Table D-13 MONTHLY AND ANNUAL RIVER FLOW AT C 48

RECORDER STATION - CLAW DAM D/S

ZONE REF. NO - C48 CATCHMENT AREA 2480.00 SQ.KM. (unit : cu.m/sec)

MONTH/ YEAR	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	TOTAL
1964/65	0.000	0.499	2.500	13.000	0.687	0.078	0.000	0.000	0.000	0.000	0.000	0.000	1.397
1965/66	0.000	0.000	0.000	3.550	13.100	8.300	0.001	0.000	0.000	0.000	0.000	0.000	2.079
1966/67	0.000	0.000	0.000	3.210	8.020	4.750	0.075	0.002	0.000	0.000	0.000	0.000	1.338
1967/68	0.000	0.000	0.000	0.000	1.110	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.093
1968/69	0.000	0.000	8.000	21.500	6.500	14.200	5.690	0.220	0.010	0.007	0.000	0.000	4.680
1969/70	0.000	0.100	12.100	1.590	0.027	0.000	0.323	0.000	0.000	0.000	0.000	0.000	1.178
1970/71	0.000	3.520	2.540	19.500	0.835	0.032	0.000	0.000	0.000	0.000	0.000	0.000	2.202
1971/72	0.000	0.000	0.257	100.000	13.400	4.760	8.680	0.140	0.000	0.000	0.000	0.000	10.603
1972/73	0.000	0.000	0.000	0.000	0.794	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.067
1973/74	***	***	***	***	***	***	***	***	***	***	***	***	0.000
1974/75	***	***	***	***	***	***	***	***	***	***	***	***	0.000
1975/76	0.095	0.069	0.000	0.009	5.940	21.000	7.540	0.416	0.037	0.100	0.099	0.144	2.954
1976/77	0.084	0.105	0.096	0.063	15.400	41.400	0.886	0.004	0.062	0.100	0.087	0.090	4.865
1977/78	0.211	0.218	7.390	67.700	78.300	51.100	15.000	1.800	0.594	0.079	0.022	0.027	18.537
1978/79	0.000	0.389	9.190	1.860	0.042	0.006	0.017	0.083	***	***	***	***	0.966
1979/80	0.079	0.067	5.130	1.960	11.700	4.650	0.036	0.000	0.128	0.197	0.209	0.188	2.029
1980/81	0.005	0.010	1.260	22.300	165.000	25.000	2.470	1.040	***	***	0.100	0.144	18.111
1981/82	0.124	2.140	0.672	1.290	2.640	0.215	0.198	0.250	0.274	0.192	0.383	0.228	0.717
1982/83	0.032	0.142	0.710	0.057	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.078
1983/84	***	0.000	0.000	0.000	0.000	0.037	1.880	0.369	0.276	0.272	0.305	0.279	0.285
1984/85	***	***	***	***	***	***	***	***	***	***	***	***	0.000
1985/86	0.031	0.682	1.600	22.800	28.200	1.540	0.657	0.187	0.574	0.159	0.146	0.077	4.721
1986/87	0.054	0.279	0.050	0.368	0.173	0.247	0.000	0.000	0.751	1.010	0.048	0.000	0.248
1987/88	0.000	0.000	0.000	0.000	8.260	24.900	0.002	0.050	0.246	0.121	0.797	0.179	2.880
1988/89	0.162	0.119	0.104	0.002	5.230	2.350	0.000	0.127	0.175	0.176	0.303	0.138	0.741
1989/90	***	***	***	***	***	***	***	***	***	***	***	***	***
1990/91	0.000	0.000	0.000	0.000	0.000	0.006	0.000	0.083	0.193	0.119	0.122	0.228	0.063
1991/92	0.000	0.184	0.138	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.027
1992/93	0.000	0.000	0.000	0.001	0.050	0.011	0.070	0.376	0.000	0.476	0.199	0.245	0.119
1993/94	0.000	0.000	0.306	0.006	0.063	0.235	0.000	0.073	0.354	0.299	0.000	0.000	0.111
MEAN	0.035	0.328	2.002	10.799	14.057	7.878	1.674	0.201	0.154	0.138	0.113	0.079	2.703
1964-73	0.000	0.458	2.822	18.039	4.941	3.569	1.642	0.040	0.004	0.001	0.000	0.000	2.364
1974-83	0.079	0.349	2.716	10.582	31.002	15.934	3.114	0.440	0.196	0.134	0.151	0.138	4.854
1984/93	0.027	0.140	0.244	2.575	4.664	3.254	0.081	0.100	0.255	0.262	0.179	0.096	0.891

Table D-14 MONTHLY AND ANNUAL RIVER FLOW AT C 87

RECORDER STATION - UMUSWESWE CLAW DAM U/S

ZONE REF. NO - C87 CATCHMENT AREA 1990.00 SQ.KM. (unit : ÛG/sec)

