402	46,463	4,493	266	581	228	5,568
MAGOMENI	501	22,895	1,569	0	8	344	1,921
MAKURUMLA	502	59,775	4,319	0	0	14	4,333
NDUGUMBI	503	36,243	2,983	0	10	96	3,089
TANDALE	504	64,671	3,538	0	0	0	3,538
MZIMUNI	505	26,555	1,987	0	0	0	1,987
KIGOGO	506	23,496	1,846	14	5	64	1,929
MABIBO	507	50,887	4,189	0	1	26	4,216
MANZESE	508	60,338	2,694	0	0	0	2,694
UBUNGO	509	63,480	7,890	93	156	658	8,797
TOTAL(SMALL CONSUMER)		1,519,339	145,034	3,218	5,384	6,845	160,481
TOTAL(SMALL+LARGE)		1,519,339	145,034	5,479	6,363	7,462	164,338

(iv) Demands for Pugu allocated to node 211.

(v) Demands for Yombo Vituka allocated equally to nodes 232 and 320.

(vi) The new pipe sections, currently being constructed, between nodes 203 to 219, 218 to 219 and 219 to 304 included in the rehabilitated system. The demand for node 219 was allocated by distributing 50% of the demands from each of nodes 220 and 228 to node 219.

(vii) The static pump lift at Mtoni source set at 60 metres for the Mbagala and st 37 meters for the city.

(viii) The 75 mm pumping main from Mtoni to Mbagala replaced with a 250 mm diameter pipe section.

(ix) Connections between nodes 101 to 111 and 102 to 108 restored by deleting nodes 112 and 113 and allocating their demands to nodes 101 and 102 respectively.

(x) The valve connecting node 203 to node 204 opened.

(xi) The valve connecting node 103 to node 114 opened, with the demands for node 114 allocated to node 103.

(xii) The valve connecting node 214 to node 215 opened, with the demands for node 215 allocated to node 214.

The data file containing the program data for the rehabilitated system with 1995 demands is given in Table D.2.4, while the results of the analysis are given in "DATA".

The results of the hydraulic analysis for the rehabilitated system indicate that areas along and near large-diameter pipes are supplied adequately. Such areas are generally surrounded by the new Bagamoyo road in the north, the Indian ocean in the east, Pugu road in the south and between Mandela road and Morocco road in the west. On the other hand, inadequately supplied areas are outlying areas from the above-mentioned boundary. These include Oyster Bay and Msasani in the north, Temeke, Kurasini, Mtoni, Keko etc. in the south due to undersized distribution pipes

The problems identified in the following items of section 5, Appendix C will be solved;
(3) Ubungo and Manzese, (4) Kivukoni, (5) Ubungo, (6) Vingunguti, (8) along Uhuru Street and (9) Mtoni area, partly.

On the other hand, the problems identified in the following items will persist to some degree as a result of the undersized pipes within part of the primary distribution system and increased demand;

(1) Oyster Bay area, (2) Kinondoni area, (7) Temeke area, (9) Mtoni area partly, (10) Mbagala area, (11) Mbagala area, (12) Kurasini and (13) Kigamboni.

In addition, low pressures will be experienced in Vingunguti areas covered by nodes 211, 212, 213,

TABLE D.2.4 NODAL DEMAND ALLOCATION

NODE NO.	CONTRIBUTIONS			POPULATION			DOMESTIC			INDUSTRIAL		
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL B	WARD CNTRBN C	NODE TOTAL D	WARD TOTAL E	WARD CNTRBN F	NODE TOTAL G	WARD TOTAL H	WARD CNTRBN I	NODE TOTAL J
102	MANZESE	508	2	60,338	1,207	5,016	2,694	53.9	527.3	0	0.0	5.6
	UBUNGO	509	6	63,480	3,809		7,890	473.4		93	5.6	
		1401	100	0	0		0	0.0		0	0.0	
103	MANZESE	508	4	60,338	2,414	3,684	2,694	107.8	265.6	0	0.0	1.9
	UBUNGO	509	2	63,480	1,270		7,890	157.8		93	1.9	
105	MSASANI	301	1	69,307	693	3,927	19,406	194.1	371.0	17	0.2	0.2
	TANDALE	504	5	64,671	3,234		3,538	176.9		0	0.0	
107	MAGOMENI	501	87	22,895	19,919	58,104	1,569	1,365.0	4,331.0	0	0.0	3.5
	NDUGUMBI	503	32	36,243	11,598		2,983	954.6		0	0.0	
	MZIMUNI	505	78	26,555	20,713		1,987	1,549.9		0	0.0	
	KIGOGO	506	25	23,496	5,874		1,846	461.5		14	3.5	
		1508	100	0	0		0	0.0		0	0.0	
108	TANDALE	504	48	64,671	31,042	31,042	3,538	1,698.2	1,698.2	0	0.0	0.0
109	MANZESE	508	51	60,338	30,772	30,772	2,694	1,373.9	1,373.9	0	0.0	0.0
	UBUNGO	509	0	63,480	0		7,890	0.0		93	0.0	
		1505	0	0	0		0	0.0		0	0.0	
110	KAWE	402	50	46,463	23,232	26,466	4,493	2,246.5	2,423.4	266	133.0	133.0
	TANDALE	504	5	64,671	3,234		3,538	176.9		0	0.0	
111	KAWE	402	50	46,463	23,232	29,052	4,493	2,246.5	2,564.9	266	133.0	133.0
	TANDALE	504	9	64,671	5,820		3,538	318.4		0	0.0	
112	MANZESE	508	2	60,338	1,207	5,016	2,694	53.9	527.3	0	0.0	5.6
	UBUNGO	509	6	63,480	3,809		7,890	473.4		93	5.6	
113	MANZESE	508	2	60,338	1,207	5,016	2,694	53.9	527.3	0	0.0	5.6
	UBUNGO	509	6	63,480	3,809		7,890	473.4		93	5.6	
114	MANZESE	508	4	60,338	2,414	3,684	2,694	107.8	265.6	0	0.0	1.9
	UBUNGO	509	2	63,480	1,270		7,890	157.8		93	1.9	
115	MSASANI	301	21	69,307	14,555	35,303	19,406	4,075.3	6,339.2	17	3.6	5.9
	KINONDONI	302	10	46,928	4,693		9,015	901.5		23	2.3	
	MWA'YMALA	303	20	80,276	16,055		6,812	1,362.4		0	0.0	
116	MSASANI	301	5	69,307	3,465	3,465	19,406	970.3	970.3	17	0.9	0.9
117	MSASANI	301	1	69,307	693	3,927	19,406	194.1	371.0	17	0.2	36.9
	TANDALE	504	5	64,671	3,234		3,538	176.9		0	0.0	
		1402	100	0	0		0	0.0		37	36.7	
118	MSASANI	301	2	69,307	1,386	1,386	19,406	388.1	388.1	17	0.3	0.3
		1404	100	0	0		0	0.0		0	0.0	
		1403	100	0	0		0	0.0		0	0.0	
120	MSASANI	301	5	69,307	3,465	8,158	19,406	970.3	1,871.8	17	0.9	3.2
	KINONDONI	302	10	46,928	4,693		9,015	901.5		23	2.3	
121	MSASANI	301	28	69,307	19,406	19,406	19,406	5,433.7	5,433.7	17	4.8	4.8
122	MSASANI	301	2	69,307	1,386	1,386	19,406	388.1	388.1	17	0.3	0.3
123	MSASANI	301	6	69,307	4,158	4,158	19,406	1,164.4	1,164.4	17	1.0	1.0
124	MSASANI	301	3	69,307	2,079	2,079	19,406	582.2	582.2	17	0.5	0.5
125	MSASANI	301	3	69,307	2,079	2,079	19,406	582.2	582.2	17	0.5	0.5
126	MSASANI	301	2	69,307	1,386	1,386	19,406	388.1	388.1	17	0.3	0.3
127	MSASANI	301	2	69,307	1,386	1,386	19,406	388.1	388.1	17	0.3	0.3
128	MSASANI	301	2	69,307	1,386	6,079	19,406	388.1	1,289.6	17	0.3	2.6
	KINONDONI	302	10	46,928	4,693		9,015	901.5		23	2.3	
129	MSASANI	301	2	69,307	1,386	6,079	19,406	388.1	1,289.6	17	0.3	2.6
	KINONDONI	302	10	46,928	4,693		9,015	901.5		23	2.3	
130	KINONDONI	302	18	46,928	8,447	8,447	9,015	1,622.7	1,622.7	23	4.1	4.1
131	KINONDONI	302	32	46,928	15,017	15,017	9,015	2,884.8	2,884.8	23	7.4	7.4
133	UP'A EAST	116	18	12,003	2,161	6,947	4,801	864.2	2,148.1	0	0.0	9.7
	UP'A WEST	117	7	13,488	944		5,395	377.7		0	0.0	
	KIYUKONI	118	40	7,259	2,903		1,815	726.0		23	9.2	
	KINONDONI	302	2	46,928	939		9,015	180.3		23	0.5	
134	JANGWANI	112	80	16,961	13,569	19,100	1,099	879.2	3,091.6	14	11.2	11.2
	UP'A EAST	116	9	12,003	1,080		4,801	432.1		0	0.0	
	UP'A WEST	117	33	13,488	4,451		5,395	1,780.4		0	0.0	
		1107	100	0	0		0	0.0		0	0.0	
		1104	35	0	0		0	0.0		0	0.0	