MONTH/ YEAR	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	TOTAL
1964/65	***	***	***	***	***	***	***	***	***	***	***	***	***
1965/66	***	***	***	***	***	***	***	***	***	***	***	***	***
1966/67	***	***	***	***	***	***	***	***	***	***	***	***	***
1967/68	***	***	***	***	***	***	***	***	***	***	***	***	***
1968/69	***	***	***	***	***	***	***	***	***	***	***	***	***
1969/70	***	***	***	***	***	***	***	***	***	***	***	***	***
1970/71	***	***	***	***	***	***	***	***	***	***	***	***	***
1971/72	***	***	***	***	***	***	***	***	***	***	***	***	***
1972/73	***	***	***	***	***	***	***	***	***	***	***	***	***
1973/74	***	***	***	***	***	***	***	***	***	***	***	***	***
1974/75	***	***	***	***	***	***	***	***	***	***	***	***	***
1975/76	***	***	***	***	***	***	***	***	***	***	***	***	***
1976/77	0.000	0.109	0.291	0.431	14.100	27.000	0.894	0.187	0.068	0.044	0.025	0.006	3.596
1977/78	0.000	0.000	9.930	40.000	53.400	33.700	11.200	2.010	0.904	0.390	0.171	0.175	12.657
1978/79	0.396	0.932	1.930	0.957	0.155	0.136	0.022	0.007	0.000	0.000	0.000	0.000	0.378
1979/80	0.000	0.505	8.210	3.530	5.280	2.650	0.530	0.000	0.000	0.000	0.000	0.000	1.725
1980/81	0.000	0.244	2.160	17.000	67.200	27.100	1.490	0.682	0.331	0.202	0.138	0.089	9.720
1981/82	0.045	0.168	0.644	2.260	2.860	***	***	0.000	0.000	0.000	0.000	0.000	0.498
1982/83	0.013	0.093	0.253	0.810	0.870	0.250	0.009	0.000	0.000	0.000	0.000	0.000	0.192
1983/84	***	***	1.050	0.272	0.686	3.010	2.570	0.000	0.000	0.000	0.000	0.000	0.632
1984/85	0.000	0.000	3.790	32.600	20.600	2.620	0.119	0.002	0.000	0.000	0.000	0.000	4.978
1985/86	0.000	0.000	7.670	27.000	7.090	0.635	1.130	0.251	0.000	0.000	0.000	0.000	3.648
1986/87	0.000	0.000	6.430	3.280	0.252	0.094	0.077	0.000	0.000	0.000	0.000	0.000	0.844
1987/88	0.000	0.000	3.260	3.220	5.450	16.100	0.525	0.159	0.000	0.000	0.000	0.000	2.393
1988/89	0.284	0.059	0.892	1.150	4.350	2.380	0.000	0.000	0.000	0.000	0.000	0.000	0.760
1989/90	0.000	0.379	0.117	5.590	21.500	0.655	0.719	0.157	0.000	0.000	0.000	0.000	2.426
1990/91	0.000	0.000	0.024	1.840	2.650	1.610	0.036	***	***	***	***	***	0.513
1991/92	0.000	0.000	0.268	0.417	0.013	0.402	0.039	0.003	0.000	0.000	0.000	0.000	0.095
1992/93	0.000	0.407	9.100	6.200	3.090	0.430	0.011	0.000	0.000	0.000	0.000	0.000	1.603
1993/94	0.000	0.185	0.898	3.520	0.328	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.411
MEAN	0.025	0.103	1.899	5.003	6.996	3.959	0.646	0.115	0.043	0.021	0.011	0.007	1.569
1964-73	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1974-83	0.045	0.205	2.452	6.526	14.455	9.385	1.672	0.289	0.130	0.064	0.033	0.022	2.940
1984/93	0.028	0.103	3.245	8.482	6.532	2.493	0.266	0.057	0.000	0.000	0.000	0.000	1.767

Table D-15 MONTHLY AND ANNUAL RIVER FLOW AT C 88

RECORDER STATION - UMNIATI COPPER QUEEN G/W

ZONE REF. NO - C88 CATCHMENT AREA 24400.00 SQ.KM. (unit : cu.m/sec)

MONTH/ YEAR	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	TOTAL
1964/65	***	***	***	***	***	***	***	***	***	***	***	***	***
1965/66	***	***	***	***	***	***	***	***	***	***	***	***	***
1966/67	***	***	***	***	***	***	***	***	***	***	***	***	***
1967/68	***	***	***	***	***	***	***	***	***	***	***	***	***
1968/69	***	***	***	***	***	***	***	***	***	***	***	***	***
1969/70	***	***	***	***	***	***	***	***	***	***	***	***	***
1970/71	***	***	***	***	***	***	***	***	***	***	***	***	***
1971/72	***	***	***	***	***	***	***	***	***	***	***	***	***
1972/73	***	***	***	***	***	***	***	***	***	***	***	***	***
1973/74	***	***	***	***	***	***	***	***	***	***	***	***	***
1974/75	***	***	***	***	***	***	***	***	***	***	***	***	***
1975/76	***	***	***	***	***	***	***	***	***	***	***	***	***
1976/77	0.214	1.310	2.010	12.400	98.800	***	27.400	6.360	1.600	0.788	0.209	0.038	12.594
1977/78	0.008	0.000	63.200	779.000	463.000	***	***	***	***	***	***	***	***
1978/79	***	***	***	***	***	***	***	***	***	***	***	***	***
1979/80	***	***	***	***	***	***	***	***	***	***	***	***	***
1980/81	***	***	***	***	***	***	***	***	***	***	***	***	***
1981/82	***	***	***	***	***	***	***	***	***	***	***	***	***
1982/83	***	***	***	***	***	***	***	***	***	***	***	***	***
1983/84	***	***	***	***	***	***	***	***	***	***	***	***	***
1984/85	***	***	***	***	***	***	***	***	***	***	***	***	***
1985/86	***	***	***	***	***	***	***	***	***	***	***	***	***
1986/87	***	***	***	***	***	***	***	***	***	***	***	***	***
1987/88	***	***	***	***	***	***	***	***	***	***	***	***	***
1988/89	***	***	***	***	***	***	***	***	***	***	***	***	***
1989/90	***	***	***	***	***	***	***	***	***	***	***	***	***
1990/91	***	***	***	***	***	***	***	***	***	***	***	***	***
1991/92	0.000	0.000	9.180	8.700	4.060	11.200	1.220	0.065	0.000	0.000	0.000	0.000	2.869
1992/93	0.000	0.000	5.290	***	***	***	***	3.720	0.339	0.000	0.000	0.000	0.779
1993/94	0.000	1.430	***	***	***	1.090	0.214	0.019	0.000	0.000	0.000	0.000	0.229
MEAN	0.056	0.685	26.560	400.050	188.620	6.145	9.611	3.388	0.646	0.263	0.070	0.010	0.549
1964-73	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1974-83	0.022	0.131	6.521	79.140	56.180	0.000	2.740	0.636	0.160	0.079	0.021	0.004	1.259
1984-93	0.000	0.143	1.447	0.870	0.406	1.229	0.143	0.380	0.034	0.000	0.000	0.000	0.388

Table D-16 MONTHLY AND ANNUAL MAXIMUM TEMPREATURES AT KADOMA

ZIMBABWE 67869 KADOMA COTTON RES. INST. LAT: 18 19 LONG: 29 53 ELEV: 1149 M

MAX. TEMPERATURES (DEG. C)

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
1951-52	23.4	25.8	30.9	31.3	29.5	27.7	26.5	27.3	29.1	28.4	24.8	23.3	27.3
1952-53	23.9	27.6	30.3	32.1	29.0	29.2	26.6	27.6	26.4	27.1	24.9	22.8	27.3
1953-54	22.3	26.5	26.9	32.0	30.0	28.0	28.1	28.3	28.4	28.3	27.5	22.6	27.4
1954-55	23.9	26.4	29.7	33.1	28.3	27.3	28.1	28.4	27.1	27.1	25.3	23.9	27.4
1955-56	24.5	27.8	29.5	32.3	32.1	28.1	27.5	27.4	27.3	25.8	25.5	23.2	27.6
1956-57	23.5	28.1	29.0	32.4	27.8	27.1	28.5	28.8	28.2	29.2	26.0	24.8	27.8
1957-58	26.3	27.0	31.0	32.1	32.1	28.9	28.0	26.9	28.3	28.6	27.4	23.4	28.3
1958-59	23.3	25.2	30.9	30.1	31.6	29.0	28.9	28.2	28.8	29.8	29.2	24.7	28.3
1959-60	24.7	26.0	29.2	33.2	31.1	29.0	30.1	28.2	29.1	28.2	25.4	23.6	28.2
1960-61	23.1	27.8	29.9	33.0	28.7	29.5	27.2	27.8	28.2	28.0	28.4	23.9	28.0
1961-62	23.2	24.8	30.4	33.2	27.6	30.3	27.8	28.0	28.7	28.1	24.7	26.2	27.7
1962-63	23.9	26.9	30.9	33.6	29.4	26.1	28.2	25.8	28.0	26.9	24.6	23.8	27.3
1963-64	24.8	27.0	30.8	32.7	31.2	28.3	28.4	28.5	32.0	29.8	25.9	24.0	28.6
1964-65	22.7	26.1	30.3	32.9	30.6	27.6	27.2	30.0	29.2	29.3	25.7	23.8	27.9
1965-66	24.0	26.7	28.4	30.4	30.1	31.7	31.0	26.9	28.0	27.2	26.9	24.1	27.9
1966-67	24.8	27.0	30.5	32.9	32.0	30.4	27.9	27.1	28.3	29.3	26.1	25.0	28.4
1967-68	22.5	25.5	29.6	31.8	30.6	30.1	32.1	28.7	30.5	29.1	27.3	22.9	28.4
1968-69	25.5	28.3	30.6	34.2	27.6	28.4	28.3	30.1	26.6	27.9	25.5	24.5	28.1
1969-70	23.8	26.3	30.8	31.3	30.8	26.3	30.3	30.3	31.0	28.2	28.1	24.4	28.5
1970-71	25.7	27.6	32.3	32.2	29.4	29.8	26.6	28.7	30.1	29.8	25.6	23.5	28.4
1971-72	24.0	27.6	30.0	31.9	28.6	29.7	26.4	27.3	27.3	26.8	25.7	23.0	27.4
1972-73	23.4	26.5	31.0	31.7	31.2	32.6	31.7	29.2	30.7	28.3	27.6	23.1	28.9
1973-74	24.1	25.6	31.5	31.9	28.6	26.2	26.9	27.3	27.3	25.6	24.6	23.6	26.9
1974-75	23.2	27.6	29.2	32.8	29.2	27.3	28.0	27.3	27.6	27.7	26.9	23.4	27.5
1975-76	24.5	25.0	30.5	30.6	32.5	28.1	27.8	27.5	26.2	25.7	23.7	23.0	27.1
1976-77	23.5	24.6	30.2	30.5	31.4	29.4	30.3	26.7	27.2	27.6	27.1	24.8	27.8
1977-78	23.8	26.5	30.1	33.7	31.9	28.0	27.3	28.2	27.4	25.5	24.5	22.0	27.4
1978-79	22.1	28.8	31.2	31.2	30.3	27.1	29.3	30.2	28.3	29.1	26.4	23.4	28.1
1979-80	23.5	27.8	31.2	31.5	29.6	26.9	29.7	29.5	28.2	28.0	26.7	23.4	28.0
1980-81	22.6	26.0	30.6	31.5	30.3	28.3	28.0	26.9	27.7	26.5	23.8	23.4	27.1
1981-82	23.6	27.5	29.5	30.5	32.4	30.5	29.0	29.8	30.4	29.0	26.2	25.1	28.6
1982-83	23.9	26.5	29.2	29.8	31.5	30.6	31.0	30.2	31.0	30.2	28.5	26.3	29.1
1983-84	24.9	25.7	32.4	31.3	33.2	29.6	30.7	29.7	29.4	28.0	27.1	23.8	28.8
1984-85	24.1	26.5	31.7	32.3	29.9	28.8	28.2	27.8	29.0	27.8	25.5	23.6	27.9
1985-86	24.2	26.2	29.8	30.9	30.9	28.0	27.3	28.1	28.6	26.6	25.8	23.9	27.5
1986-87	24.5	27.8	30.0	31.6	31.2	28.9	30.1	31.6	31.5	30.8	28.5	24.1	29.2
1987-88	24.4	27.2	31.5	31.4	33.5	29.7	30.5	28.2	28.2	28.7	25.8	24.6	28.6
1988-89	24.5	27.3	31.1	31.9	30.6	29.1	28.7	26.3	28.5	27.6	26.7	24.6	28.1
1989-90	24.6	26.8	30.5	31.0	31.0	31.0	28.5	28.1	30.1	28.2	26.4	25.6	28.5
1990-91	26.3	26.2	29.4	33.4	32.4	30.2	29.7	29.2	29.6	27.5	26.8	25.0	28.8
1991-92	24.3	22.7	25.9	29.4	29.5	28.3	27.2	27.9	29.5	27.5	28.3	26.1	23.9
1992-93	24.4	26.4	32.1	33.8	31.0	28.7	28.3	28.0	28.5	28.7	28.5	24.9	
1993-94	24.0	26.7	30.3	33.6	30.1	30.2	28.3	29.0	31.6			24.3	
1994.95	23.5												
MEAN 1951-92	24.0	26.7	30.3	32.0	30.5	28.8	28.7	28.3	28.7	28.0	26.2	24.0	28.0
STDV 1951-92	1.0	1.0	1.0	1.1	1.5	1.5	1.5	1.3	1.4	1.3	1.3	.9	.6