FOR HYDRAULIC NETWORK ANALYSIS IN 1995

(Unit: person, m^3/day)

NODE No.	CONTRIBUTIONS			INSTITUTIONAL			COMMERCIAL			NODAL GRAND TOTAL
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL K	WARD CNTRBN L	NODE TOTAL M	WARD TOTAL N	WARD CNTRBN O	NODE TOTAL P	Q
102	MANZESE	508	2	0	0.0	673.7	0	0.0	39.5	1,246.0
	UBUNGO	509	6	156	9.4		658	39.5		
		1401	100	664	664.3		0	0.0		
103	MANZESE	508	4	0	0.0	3.1	0	0.0	13.2	283.7
	UBUNGO	509	2	156	3.1		658	13.2		
105	MSASANI	301	1	308	3.1	3.1	359	3.6	3.6	377.8
	TANDALE	504	5	0	0.0		0	0.0		
107	MAGOMENI	501	87	8	7.0	11.4	344	299.3	361.4	4,707.3
	NDUGUMBI	503	32	10	3.2		96	30.7		
	MZIMUNI	505	78	0	0.0		0	0.0		
	KIGOGO	506	25	5	1.3		64	16.0		
		1508	100	0	0.0		15	15.4		
108	TANDALE	504	48	0	0.0	0.0	0	0.0	0.0	1,698.2
109	MANZESE	508	51	0	0.0	0.0	0	0.0	0.0	1,373.9
	UBUNGO	509	0	156	0.0		658	0.0		
		1505	0	19	0.0		0	0.0		
110	KAWE	402	50	581	290.5	290.5	228	114.0	114.0	2,960.9
	TANDALE	504	5	0	0.0		0	0.0		
111	KAWE	402	50	581	290.5	290.5	228	114.0	114.0	3,102.4
	TANDALE	504	9	0	0.0		0	0.0		
112	MANZESE	508	2	0	0.0	9.4	0	0.0	39.5	581.7
	UBUNGO	509	6	156	9.4		658	39.5		
113	MANZESE	508	2	0	0.0	9.4	0	0.0	39.5	581.7
	UBUNGO	509	6	156	9.4		658	39.5		
114	MANZESE	508	4	0	0.0	3.1	0	0.0	13.2	283.7
	UBUNGO	509	2	156	3.1		658	13.2		
115	MSASANI	301	21	308	64.7	108.4	359	75.4	256.6	6,710.0
	KINONDONI	302	10	261	26.1		690	69.0		
	MWA'YMALA	303	20	88	17.6		561	112.2		
116	MSASANI	301	5	308	15.4	15.4	359	18.0	18.0	1,004.5
117	MSASANI	301	1	308	3.1	3.1	359	3.6	3.6	414.5
	TANDALE	504	5	0	0.0		0	0.0		
		1402	100	0	0.0		0	0.0		
118	MSASANI	301	2	308	6.2	53.8	359	7.2	7.2	449.4
		1404	100	19	18.6		0	0.0		
		1403	100	29	29.0		0	0.0		
120	MSASANI	301	5	308	15.4	41.5	359	18.0	87.0	2,003.4
	KINONDONI	302	10	261	26.1		690	69.0		
121	MSASANI	301	28	308	86.2	86.2	359	100.5	100.5	5,625.2
122	MSASANI	301	2	308	6.2	6.2	359	7.2	7.2	401.8
123	MSASANI	301	6	308	18.5	18.5	359	21.5	21.5	1,205.4
124	MSASANI	301	3	308	9.2	9.2	359	10.8	10.8	602.7
125	MSASANI	301	3	308	9.2	9.2	359	10.8	10.8	602.7
126	MSASANI	301	2	308	6.2	6.2	359	7.2	7.2	401.8
127	MSASANI	301	2	308	6.2	6.2	359	7.2	7.2	401.8
128	MSASANI	301	2	308	6.2	32.3	359	7.2	76.2	1,400.7
	KINONDONI	302	10	261	26.1		690	69.0		
129	MSASANI	301	2	308	6.2	32.3	359	7.2	76.2	1,400.7
	KINONDONI	302	10	261	26.1		690	69.0		
130	KINONDONI	302	18	261	47.0	47.0	690	124.2	124.2	1,798.0
131	KINONDONI	302	32	261	83.5	83.5	690	220.8	220.8	3,196.5
133	UP'A EAST	116	18	271	48.8	405.7	11	2.0	64.7	2,628.1
	UP'A WEST	117	7	578	40.5		13	0.9		
	KIVUKONI	118	40	778	311.2		120	48.0		
	KINONDONI	302	2	261	5.2		690	13.8		
134	JANGWANI	112	80	10	8.0	238.4	136	108.8	144.1	3,485.4
	UP'A EAST	116	9	271	24.4		11	1.0		
	UP'A WEST	117	33	578	190.7		13	4.3		
		1107	100	15	15.3		0	0.0		
		1104	35	0	0.0		86	30.0		

TABLE D.2.4 NODAL DEMAND ALLOCATION

NODE NO.	CONTRIBUTIONS			POPULATION			DOMESTIC			INDUSTRIAL		
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL B	WARD CNTRBN C	NODE TOTAL D	WARD TOTAL E	WARD CNTRBN F	NODE TOTAL G	WARD TOTAL H	WARD CNTRBN I	NODE TOTAL J
135	JANGWANI	112	13	16,961	2,205	8,394	1,099	142.9	1,884.7	14	1.8	31.0
	KARIAKOO	111	7	13,916	974		1,634	114.4		30	2.1	
	KISUTU	114	33	9,253	3,054		2,313	763.3		82	27.1	
	UP'A EAST	116	18	12,003	2,161		4,801	864.2		0	0.0	
136	KISUTU	114	30	9,253	2,776	2,776	2,313	693.9	693.9	82	24.6	24.6
137	KISUTU	114	7	9,253	648	4,489	2,313	161.9	1,698.2	82	5.7	5.7
	UP'A EAST	116	32	12,003	3,841		4,801	1,536.3		0	0.0	
138	KISUTU	114	20	9,253	1,851	2,214	2,313	462.6	553.4	82	16.4	17.6
	KIVUKONI	118	5	7,259	363		1,815	90.8		23	1.2	
		1106	60	0	0		0	0.0		0	0.0	
139	KIVUKONI	118	5	7,259	363	363	1,815	90.8	90.8	23	1.2	1.2
		1106	40	0	0		0	0.0		0	0.0	
		1103	90	0	0		0	0.0		0	0.0	
140	KIVUKONI	118	5	7,259	363	363	1,815	90.8	90.8	23	1.2	1.2
		1108	50	0	0		0	0.0		0	0.0	
		1103	10	0	0		0	0.0		0	0.0	
141	KINONDONI	302	8	46,928	3,754	3,754	9,015	721.2	721.2	23	1.8	1.8
142	UBUNGO	509	16	63,480	10,157	10,157	7,890	1,262.4	1,262.4	93	14.9	14.9
143	MAKURUMLA	502	75	59,775	44,832	87,585	4,319	3,239.3	6,258.3	0	0.0	0.0
	NDUGUMBI	503	58	36,243	24,645		2,983	2,028.4		0	0.0	
	TANDALE	504	28	64,671	18,108		3,538	990.6		0	0.0	
144	UP'A EAST	116	23	12,003	2,761	10,854	4,801	1,104.2	4,341.2	0	0.0	0.0
	UP'A WEST	117	60	13,488	8,093		5,395	3,237.0		0	0.0	
145	KIVUKONI	118	5	7,259	363	363	1,815	90.8	90.8	23	1.2	1.2
		1108	50	0	0		0	0.0		0	0.0	
146	JANGWANI	112	7	16,961	1,187	10,005	1,099	76.9	718.0	14	1.0	1.0
	MAGOMENI	501	13	22,895	2,976		1,569	204.0		0	0.0	
	MZIMUNI	505	22	26,555	5,842		1,987	437.1		0	0.0	
		1504	100	0	0		0	0.0		0	0.0	
147	MWA'YMALA	303	25	80,276	20,069	20,069	6,812	1,703.0	1,703.0	0	0.0	0.0
148	MWA'YMALA	303	30	80,276	24,083	24,083	6,812	2,043.6	2,043.6	0	0.0	0.0
150	MWA'YMALA	303	25	80,276	20,069	20,069	6,812	1,703.0	1,703.0	0	0.0	0.0
153	MSASANI	301	3	69,307	2,079	2,079	19,406	582.2	582.2	17	0.5	0.5
154	MSASANI	301	2	69,307	1,386	1,386	19,406	388.1	388.1	17	0.3	0.3
155	MSASANI	301	7	69,307	4,852	4,852	19,406	1,358.4	1,358.4	17	1.2	1.2
156	KISUTU	114	10	9,253	925	1,651	2,313	231.3	412.8	82	8.2	10.5
	KIVUKONI	118	10	7,259	726		1,815	181.5		23	2.3	
158	KIVUKONI	118	20	7,259	1,452	1,452	1,815	363.0	363.0	23	4.6	4.6
159	KIVUKONI	118	10	7,259	726	726	1,815	181.5	181.5	23	2.3	2.3
162	MSASANI	301	3	69,307	2,079	2,079	19,406	582.2	582.2	17	0.5	0.5
201	UBUNGO	509	17	63,480	10,792	10,792	7,890	1,341.3	1,341.3	93	15.8	15.8
202	UBUNGO	509	13	63,480	8,252	8,252	7,890	1,025.7	1,025.7	93	12.1	12.1
203	UBUNGO	509	10	63,480	6,348	6,348	7,890	789.0	789.0	93	9.3	9.3
204	UBUNGO	509	2	63,480	1,270	1,270	7,890	157.8	157.8	93	1.9	1.9
205	UBUNGO	509	2	63,480	1,270	1,270	7,890	157.8	157.8	93	1.9	20.2
		1506	100	0	0		0	0.0		18	18.3	
206	MANZESE	508	35	60,338	21,118	21,118	2,694	942.9	942.9	0	0.0	0.0
		1501	0	0	0		0	0.0		930	0.0	
207	UBUNGO	509	10	63,480	6,348	6,348	7,890	789.0	789.0	93	9.3	44.5
		1503	75	0	0		0	0.0		47	35.2	
208	MABIBO	507	32	50,887	16,284	16,284	4,189	1,340.5	1,340.5	0	0.0	17.0
		1505	0	0	0		0	0.0		0	0.0	
		1507	100	0	0		0	0.0		17	17.0	
209	TABATA	104	6	24,950	1,497	3,605	1,301	78.1	254.6	14	0.8	0.8
	KINYEREZI	105	10	726	73		90	9.0		0	0.0	
	MABIBO	507	4	50,887	2,035		4,189	167.6		0	0.0	
210	TABATA	104	6	24,950	1,497	3,605	1,301	78.1	254.6	14	0.8	0.8
	KINYEREZI	105	10	726	73		90	9.0		0	0.0	
	MABIBO	507	4	50,887	2,035		4,189	167.6		0	0.0	

FOR HYDRAULIC NETWORK ANALYSIS IN 1995

(Unit: person, m^3/day)