Table D-17 MONTHLY AND ANNUAL MINIMUM TEMPREATURES AT KADOMA

ZIMBABWE 67869 KADOMA COTTON RES. INST. LAT: 18 19 LONG: 29 53 ELEV: 1149 M

MIN. TEMPERATURES (DEG. C)

		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
	1951-52	7.2	10.2	13.4	17.4	16.8	17.3	18.0	17.6	14.7	14.3	10.7	9.0	13.9
	1952-53	7.6	10.8	14.4	17.1	16.9	17.5	17.8	17.6	16.0	14.8	10.9	7.4	14.1
	1953-54	6.6	10.5	11.2	16.4	18.0	17.6	17.6	17.3	16.0	14.4	12.0	6.8	13.7
	1954-55	7.1	9.6	13.3	16.5	16.7	18.0	17.5	17.2	15.6	14.0	10.8	8.9	13.8
	1955-56	8.6	9.0	13.0	16.6	18.1	17.3	16.6	17.5	17.1	14.4	11.8	8.3	13.9
	1956-57	8.6	9.8	12.8	15.8	16.9	17.1	17.5	17.2	15.5	14.5	11.3	8.2	13.8
	1957-58	9.4	10.7	15.9	17.7	18.8	17.8	18.5	18.3	15.5	14.8	11.3	8.2	14.8
	1958-59	7.6	8.7	14.3	16.4	18.1	17.7	17.6	17.0	16.1	14.8	13.0	9.6	14.2
	1959-60	10.2	10.3	12.7	16.7	17.2	18.6	16.6	17.0	15.6	14.6	10.5	10.3	14.2
	1960-61	7.5	11.3	13.3	16.7	17.7	18.1	17.3	16.7	17.2	15.5	12.5	9.4	14.4
	1961-62	9.3	9.3	13.5	17.2	16.9	17.5	17.6	17.1	15.5	14.9	9.9	8.6	14.0
	1962-63	8.7	10.3	12.4	16.7	17.9	17.9	16.7	16.5	15.2	13.7	8.9	7.2	13.5
	1963-64	7.9	9.3	13.1	16.9	17.5	17.2	17.2	17.1	16.0	13.9	11.4	7.8	13.8
	1964-65	6.9	10.3	12.6	17.0	17.4	17.2	17.2	16.5	15.1	13.3	10.4	8.3	13.5
	1965-66	8.8	10.5	12.6	15.3	18.0	18.2	18.5	17.9	15.5	14.4	11.0	10.0	14.2
	1966-67	8.4	10.9	13.7	16.3	17.7	18.8	18.6	17.4	16.2	15.2	12.0	10.7	14.7
	1967-68	8.3	10.5	12.8	17.3	17.5	17.3	18.5	17.2	16.3	14.9	12.7	7.0	14.2
	1968-69	9.4	11.5	13.6	17.4	16.6	17.9	18.0	17.7	17.1	15.1	10.9	9.6	14.6
	1969-70	8.7	11.1	13.5	17.6	17.5	17.8	17.3	16.6	15.4	13.9	11.1	10.3	14.2
	1970-71	9.7	11.5	15.3	16.2	18.0	17.4	17.6	16.0	15.8	15.2	11.1	8.5	14.3
	1971-72	9.2	11.7	13.6	16.0	17.0	17.7	17.8	16.3	16.3	14.6	11.2	7.6	14.1
	1972-73	7.9	9.4	13.8	16.8	16.4	18.8	18.5	18.1	17.3	14.8	12.7	10.1	14.6
	1973-74	8.9	9.7	14.8	17.2	16.9	17.6	17.4	17.7	16.2	13.5	11.3	7.9	14.1
	1974-75	8.7	11.7	12.8	16.2	17.8	17.6	17.0	17.1	16.0	14.9	12.1	9.2	14.2
	1975-76	8.1	9.6	13.1	15.2	17.6	17.8	17.4	17.2	16.8	14.1	10.6	8.7	13.9
	1976-77	7.2	8.5	13.8	16.5	18.1	17.5	17.4	17.8	16.9	13.6	11.9	8.8	14.0
	1977-78	8.4	10.8	14.9	17.2	17.8	18.2	18.3	18.1	16.9	14.4	10.9	8.0	14.5
	1978-79	7.6	11.2	14.5	17.3	16.4	17.0	16.8	17.4	16.4	13.8	11.1	8.6	14.0
	1979-80	8.4	11.1	15.2	18.0	17.8	16.9	17.2	18.3	16.2	14.7	10.8	8.0	14.4
	1980-81	7.4	9.9	14.7	16.4	18.0	17.6	18.1	18.0	16.7	13.6	10.2	7.4	14.0
	1981-82	7.5	9.8	13.2	15.5	18.3	17.7	17.6	17.3	16.1	15.2	11.0	9.8	14.1
	1982-83	9.7	11.0	13.1	16.3	18.5	18.4	19.3	17.6	17.7	16.2	13.6	11.1	15.2
	1983-84	9.8	10.0	14.7	16.8	18.7	18.0	17.2	17.1	17.3	14.9	13.0	9.7	14.8
	1984-85	10.0	10.4	15.5	18.2	17.7	17.9	17.8	16.5	17.0	13.6	11.5	8.0	14.5
	1985-86	9.0	10.5	14.6	16.5	16.8	18.0	17.4	16.6	15.7	15.1	10.6	7.7	14.0
	1986-87	7.9	10.3	13.5	16.9	17.3	17.3	17.3	17.6	17.1	14.2	13.1	7.9	14.2
	1987-88	7.8	11.4	15.4	16.0	18.9	19.1	18.3	17.8	17.0	16.0	11.2	9.2	14.8
	1988-89	8.9	9.8	12.8	16.7	16.0	17.6	17.5	17.7	15.8	13.9	10.7	9.3	13.9
	1989-90	8.9	11.2	14.3	16.0	17.6	17.6	18.0	17.0	15.8	15.3	11.8	9.8	14.4
	1990-91	8.8	10.0	12.8	17.2	17.5	18.1	18.1	17.6	16.9	12.5	11.6	9.0	14.2
	1991-92	8.7	10.0	14.7	15.8	16.8	17.7	17.8		18.3	15.3	12.2	9.5	
	1992-93	8.5	9.8	14.4	18.7	17.7		17.2	17.7	16.0	15.4	12.4	9.5	
	1993-94	10.4	10.4	13.7	18.5	18.4	18.0	18.1	16.4	15.0		1.0		
MEAN	1951-92	8.4	10.4	13.7	16.7	17.5	17.8	17.7	17.3	16.2	14.5	11.4	8.8	14.2
STDV	1951-92	.9	.8	1.0	.7	.7	.5	.6	.6	.7	.7	1.0	1.1	.4