NODE No.	CONTRIBUTIONS			INSTITUTIONAL			COMMERCIAL			NODAL GRAND TOTAL
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL K	WARD CNTRBN L	NODE TOTAL M	WARD TOTAL N	WARD CNTRBN O	NODE TOTAL P	Q
135	JANGWANI	112	13	10	1.3	159.8	136	17.7	464.5	2,540.0
	KARIAKOO	111	7	44	3.1		330	23.1		
	KISUTU	114	33	323	106.6		1,278	421.7		
	UP'A EAST	116	18	271	48.8		11	2.0		
136	KISUTU	114	30	323	96.9	96.9	1,278	383.4	383.4	1,198.8
137	KISUTU	114	7	323	22.6	109.3	1,278	89.5	93.0	1,906.3
	UP'A EAST	116	32	271	86.7		11	3.5		
138	KISUTU	114	20	323	64.6	103.5	1,278	255.6	279.7	954.1
	KIVUKONI	118	5	778	38.9		120	6.0		
		1106	60	0	0.0		30	18.1		
139	KIVUKONI	118	5	778	38.9	38.9	120	6.0	118.7	249.5
		1106	40	0	0.0		30	12.1		
		1103	90	0	0.0		112	100.6		
140	KIVUKONI	118	5	778	38.9	45.9	120	6.0	17.2	154.9
		1108	50	14	7.0		0	0.0		
		1103	10	0	0.0		112	11.2		
141	KINONDONI	302	8	261	20.9	20.9	690	55.2	55.2	799.1
142	UBUNGO	509	16	156	25.0	25.0	658	105.3	105.3	1,407.5
143	MAKURUMLA	502	75	0	0.0	6.8	14	10.5	75.8	6,340.9
	NDUGUMBI	503	68	10	6.8		96	65.3		
	TANDALE	504	28	0	0.0		0	0.0		
144	UP'A EAST	116	23	271	62.3	409.1	11	2.5	10.3	4,760.7
	UP'A WEST	117	60	578	346.8		13	7.8		
145	KIVUKONI	118	5	778	38.9	45.9	120	6.0	6.0	143.8
		1108	50	14	7.0		0	0.0		
146	JANGWANI	112	7	10	0.7	36.3	136	9.5	54.2	809.6
	MAGOMENI	501	13	8	1.0		344	44.7		
	MZIMUNI	505	22	0	0.0		0	0.0		
		1504	100	35	34.6		0	0.0		
147	MWA'YMALA	303	25	88	22.0	22.0	561	140.3	140.3	1,865.3
148	MWA'YMALA	303	30	88	26.4	26.4	561	168.3	168.3	2,238.3
150	MWA'YMALA	303	25	88	22.0	22.0	561	140.3	140.3	1,865.3
153	MSASANI	301	3	308	9.2	9.2	359	10.8	10.8	602.7
154	MSASANI	301	2	308	6.2	6.2	359	7.2	7.2	401.8
155	MSASANI	301	7	308	21.6	21.6	359	25.1	25.1	1,406.3
156	KISUTU	114	10	323	32.3	110.1	1,278	127.8	139.8	673.2
	KIVUKONI	118	10	778	77.8		120	12.0		
158	KIVUKONI	118	20	778	155.6	155.6	120	24.0	24.0	547.2
159	KIVUKONI	118	10	778	77.8	77.8	120	12.0	12.0	273.6
162	MSASANI	301	3	308	9.2	9.2	359	10.8	10.8	602.7
201	UBUNGO	509	17	156	26.5	26.5	658	111.9	111.9	1,495.5
202	UBUNGO	509	13	156	20.3	20.3	658	85.5	85.5	1,143.6
203	UBUNGO	509	10	156	15.6	15.6	658	65.8	65.8	879.7
204	UBUNGO	509	2	156	3.1	3.1	658	13.2	13.2	175.9
205	UBUNGO	509	2	156	3.1	3.1	658	13.2	13.2	194.2
		1506	100	0	0.0		0	0.0		
206	MANZESE	508	35	0	0.0	0.0	0	0.0	0.0	942.9
		1501	0	0	0.0		0	0.0		
207	UBUNGO	509	10	156	15.6	15.6	658	65.8	65.8	914.9
		1503	75	0	0.0		0	0.0		
208	MABIBO	507	32	1	0.3	0.3	26	8.3	8.3	1,366.1
		1505	0	19	0.0		0	0.0		
		1507	100	0	0.0		0	0.0		
209	TABATA	104	6	10	0.6	0.6	93	5.6	6.7	262.8
	KINYEREZI	105	10	0	0.0		1	0.1		
	MABIBO	507	4	1	0.0		26	1.0		
210	TABATA	104	6	10	0.6	0.6	93	5.6	6.7	262.8
	KINYEREZI	105	10	0	0.0		1	0.1		
	MABIBO	507	4	1	0.0		26	1.0		

TABLE D.2.4 NODAL DEMAND ALLOCATION

NODE NO.	CONTRIBUTIONS			POPULATION			DOMESTIC			INDUSTRIAL		
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL B	WARD CNTRBN C	NODE TOTAL D	WARD TOTAL E	WARD CNTRBN F	NODE TOTAL G	WARD TOTAL H	WARD CNTRBN I	NODE TOTAL J
211	UKONGA	101	80	67,335	53,868	53,868	3,259	2,607.2	3,708.2	14	11.2	11.2
	PUGU	102	100	0	0		1,101	1,101.0		0	0.0	
		1109	100	0	0		0	0.0		0	0.0	
212	UKONGA	101	15	67,335	10,100	13,092	3,259	488.9	614.9	14	2.1	17.0
	KIPAWA	109	6	49,873	2,992		2,100	126.0		248	14.9	
213	KIPAWA	109	6	49,873	2,992	2,992	2,100	126.0	126.0	248	14.9	14.9
214	VINGUGUTI	108	6	50,185	3,011	10,492	2,113	126.8	441.8	0	0.0	37.2
	KIPAWA	109	15	49,873	7,481		2,100	315.0		248	37.2	
215	VINGUGUTI	108	6	50,185	3,011	10,492	2,113	126.8	441.8	0	0.0	37.2
	KIPAWA	109	15	49,873	7,481		2,100	315.0		248	37.2	
216	VINGUGUTI	108	66	50,185	33,122	36,114	2,113	1,394.6	1,520.6	0	0.0	24.7
	KIPAWA	109	6	49,873	2,992		2,100	126.0		248	14.9	
		1210	40	0	0		0	0.0		20	8.2	
		1211	10	0	0		0	0.0		17	1.7	
217	VINGUGUTI	108	4	50,185	2,007	17,468	2,113	84.5	735.5	0	0.0	152.8
	KIPAWA	109	31	49,873	15,461		2,100	651.0		248	76.9	
		1204	80	0	0		0	0.0		95	75.9	
218	TABATA	104	44	24,950	10,978	10,978	1,301	572.4	572.4	14	6.2	6.2
220	BUGURUNI	110	10	53,416	5,342	5,342	5,134	513.4	513.4	30	3.0	3.0
221	ILALA	106	34	38,803	13,193	23,876	4,799	1,631.7	2,658.5	22	7.5	13.5
	BUGURUNI	110	20	53,416	10,683		5,134	1,026.8		30	6.0	
222	BUGURUNI	110	10	53,416	5,342	5,342	5,134	513.4	513.4	30	3.0	3.0
223	ILALA	106	42	38,803	16,297	25,622	4,799	2,015.6	2,970.4	22	9.2	379.4
	MCH'CHINI	107	56	16,651	9,325		1,705	954.8		0	0.0	
		1101	50	0	0		0	0.0		487	243.7	
		1102	50	0	0		0	0.0		253	126.5	
224	MCH'CHINI	107	44	16,651	7,327	11,909	1,705	750.2	1,431.7	0	0.0	395.7
	GEREZANI	113	50	9,164	4,582		1,363	681.5		51	25.5	
		1101	50	0	0		0	0.0		487	243.7	
		1104	65	0	0		0	0.0		0	0.0	
		1102	50	0	0		0	0.0		253	126.5	
225	KARIAKOO	111	8	13,916	1,113	11,859	1,634	130.7	2,687.5	30	2.4	9.5
	GEREZANI	113	14	9,164	1,283		1,363	190.8		51	7.1	
	MCHA'KOGE	115	100	9,463	9,463		2,366	2,366.0		0	0.0	
226	GEREZANI	113	22	9,164	2,016	13,844	1,363	299.9	1,688.8	51	11.2	36.7
	KARIAKOO	111	85	13,916	11,828		1,634	1,388.9		30	25.5	
228	BUGURUNI	110	44	53,416	23,503	23,503	5,134	2,259.0	2,259.0	30	13.2	13.2
229	UBUNGO	509	2	63,480	1,270	1,270	7,890	157.8	157.8	93	1.9	1,040.2
		1501	100	0	0		0	0.0		930	930.3	
		1505	100	0	0		0	0.0		0	0.0	
		1509	100	0	0		0	0.0		14	14.4	
		1502	100	0	0		0	0.0		94	93.6	
230	MABIBO	507	20	50,887	10,177	13,986	4,189	837.8	1,311.2	0	0.0	17.3
	UBUNGO	509	6	63,480	3,809		7,890	473.4		93	5.6	
		1503	25	0	0		0	0.0		47	11.7	
231	TABATA	104	44	24,950	10,978	63,899	1,301	572.4	4,712.3	14	6.2	16.7
	MAKURUMLA	502	25	59,775	14,944		4,319	1,079.8		0	0.0	
	KIGOGO	506	75	23,496	17,622		1,846	1,384.5		14	10.5	
	MABIBO	507	40	50,887	20,355		4,189	1,675.6		0	0.0	
232	YOMBO VIT	209	50	13,225	6,613	17,105	549	274.5	716.3	0	0.0	37.2
	VINGUGUTI	108	6	50,185	3,011		2,113	126.8		0	0.0	
	KIPAWA	109	15	49,873	7,481		2,100	315.0		248	37.2	
233	KINYEREZI	105	80	726	581	581	90	72.0	72.0	0	0.0	0.0
234	ILALA	106	8	38,803	3,104	5,241	4,799	383.9	589.3	22	1.8	3.0
	BUGURUNI	110	4	53,416	2,137		5,134	205.4		30	1.2	
238	UKONGA	101	5	67,335	3,367	3,367	3,259	163.0	163.0	14	0.7	0.7
240	GEREZANI	113	14	9,164	1,283	1,283	1,363	190.8	190.8	51	7.1	7.1
301	MIBURANI	212	13	98,492	12,804	32,878	6,126	796.4	1,969.4	0	0.0	0.0
	MTONI	214	46	43,640	20,074		2,550	1,173.0		0	0.0	
302	TEMEKE	213	5	123,154	6,158	8,712	10,135	506.8	702.4	1,951	97.6	105.9
	KEKO	215	4	63,857	2,554		4,892	195.7		208	8.3	

FOR HYDRAULIC NETWORK ANALYSIS IN 1995

(Unit: person, m^3/day)

NODE No.	CONTRIBUTIONS			INSTITUTIONAL			COMMERCIAL			NODAL GRAND TOTAL
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL K	WARD CNTRBN L	NODE TOTAL M	WARD TOTAL N	WARD CNTRBN O	NODE TOTAL P	Q
211	UKONGA	101	80	74	59.2	59.2	23	18.4	32.3	3,810.9
	PUGU	102	100	0	0.0		0	0.0		
		1109	100	0	0.0		14	13.9		
212	UKONGA	101	15	74	11.1	27.8	23	3.5	13.2	672.8
	KIPAWA	109	6	278	16.7		162	9.7		
213	KIPAWA	109	6	278	16.7	16.7	162	9.7	9.7	167.3
214	VINGUGUTI	108	6	0	0.0	41.7	0	0.0	24.3	545.0
	KIPAWA	109	15	278	41.7		162	24.3		
215	VINGUGUTI	108	6	0	0.0	41.7	0	0.0	24.3	545.0
	KIPAWA	109	15	278	41.7		162	24.3		
216	VINGUGUTI	108	66	0	0.0	16.7	0	0.0	9.7	1,571.7
	KIPAWA	109	6	278	16.7		162	9.7		
		1210	40	0	0.0		0	0.0		
		1211	10	0	0.0		0	0.0		
217	VINGUGUTI	108	4	0	0.0	86.2	0	0.0	50.2	1,024.7
	KIPAWA	109	31	278	86.2		162	50.2		
		1204	80	0	0.0		0	0.0		
218	TABATA	104	44	10	4.4	4.4	93	40.9	40.9	623.9
220	BUGURUNI	110	10	36	3.6	3.6	141	14.1	14.1	534.1
221	ILALA	106	34	172	58.5	65.7	392	133.3	161.5	2,899.1
	BUGURUNI	110	20	36	7.2		141	28.2		
222	BUGURUNI	110	10	36	3.6	3.6	141	14.1	14.1	534.1
223	ILALA	106	42	172	72.2	72.2	392	164.6	164.6	3,586.7
	MCH'CHINI	107	56	0	0.0		0	0.0		
		1101	50	0	0.0		0	0.0		
		1102	50	0	0.0		0	0.0		
224	MCH'CHINI	107	44	0	0.0	22.5	0	0.0	138.3	1,988.1
	GEREZANI	113	50	45	22.5		165	82.5		
		1101	50	0	0.0		0	0.0		
		1104	65	0	0.0		86	55.8		
		1102	50	0	0.0		0	0.0		
225	KARIAKOO	111	8	44	3.5	9.8	330	26.4	49.5	2,756.4
	GEREZANI	113	14	45	6.3		165	23.1		
	MCHA'KOGE	115	100	0	0.0		0	0.0		
226	GEREZANI	113	22	45	9.9	47.3	165	36.3	316.8	2,089.6
	KARIAKOO	111	85	44	37.4		330	280.5		
228	BUGURUNI	110	44	36	15.8	15.8	141	62.0	62.0	2,350.0
229	UBUNGO	509	2	156	3.1	21.9	658	13.2	13.2	1,233.0
		1501	100	0	0.0		0	0.0		
		1505	100	19	18.8		0	0.0		
		1509	100	0	0.0		0	0.0		
		1502	100	0	0.0		0	0.0		
230	MABIBO	507	20	1	0.2	9.6	26	5.2	44.7	1,382.8
	UBUNGO	509	6	156	9.4		658	39.5		
		1503	25	0	0.0		0	0.0		
231	TABATA	104	44	10	4.4	8.6	93	40.9	102.8	4,840.3
	MAKURUMLA	502	25	0	0.0		14	3.5		
	KIGOGO	506	75	5	3.8		64	48.0		
	MABIBO	507	40	1	0.4		26	10.4		
232	YOMBO VIT	209	50	0	0.0	41.7	0	0.0	24.3	819.5
	VINGUGUTI	108	6	0	0.0		0	0.0		
	KIPAWA	109	15	278	41.7		162	24.3		
233	KINYEREZI	105	80	0	0.0	0.0	1	0.8	0.8	72.8
234	ILALA	106	8	172	13.8	15.2	392	31.4	37.0	644.4
	BUGURUNI	110	4	36	1.4		141	5.6		
238	UKONGA	101	5	74	3.7	3.7	23	1.2	1.2	168.5
240	GEREZANI	113	14	45	6.3	6.3	165	23.1	23.1	227.4
301	MIBURANI	212	13	0	0.0	15.6	0	0.0	52.0	2,037.0
	MTONI	214	46	34	15.6		113	52.0		
302	TEMEKE	213	5	721	36.1	48.5	466	23.3	31.9	888.7
	KEKO	215	4	310	12.4		215	8.6		