Table D-18 MONTHLY AND ANNUAL AVERAGE WIND SPEED AT KADOMA

ZIMBABWE 67869 KADOMA COTTON RES. INST. LAT: 18 19 LONG: 29 53 ELEV: 1149 M

WIND SPEED (CUP, KNOTS/HR)

		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
	1951-52	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9***
	1952-53	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9***
	1953-54	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9***
	1954-55	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9***
	1955-56	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9***
	1956-57	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9***
	1957-58	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9***
	1958-59	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9***
	1959-60	3.1	3.6	3.9	3.9	3.5	3.0	2.7	2.4	2.6	2.6	2.4	3.0	3.1
	1960-61	3.3	3.1	3.8	4.3	3.4	2.7	2.5	2.4	2.1	2.0	2.0	2.5	2.8
	1961-62	2.9	3.4	3.5	3.5	3.1	2.8	2.2	1.9	2.5	2.3	2.3	1.7	2.7
	1962-63	2.3	2.6	3.0	3.4	2.2	1.7	2.0	2.1	2.1	2.1	2.3	2.2	2.3
	1963-64	3.0	3.4	3.7	4.0	3.6	3.0	2.4	1.9	2.1	3.2	3.5	3.1	3.1
	1964-65	4.0	4.2	4.3	4.9	4.1	3.7	2.7	2.0	2.6	3.2	3.0	3.4	3.5
	1965-66	3.7	4.2	5.0	5.0	4.3	4.2	3.9	2.7	2.5	3.0	2.8	3.4	3.7
	1966-67	3.2	3.8	4.6	4.6	4.3	4.2	3.8	2.5	2.2	2.7	2.9	3.6	3.5
	1967-68	3.8	4.9	5.2	5.1	4.7	4.5	4.2	3.5	3.4	3.2	3.5	3.6	4.1
	1968-69	3.5	4.7	5.5	5.9	5.1	4.1	3.3	2.5	2.6	2.8	3.4	3.5	3.9
	1969-70	4.4	4.9	5.4	5.3	5.0	4.4	3.5	3.7	3.3	3.2	3.6	4.7	4.3
	1970-71	4.9	5.3	5.7	7.4	6.0	5.5	4.6	4.4	4.9	5.0	6.0	6.0	5.5
	1971-72	5.5	5.8	7.2	7.8	6.4	5.5	4.2	4.5	4.6	4.8	5.2	5.8	5.6
	1972-73	5.9	6.1	6.6	7.2	7.2	6.0	5.2	4.8	4.8	6.3	5.3	6.8	6.0
	1973-74	6.6	6.6	6.8	7.8	6.0	5.1	3.8	4.0	4.9	5.2	4.6	5.0	5.5
	1974-75	6.3	5.6	7.4	7.3	6.8	4.9	4.0	3.9	4.8	4.7	5.4	6.1	5.6
	1975-76	5.2	7.1	6.8	7.8	7.1	5.4	4.6	4.8	5.0	5.1	5.4	5.1	5.8
	1976-77	4.9	6.0	6.2	6.6	5.4	4.9	4.4	4.0	4.4	4.9	5.0	5.3	5.2
	1977-78	6.1	6.4	6.9	7.3	6.2	5.2	4.4	4.2	4.5	4.7	4.3	5.9	5.5
	1978-79	5.9	5.0	6.1	6.8	6.1	5.5	5.2	5.0	5.1	5.5	5.7	6.3	5.7
	1979-80	6.6	6.2	7.2	7.1	5.9	5.1	4.6	4.4	4.7	4.8	5.5	5.6	5.7
	1980-81	6.6	7.2	6.9	6.7	5.9	4.6	4.1	4.3	4.3	5.2	5.7	5.4	5.6
	1981-82	5.8	6.0	7.0	7.5	6.1	5.4	4.1	4.6	4.8	5.2	5.2	5.5	5.6
	1982-83	6.7	6.4	7.3	6.7	5.5	5.0	4.2	4.2	4.9	4.6	4.9	4.8	5.4
	1983-84	5.6	6.2	9999.9	6.2	5.5	4.9	5.1	4.8	4.8	4.9	4.9	5.8	5.3**
	1984-85	5.7	6.1	6.7	7.0	6.4	4.8	4.4	4.6	4.2	4.7	5.3	5.4	5.4
	1985-86	5.3	6.5	6.1	7.2	6.4	5.1	4.7	3.6	4.2	4.3	4.4	4.9	5.2
	1986-87	5.3	7.1	6.6	5.9	5.9	4.9	4.1	3.9	4.4	5.4	5.2	5.8	5.4
	1987-88	5.7	5.7	6.3	7.1	7.5	5.3	4.5	3.7	3.9	3.8	4.7	4.3	5.2
	1988-89	4.5	5.8	6.2	6.3	6.3	4.9	3.3	3.9	3.5	4.7	4.5	4.8	4.9
	1989-90	5.1	5.7	6.5	7.0	6.5	5.3	4.7	2.4	2.2	5.2	5.4	4.9	5.1
	1990-91	6.0	7.6	7.8	7.2	6.8	4.9	4.6	3.0	4.7	7.4	6.9	6.6	6.1
	1991-92	6.8	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	6.8**
MEAN	1951-92	5.0	5.4	5.9	6.2	5.5	4.6	3.9	3.6	3.8	4.3	4.4	4.7	4.7
STDV	1951-92	1.3	1.3	1.3	1.4	1.3	1.0	.9	1.0	1.1	1.3	1.3	1.3	1.1

Table D-19 MONTHLY AND ANNUAL CLOUD AMOUNT AT KADOMA

ZIMBABWE 67869 KADOMA COTTON RES. INST. LAT: 18 19 LONG: 29 53 ELEV: 1149 M

CLOUD AMOUNT (OKTAS)

		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
	1951-52	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
	1952-53	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
	1953-54	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
	1954-55	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
	1955-56	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
	1956-57	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
	1957-58	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
	1958-59	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	2.7	1.4	1.9	2.0**
	1959-60	2.6	1.1	1.2	1.7	3.6	5.7	3.8	4.7	3.3	3.5	2.2	3.3	3.1
	1960-61	1.8	.4	1.0	1.7	5.4	5.2	5.9	4.9	5.0	3.2	1.5	2.5	3.2
	1961-62	3.2	2.3	1.1	2.2	5.4	5.0	6.0	5.0	4.4	4.6	2.7	1.2	3.6
	1962-63	1.7	1.0	.5	1.0	5.8	6.8	4.6	6.1	4.2	3.5	1.3	1.0	3.1
	1963-64	1.0	1.3	1.0	3.1	4.0	5.2	5.0	4.6	2.0	1.5	2.9	1.4	2.7
	1964-65	1.2	1.7	.5	2.4	4.5	6.0	5.8	4.4	3.2	1.8	1.3	1.6	2.9
	1965-66	.9	.7	1.8	2.9	5.5	4.9	5.4	6.7	3.9	3.9	2.2	2.9	3.5
	1966-67	1.0	1.5	1.6	1.8	3.8	5.5	6.3	5.6	4.4	3.3	3.1	3.0	3.4
	1967-68	3.1	2.2	1.6	2.8	4.0	4.0	4.2	4.3	3.3	2.9	1.8	1.1	2.9
	1968-69	.9	.4	.8	1.2	5.4	5.4	5.6	4.0	5.8	2.6	1.3	1.8	2.9
	1969-70	1.5	1.9	1.2	4.1	3.9	6.5	3.1	3.6	2.0	2.8	1.0	2.4	2.8
	1970-71	.7	1.4	1.1	2.2	5.3	3.8	5.6	3.2	2.7	2.2	1.8	1.4	2.6
	1971-72	1.3	.4	1.1	2.2	4.8	4.9	6.2	4.9	3.8	3.4	1.8	1.0	3.0
	1972-73	1.6	.4	.9	2.6	2.6	3.7	4.0	4.4	2.4	2.7	1.6	2.7	2.5
	1973-74	1.3	1.2	.8	2.7	4.7	6.3	5.5	5.7	4.0	3.4	3.3	1.0	3.3
	1974-75	1.9	1.5	1.8	1.4	5.2	6.1	5.1	5.4	4.5	3.8	1.7	1.8	3.4
	1975-76	.9	1.3	.7	1.7	2.8	6.2	5.2	5.1	5.4	4.3	2.9	1.8	3.2
	1976-77	.9	.6	2.2	3.2	4.0	5.6	4.1	6.0	5.0	2.4	2.3	1.5	3.1
	1977-78	1.6	1.4	1.9	1.9	3.8	6.0	6.2	5.3	4.9	4.1	2.8	1.7	3.5
	1978-79	2.3	.4	.7	3.5	3.6	6.0	4.6	4.2	4.7	2.4	2.1	1.3	3.0
	1979-80	1.5	1.2	.9	3.9	5.3	5.4	4.1	5.3	4.1	3.7	1.0	1.6	3.2
	1980-81	1.0	1.4	2.0	2.8	4.8	5.4	5.9	6.6	4.7	3.4	2.9	.8	3.5
	1981-82	1.2	.6	1.7	3.1	4.2	4.4	5.1	4.5	2.9	3.6	2.1	1.8	2.9
	1982-83	2.0	1.1	1.8	3.7	5.2	4.3	4.8	4.3	4.0	3.5	2.3	1.5	3.2
	1983-84	1.6	1.3	.5	3.0	4.2	5.4	4.1	4.3	4.9	2.5	2.2	2.0	3.0
	1984-85	2.6	.8	1.0	3.2	5.4	5.9	6.1	4.8	4.5	3.0	3.1	1.8	3.5
	1985-86	2.8	1.5	2.3	2.8	4.3	6.6	5.7	4.7	4.1	4.3	1.7	1.2	3.5
	1986-87	.9	1.0	1.6	4.1	3.7	4.7	5.0	4.0	3.8	1.7	2.6	1.1	2.9
	1987-88	.6	1.4	1.8	3.0	3.7	6.6	4.8	5.5	5.0	4.4	2.8	2.6	3.5
	1988-89	1.2	.9	1.3	2.9	4.0	5.7	5.8	6.9	4.6	3.8	2.0	2.2	3.4
	1989-90	2.1	1.8	1.3	3.0	4.7	5.6	6.3	5.2	3.4	3.8	2.9	2.8	3.6
	1990-91	.7	1.9	1.4	2.4	3.0	5.2	5.6	5.4	4.2	1.9	2.1	1.7	3.0
	1991-92	1.1	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	1.1**
MEAN	1951-92	1.5	1.2	1.3	2.6	4.4	5.4	5.2	5.0	4.0	3.2	2.1	1.8	3.2
STDV	1951-92	.7	.5	.5	.8	.8	.8	.8	.9	.9	.8	.7	.7	.3

Table D-20 MONTHLY AND ANNUAL SUNSHINE DURATION AT KADOMA

ZIMBABWE 67869 KADOMA COTTON RES. INST. LAT: 18 19 LONG: 29 53 ELEV: 1149 M

SUNSHINE DURATION (HRS)