TABLE D.2.4 NODAL DEMAND ALLOCATION

NODE NO.	CONTRIBUTIONS			POPULATION			DOMESTIC			INDUSTRIAL		
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL B	WARD CNTRBN C	NODE TOTAL D	WARD TOTAL E	WARD CNTRBN F	NODE TOTAL G	WARD TOTAL H	WARD CNTRBN I	NODE TOTAL J
303	TEMEKE	213	8	123,154	9,852	9,852	10,135	810.8	810.8	1,951	156.1	186.4
		1208	20	0	0		0	0.0		36	7.2	
		1209	75	0	0		0	0.0		31	23.2	
304	VINGUGUTI	108	4	50,185	2,007	4,144	2,113	84.5	289.9	0	0.0	47.3
	BUGURUNI	110	4	53,416	2,137		5,134	205.4		30	1.2	
		1204	20	0	0		0	0.0		95	19.0	
		1210	60	0	0		0	0.0		20	12.2	
		1211	90	0	0		0	0.0		17	14.9	
305	MIBURANI	212	4	98,492	3,940	25,651	6,126	245.0	1,908.3	0	0.0	70.7
	KEKO	215	34	63,857	21,711		4,892	1,663.3		208	70.7	
306	KEKO	215	17	63,857	10,856	10,856	4,892	831.6	831.6	208	35.4	35.4
		1207	50	0	0		0	0.0		0	0.0	
307	ILALA	106	8	38,803	3,104	3,104	4,799	383.9	383.9	22	1.8	1.8
		1105	100	0	0		0	0.0		0	0.0	
308	VINGUGUTI	108	4	50,185	2,007	4,144	2,113	84.5	289.9	0	0.0	1.2
	BUGURUNI	110	4	53,416	2,137		5,134	205.4		30	1.2	
309	VINGUGUTI	108	4	50,185	2,007	4,144	2,113	84.5	289.9	0	0.0	1.2
	BUGURUNI	110	4	53,416	2,137		5,134	205.4		30	1.2	
		1212	60	0	0		0	0.0		0	0.0	
310	MIBURANI	212	4	98,492	3,940	11,683	6,126	245.0	727.5	0	0.0	2.6
	MTONI	214	15	43,640	6,546		2,550	382.5		0	0.0	
	KURASINI	216	3	39,886	1,197		3,331	99.9		88	2.6	
311	MIBURANI	212	4	98,492	3,940	6,732	6,126	245.0	478.2	0	0.0	6.2
	KURASINI	216	7	39,886	2,792		3,331	233.2		88	6.2	
		1202	100	0	0		0	0.0		0	0.0	
312	KURASINI	216	23	39,886	9,174	9,174	3,331	766.1	766.1	88	20.2	20.2
313	KURASINI	216	3	39,886	1,197	1,197	3,331	99.9	99.9	88	2.6	2.6
314	MTONI	214	15	43,640	6,546	6,546	2,550	382.5	382.5	0	0.0	0.0
315	VIJIBWENI	202	100	1,752	1,752	1,752	96	96.0	96.0	0	0.0	0.0
316	KIGAMBONI	201	100	35,350	35,350	35,350	1,934	1,934.0	1,934.0	23	23.0	189.5
		1201	100	0	0		0	0.0		167	166.5	
317	KURASINI	216	13	39,886	5,185	5,185	3,331	433.0	433.0	88	11.4	11.4
318	MIBURANI	212	11	98,492	10,834	33,002	6,126	673.9	2,498.2	0	0.0	351.2
	TEMEKE	213	18	123,154	22,168		10,135	1,824.3		1,951	351.2	
319	MIBURANI	212	3	98,492	2,955	2,955	6,126	183.8	183.8	0	0.0	0.0
320	KIPAWA	109	6	49,873	2,992	58,867	2,100	126.0	4,454.5	248	14.9	795.3
	TEMEKE	213	40	123,154	49,262		10,135	4,054.0		1,951	780.4	
	YOMBO VIT	209	50	13,225	6,613		549	274.5		0	0.0	
321	MIBURANI	212	9	98,492	8,864	16,527	6,126	551.3	1,138.4	0	0.0	25.0
	KEKO	215	12	63,857	7,663		4,892	587.0		208	25.0	
		1205	100	0	0		0	0.0		0	0.0	
322	KEKO	215	12	63,857	7,663	7,663	4,892	587.0	587.0	208	25.0	61.4
		1209	25	0	0		0	0.0		31	7.7	
		1207	50	0	0		0	0.0		0	0.0	
		1208	80	0	0		0	0.0		36	28.7	
323	MIBURANI	212	10	98,492	9,849	17,826	6,126	612.6	1,278.8	0	0.0	17.6
	KURASINI	216	20	39,886	7,977		3,331	666.2		88	17.6	
324	KURASINI	216	31	39,886	12,365	12,365	3,331	1,032.6	1,032.6	88	27.3	27.3
		1206	100	0	0		0	0.0		0	0.0	
		1203	100	0	0		0	0.0		0	0.0	
325	ILALA	106	8	38,803	3,104	16,514	4,799	383.9	1,411.2	22	1.8	45.4
	KEKO	215	21	63,857	13,410		4,892	1,027.3		208	43.7	
		1212	40	0	0		0	0.0		0	0.0	
326	TEMEKE	213	14	123,154	17,242	17,242	10,135	1,418.9	1,418.9	1,951	273.1	273.1
327	MIBURANI	212	22	98,492	21,668	21,668	6,126	1,347.7	1,347.7	0	0.0	0.0
328	MIBURANI	212	4	98,492	3,940	16,255	6,126	245.0	1,258.5	0	0.0	195.1
	TEMEKE	213	10	123,154	12,315		10,135	1,013.5		1,951	195.1	
329	MIBURANI	212	13	98,492	12,804	18,962	6,126	796.4	1,303.1	0	0.0	97.6
	TEMEKE	213	5	123,154	6,158		10,135	506.8		1,951	97.6	