		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
	1951-52	9.7	9.2	10.1	6.1	7.8	6.5	4.9	6.0	8.9	8.2	7.9	8.2	7.8
	1952-53	9.3	9.2	9999.9	7.5	6.3	6.3	3.8	6.2	6.1	8.4	8.7	9.9	7.4**
	1953-54	9.8	9.7	9.6	8.9	5.7	5.9	6.5	6.6	8.5	8.7	9.4	9.4	8.2
	1954-55	9.5	9.7	9.4	9.6	6.2	4.2	6.9	8.1	6.8	7.6	8.8	8.7	8.0
	1955-56	9.1	9.6	8.8	8.4	8.1	6.3	6.7	6.2	6.5	6.9	8.7	8.2	7.8
	1956-57	8.8	10.2	9.3	9.9	4.7	5.4	7.4	7.4	8.1	9.4	8.0	9.3	8.2
	1957-58	9.8	9.2	8.4	7.7	7.5	6.2	4.9	3.2	9.2	8.8	9.3	9.1	7.8
	1958-59	9.1	9.9	9.7	7.3	7.7	6.0	6.7	5.8	7.4	9.2	9.6	8.6	8.1
	1959-60	7.7	9.9	9.6	10.3	7.6	4.8	9.2	7.2	9.2	7.8	8.6	6.8	8.2
	1960-61	8.8	10.3	10.2	10.4	5.3	6.5	5.4	7.6	6.5	8.3	9.8	8.1	8.1
	1961-62	7.3	9.0	10.0	9.8	6.1	8.1	5.2	8.2	9.3	7.5	8.5	9.3	8.2
	1962-63	8.4	9.5	10.4	10.7	5.0	3.0	8.1	4.5	8.0	7.7	8.7	8.0	7.7
	1963-64	8.4	8.1	8.4	6.8	7.6	5.8	6.3	5.4	9.4	9.5	6.8	8.2	7.6
	1964-65	8.8	8.4	9.9	8.2	6.4	3.6	6.1	9.4	8.8	10.3	10.1	9.8	8.3
	1965-66	10.3	10.5	9.8	9.0	6.1	8.1	7.7	4.3	8.7	8.3	10.0	8.2	8.4
	1966-67	10.0	9.8	10.0	10.3	8.3	6.8	5.4	6.4	8.2	9.0	7.8	7.4	8.3
	1967-68	7.4	8.9	9.9	8.1	7.8	7.7	8.6	7.3	9.1	8.5	9.5	9.7	8.5
	1968-69	9.9	10.7	10.3	10.6	5.5	6.3	6.6	8.7	4.5	9.0	9.9	8.7	8.4
	1969-70	9.3	9.0	10.3	6.4	7.2	2.7	9.7	8.5	10.0	8.5	10.4	8.4	8.4
	1970-71	10.1	9.5	9.8	10.3	5.8	9.1	6.3	9.6	9.9	9.4	9.4	9.8	9.1
	1971-72	9.6	10.8	10.3	9.9	7.2	8.1	5.0	8.1	8.3	8.7	9.7	10.3	8.8
	1972-73	9.5	10.8	10.6	9.4	9.6	9.0	8.9	8.3	10.0	9.0	9.7	8.0	9.4
	1973-74	10.2	10.3	10.6	9.0	7.0	5.0	6.9	6.2	8.6	8.0	7.8	10.0	8.3
	1974-75	9.0	9.6	10.1	10.4	6.3	5.7	7.4	6.8	8.5	8.0	10.1	9.4	8.4
	1975-76	10.0	10.4	10.7	10.1	9.5	5.4	7.3	7.4	5.9	7.5	8.4	9.2	8.5
	1976-77	10.2	10.6	9.6	8.3	8.0	6.0	9.6	5.2	6.6	10.3	9.4	9.8	8.6
	1977-78	8.9	9.7	8.9	10.6	8.1	5.5	5.4	6.7	6.7	7.6	8.4	9.3	8.0
	1978-79	8.7	10.8	10.4	8.3	9.6	6.0	8.7	9.2	7.2	10.1	9.2	9.4	9.0
	1979-80	10.0	10.4	10.4	7.7	7.1	5.9	9.6	7.1	8.6	8.5	10.4	10.0	8.8
	1980-81	10.0	10.0	10.1	9.3	7.4	7.3	6.4	4.2	7.4	8.8	8.5	10.4	8.3
	1981-82	10.1	10.6	9.5	9.6	7.8	9.3	8.1	8.7	9.8	9.0	9.2	9.5	9.3
	1982-83	9.3	10.2	9.8	8.1	7.8	8.5	8.1	9.1	8.4	8.4	9.3	9.6	8.9
	1983-84	9.7	10.3	10.7	8.9	7.6	6.9	9.5	8.5	7.8	9.4	8.9	9.2	9.0
	1984-85	8.2	10.6	10.0	8.4	6.6	7.0	5.9	7.6	8.4	9.3	8.1	9.1	8.3
	1985-86	9.0	9.8	8.6	9.4	8.9	4.4	6.3	8.4	8.6	7.2	9.5	9.8	8.3
	1986-87	10.3	10.6	9.8	8.3	9.3	7.6	8.6	10.1	8.9	10.9	9.1	10.3	9.5
	1987-88	10.4	9.9	9.6	9.8	8.9	5.6	9.5	7.4	7.8	8.7	9.0	9.1	8.8
	1988-89	10.4	10.7	10.6	9.4	9.5	7.5	7.2	4.0	8.4	8.8	10.2	9.1	8.8
	1989-90	9.5	9.3	9.8	8.7	8.6	8.8	6.5	8.1	9.7	8.7	9.8	8.6	8.8
	1990-91	10.3	10.2	10.5	10.4	9.5	7.4	8.2	8.8	8.7	10.6	10.2	10.0	9.6
	1991-92		10.8	10.1	9.2		7.5	9.9	7.4	9.3	9.9	10.1		
	1992-93	10.5	10.4	10.6	10.3	8.2		7.3	7.9	8.6	8.4	10.6	9.5	
	1993-94	7.8	9.8	9.6	10.7	7.5	7.9	6.9	8.9	10.8			9.5	
	1994-95	10.2												
MEAN	1951-92	9.4	9.9	9.9	9.0	7.4	6.4	7.1	7.2	8.2	8.7	9.1	9.1	8.5
STDV	1951-92	.8	.7	.6	1.2	1.4	1.6	1.5	1.7	1.2	.9	.8	.8	.5

Table D-21 MONTHLY AND ANNUAL PAN EVAPORATION AT KADOMA

ZIMBABWE 67869 KADOMA COTTON RES. INST. LAT: 18 19 LONG: 29 53 ELEV: 1149 M

PAN EVAPORATION (MM)