FOR HYDRAULIC NETWORK ANALYSIS IN 1995

(Unit: person, m^3/day)

NODE No.	CONTRIBUTIONS			INSTITUTIONAL			COMMERCIAL			NODAL GRAND TOTAL
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL K	WARD CNTRBN L	NODE TOTAL M	WARD TOTAL N	WARD CNTRBN O	NODE TOTAL P	Q
303	TEMEKE	213	8	721	57.7	57.7	466	37.3	37.3	1,092.2
		1208	20	0	0.0		0	0.0		
		1209	75	0	0.0		0	0.0		
304	VINGUGUTI	108	4	0	0.0	1.4	0	0.0	5.6	344.2
	BUGURUNI	110	4	36	1.4		141	5.6		
		1204	20	0	0.0		0	0.0		
		1210	60	0	0.0		0	0.0		
		1211	90	0	0.0		0	0.0		
305	MIBURANI	212	4	0	0.0	105.4	0	0.0	73.1	2,157.5
	KEKO	215	34	310	105.4		215	73.1		
306	KEKO	215	17	310	52.7	52.7	215	36.6	64.5	984.2
		1207	50	0	0.0		56	27.9		
307	ILALA	106	8	172	13.8	49.0	392	31.4	31.4	466.0
		1105	100	35	35.2		0	0.0		
308	VINGUGUTI	108	4	0	0.0	1.4	0	0.0	5.6	298.2
	BUGURUNI	110	4	36	1.4		141	5.6		
309	VINGUGUTI	108	4	0	0.0	1.4	0	0.0	14.4	306.9
	BUGURUNI	110	4	36	1.4		141	5.6		
		1212	60	0	0.0		15	8.8		
310	MIBURANI	212	4	0	0.0	12.2	0	0.0	20.6	762.9
	MTONI	214	15	34	5.1		113	17.0		
	KURASINI	216	3	238	7.1		121	3.6		
311	MIBURANI	212	4	0	0.0	166.2	0	0.0	8.5	659.0
	KURASINI	216	7	238	16.7		121	8.5		
		1202	100	150	149.5		0	0.0		
312	KURASINI	216	23	238	54.7	54.7	121	27.8	27.8	868.9
313	KURASINI	216	3	238	7.1	7.1	121	3.6	3.6	113.3
314	MTONI	214	15	34	5.1	5.1	113	17.0	17.0	404.6
315	VIJIBWENI	202	100	0	0.0	0.0	0	0.0	0.0	96.0
316	KIGAMBONI	201	100	44	44.0	44.0	7	7.0	7.0	2,174.5
		1201	100	0	0.0		0	0.0		
317	KURASINI	216	13	238	30.9	30.9	121	15.7	15.7	491.1
318	MIBURANI	212	11	0	0.0	129.8	0	0.0	83.9	3,063.0
	TEMEKE	213	18	721	129.8		466	83.9		
319	MIBURANI	212	3	0	0.0	0.0	0	0.0	0.0	183.8
320	KIPAWA	109	6	278	16.7	305.1	162	9.7	196.1	5,751.0
	TEMEKE	213	40	721	288.4		466	186.4		
	YOMBO VIT	209	50	0	0.0		0	0.0		
321	MIBURANI	212	9	0	0.0	37.2	0	0.0	109.8	1,310.3
	KEKO	215	12	310	37.2		215	25.8		
		1205	100	0	0.0		84	84.0		
322	KEKO	215	12	310	37.2	37.2	215	25.8	53.7	739.4
		1209	25	0	0.0		0	0.0		
		1207	50	0	0.0		56	27.9		
		1208	80	0	0.0		0	0.0		
323	MIBURANI	212	10	0	0.0	47.6	0	0.0	24.2	1,368.2
	KURASINI	216	20	238	47.6		121	24.2		
324	KURASINI	216	31	238	73.8	73.8	121	37.5	243.8	1,377.5
		1206	100	0	0.0		83	83.9		
		1203	100	0	0.0		123	123.3		
325	ILALA	106	8	172	13.8	78.9	392	31.4	82.4	1,617.9
	KEKO	215	21	310	65.1		215	45.2		
		1212	40	0	0.0		15	5.8		
326	TEMEKE	213	14	721	100.9	100.9	466	65.2	65.2	1,858.2
327	MIBURANI	212	22	0	0.0	0.0	0	0.0	0.0	1,347.7
328	MIBURANI	212	4	0	0.0	72.1	0	0.0	46.6	1,572.3
	TEMEKE	213	10	721	72.1		466	46.6		
329	MIBURANI	212	13	0	0.0	36.1	0	0.0	23.3	1,460.0
	TEMEKE	213	5	721	36.1		466	23.3		
331	MTONI	214	24	34	8.2	8.2	113	27.1	27.1	831.1
	MIBURANI	212	3	0	0.0		0	0.0		

TABLE D.2.4 NODAL DEMAND ALLOCATION

NODE NO.	CONTRIBUTIONS			POPULATION			DOMESTIC			INDUSTRIAL		
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL B	WARD CNTRBN C	NODE TOTAL D	WARD TOTAL E	WARD CNTRBN F	NODE TOTAL G	WARD TOTAL H	WARD CNTRBN I	NODE TOTAL J
331	MTONI	214	24	43,640	10,474	13,429	2,550	612.0	795.8	0	0.0	0.0
	MIBURANI	212	3	98,492	2,955		6,126	183.8		0	0.0	
351	MBAGALA	207	70	55,218	38,653	38,653	2,292	1,604.4	1,604.4	7	4.9	4.9
352	MBAGALA	207	24	55,218	13,252	13,252	2,292	550.1	550.1	7	1.7	1.7
353	MBAGALA	207	6	55,218	3,313	3,313	2,292	137.5	137.5	7	0.4	0.4
	T O T A L					1,519,339			145,034			5,479

FOR HYDRAULIC NETWORK ANALYSIS IN 1995

(Unit: person, m^3/day)

NODE No.	CONTRIBUTIONS			INSTITUTIONAL			COMMERCIAL			NODAL GRAND TOTAL
	WARD NAME	WARD No.	WARD %age A	WARD TOTAL K	WARD CNTRBN L	NODE TOTAL M	WARD TOTAL N	WARD CNTRBN O	NODE TOTAL P	Q
351	MBAGALA	207	70	0	0.0	0.0	18	12.6	12.6	1,621.9
352	MBAGALA	207	24	0	0.0	0.0	18	4.3	4.3	556.1
353	MBAGALA	207	6	0	0.0	0.0	18	1.1	1.1	139.0
	T O T A L					6,363			7,462	164,338

232 and 233 brought about mainly by supply of water to Pugu and Yombo Vituka being restored from the city distribution system.

2.2 ADDITIONAL MAIN PIPES

To increase the capacity of distribution mains, additional pipes are planned along the existing pipes and retaining them in service as they are. Proposed additional pipes are listed in Table D.2.5. These are planned for areas where effective pressures are less than 10 meters during hourly maximum demand periods. The planned sizes of pipes can provide at least 15 meters pressure during the same periods and, the pipe routes are planned so as to be the shortest possible route from adjacent mains. All areas are sufficiently served with water.

TABLE D.2.5 MAIN LAYING PROGRAMME (PRIMARY)

Node	Major Improved Area	Pipe Diameter	Pipe Length
115 - 120	Msasani peninsular	500 mm	1,000 m
120 - 128 - 127 - 124	or Oyster bay	400	2,900
124 - 155	ditto.	300	1,300
155 - 123	ditto.	200	1,500
115 - 141 - 147 - 130	Kinondoni	400	1,600
130 - 131	ditto.	300	1,000
147 - 148 - 149	ditto.	200	2,000
304 - 326 - 320	Temeke, Mtoni	500	2,300
320 - 318 - 329 - 301	ditto.	400	2,000
307 - 306 - 305	Kurasini, Miburani	500	1,300
305 - 311 - 330	ditto.	400	1,700
323 - 324	ditto.	250	1,300
306 - 322	ditto.	200	500
313 - 314 - 315 - 316	Vijibweni, Kigamboni	300	5,100
Mtoni(350)- 351, 352, 353	Mbagala	250	5,100
400 - 203 for Middle Zone		900	2,800
210 - 218 - 214	Vingunguti, Kipawa	500	5,000
TOTAL			38,400m

The Vijibweni booster pump station has been working for a demand of Vijibweni and Kigamboni areas. However, this can be economically abandoned when additional 12" mains are laid along the existing 8" pipe, between nodes 315 and 316. The current 8" pipe shows a very steep hydraulic gradient, 31 meters head losses per 1,000 meters for a demand of 4,000 m^3/day. It gives 110 meters head losses total for a 3,600 meters length against the pump head of 50 meters. Addition of 12" pipe will give an effective pressure of 19 meters at the node 316 without the boosting head.

2.3 MIDDLE ZONE CREATION

Additional distribution mains will be able to carry water into the service areas within the distribution system and low pressure areas will disappear. In this sub-section, however, effective water use is considered; pressure control or reduction of high pressure areas. Excessive pressure also has adverse effects on the distribution system. These include high leakage, wastage, pipe bursts, etc. These will increase water production cost and, particularly in DSM, will result in no water being distributed in a) some high elevation areas and b) hydraulically unfavourable areas. Therefore, creation of a middle zone is proposed between the existing Kimara (upper) zone and the University (lower) zone.

As illustrated in Figure D.2.2, the University reservoirs can cover areas with elevations up to about 40 and less, since the low water level of the reservoir is about 60 meters. On the other hand, the low water level at the Kimara reservoir is about 130 meters, and therefore, this can cover not only the above-mentioned low areas, but also the remaining high areas. If neither a middle zone nor high and low zones are created - that is, there is no control of flow from the reservoirs - supply from Kimara cannot satisfy water demand in the distribution system, while supply from the University reservoir is sometimes unused.

Without zoning, half hourly peak demand of about 304,800 m^3/day is to be met from the University and Kimara reservoirs, with a little supply from the Mtoni pumps. But, during hourly minimum demand periods, Kimara reservoir can supply almost the entire demand in the city. On an average, to meet the daily demand, the three reservoirs need to supply the following quantities of water;

University; 77,400 m^3/day
Kimara ; 119,100 m^3/day
Mtoni ; 6,700 m^3/day

Water demand in the Mtoni system is almost equal to its total water supply capacity. However, demand exceeds supply by a large degree in the Kimara system, while the reverse is true in the University system. Therefore, in order to balance supply from the both reservoirs and demand in the distribution system, zoning into upper and lower is required.

TABLE D.2.7 WATER BALANCE WITH AND WITHOUT ZONING IN 1995

(Unit:m^3/day)

	- WITHOUT ZONING-			- WITH ZONING-	SUPPLY CAPACITY
	during hourly maximum demand	during hourly minimum demand	during average demand	during average demand	
University	204,800	7,300	77,400	145,800	149,100
kimara	89,900	71,300	119,100	50,600	50,000
Mtoni	10,100	2,700	6,700	6,800	6,800
Total	304,800	81,300	203,200	203,200	205,900

By zoning into upper and lower areas, water can be distributed to meet the entire demand. But, even with this zoning, one problem arises. There is excessively high pressure in some areas within the upper zone. The highest static pressure in the lower zone is 66 meters, while that in the upper zone reaches a pressure as high as 108 meters, as illustrated in Figure D.2.3. The areas with high pressure stretch along Mandela road, with ground elevation of about 40 meters, towards the western side. These areas are proposed as middle zone.

When setting up the middle zone, a part of the western Temeke area should be separated from the current lower zone and incorporated into the middle zone. The area has suffered from chronic low water pressure, due to the relatively small height difference. The elevation of western Temeke is 40 to 50 meters, while the low water level in the University reservoir is about 60 meters. Hence, the height difference is only 10 to 20 meters and, considering head loss, there is hardly any effective pressure available in Temeke. Other alternatives such as adding distribution mains leading to the Temeke within the lower zone and installing booster pumps are uneconomical.

The supply to the middle zone will be from the Upper Ruvu system, through Kimara reservoir. In the long-term, new reservoirs are to be constructed for the middle zone. The high water level of the reservoirs are to be about 100 meters, which is the intermediate point of the high water levels of the two existing reservoirs, 135.9 m and 70.19 meters, respectively. By this, the highest pressure in the middle zone can be reduced to 72.8 meters. By separating the middle zone from the upper zone, the highest pressure of the upper pressure will also be reduced to 75 meters.

The reservoir should be sited near the distribution mains along Morogoro road, since water is to be taken from the Upper Ruvu system at Kimara, and consequently, the length of additional pipes that need to be laid will be short. Hence, it should be constructed near the Morogoro road, between the Kimara reservoir and Ubungo junction, near the University reservoir.

With the creation of the middle zone, effective pressures in the distribution system will be improved (refer to Figures D.2.4 to D.2.6). Effective pressures reduction will be of the order of 70 meters.