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
1951-52	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
1952-53	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
1953-54	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
1954-55	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
1955-56	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
1956-57	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
1957-58	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
1958-59	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
1959-60	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
1960-61	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
1961-62	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
1962-63	3.9	5.5	7.9	9.3	5.3	3.7	5.6	3.9	4.9	4.2	3.9	3.4	5.1
1963-64	4.5	5.8	7.8	8.2	7.8	5.4	4.7	4.4	6.5	6.6	5.1	4.8	6.0
1964-65	4.9	5.8	8.6	9.8	7.5	5.0	4.9	5.7	5.9	6.3	5.3	4.7	6.2
1965-66	5.1	6.4	7.5	8.8	6.2	7.7	7.0	3.6	4.8	4.7	4.7	3.9	5.9
1966-67	4.6	5.7	7.9	9.4	7.9	6.4	4.6	4.4	4.7	4.8	4.0	4.2	5.7
1967-68	4.0	5.5	7.8	7.9	7.4	6.8	7.6	5.3	6.3	5.5	5.1	4.2	6.1
1968-69	4.7	6.3	8.8	10.2	6.2	5.3	5.1	5.7	3.5	4.2	4.2	4.1	5.7
1969-70	4.4	5.7	8.2	6.5	6.4	3.8	6.6	5.8	6.9	5.0	5.4	4.5	5.8
1970-71	5.3	6.6	8.1	10.3	6.1	7.0	4.8	6.7	7.2	6.2	5.6	5.0	6.6
1971-72	5.1	6.9	9.0	9.4	6.5	7.1	4.1	5.5	5.0	4.4	4.5	4.3	6.0
1972-73	4.7	6.5	8.3	8.6	9.0	8.2	7.1	5.6	6.7	6.2	5.4	4.7	6.7
1973-74	5.5	6.5	9.1	8.9	5.7	3.9	4.0	4.1	4.9	4.4	3.7	4.3	5.4
1974-75	4.4	5.7	8.8	10.4	6.4	4.7	4.9	4.5	5.3	4.9	5.1	4.5	5.8
1975-76	4.8	6.6	9.2	10.0	9.4	5.4	5.2	5.3	3.9	4.2	4.0	3.8	6.0
1976-77	4.3	6.0	7.9	7.6	7.1	5.5	6.6	3.8	4.4	5.8	5.2	5.0	5.7
1977-78	4.8	5.7	7.7	10.7	8.5	5.0	3.9	4.8	4.4	4.4	3.9	3.6	5.6
1978-79	4.1	6.2	8.5	8.0	8.2	4.8	6.5	6.3	5.4	6.5	5.4	5.2	6.3
1979-80	5.2	7.0	9.3	8.5	6.4	4.5	6.6	5.4	5.3	5.1	5.6	5.0	6.1
1980-81	4.9	7.3	7.9	9.2	6.7	5.1	4.5	3.3	3.3	4.4	3.9	4.2	5.4
1981-82	4.4	5.9	7.2	8.2	8.3	7.0	5.4	6.0	6.3	6.1	5.1	5.1	6.2
1982-83	5.6	6.7	8.7	7.5	7.4	7.3	7.0	6.7	6.8	6.2	5.7	5.2	6.7
1983-84	5.4	6.7	8.5	8.6	8.4	6.6	7.5	6.5	5.9	5.7	5.2	4.8	6.6
1984-85	5.1	6.6	9.0	9.2	7.0	5.1	5.0	4.5	5.1	5.1	5.0	4.8	6.0
1985-86	4.8	7.0	7.5	9.4	8.3	4.8	4.9	5.4	5.1	4.0	4.3	4.2	5.8
1986-87	5.0	6.4	7.9	7.5	7.7	5.7	6.0	6.8	6.4	6.9	5.9	5.1	6.4
1987-88	5.3	6.1	8.3	9.1	9.5	5.4	6.7	4.5	4.5	4.4	4.3	3.9	6.0
1988-89	4.3	6.3	8.6	8.2	8.4	6.4	5.1	3.2	4.7	4.6	4.6	4.2	5.7
1989-90	4.7	5.6	8.1	8.0	7.8	6.6	4.9	4.6	5.8	4.1	4.7	4.2	5.8
1990-91	4.8	6.1	7.7	9.4	8.7	6.0	5.6	4.8	5.4	5.5	5.1	4.4	6.1
1991-92	4.8	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	4.8**
MEAN 1951-92	4.8	6.3	8.3	8.8	7.5	5.7	5.6	5.1	5.3	5.2	4.8	4.5	6.0
STDV 1951-92	.4	.5	.6	1.0	1.1	1.2	1.1	1.0	1.0	.9	.6	.5	.4
	148.9	195.3	249.4	272.8	225.4	176.7	173.6	142.8	164.3	156.0	148.8	135.0	2128.1 mm/year

Table D-22 MONTHLY AND ANNUAL SOLAR RADIATION AT KADOMA

ZIMBABWE 67869 KADOMA COTTON RES. INST. LAT: 18 19 LONG: 29 53 ELEV: 1149 M

SOLAR RADIATION (MJ/DAY)

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
1970-71	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	20.2	23.9	24.2	21.6	19.1	17.9	21.1**
1971-72	18.5	22.0	23.8	24.6	22.6	24.9	19.5	23.8	22.3	20.9	20.2	18.8	21.8
1972-73	18.5	21.8	24.2	24.0	25.5	24.7	23.9	23.0	25.0	20.8	19.1	16.5	22.3
1973-74	19.6	21.6	24.2	23.9	22.2	19.3	21.4	21.3	22.6	19.5	18.1	18.7	21.0
1974-75	17.9	20.1	24.0	25.5	20.4	21.6	22.5	21.8	23.2	20.4	20.8	18.4	21.4
1975-76	18.8	22.0	26.3	27.1	27.8	21.2	25.0	24.1	20.3	20.5	19.8	19.3	22.7
1976-77	20.8	23.8	24.0	23.4	25.3	23.2	28.0	20.9	21.5	24.7	20.3	20.2	23.0
1977-78	19.2	21.9	22.3	26.9	24.8	22.6	21.6	23.6	21.6	20.9	18.3	19.2	21.9
1978-79	19.2	22.6	23.3	23.3	26.4	20.8	26.6	26.6	22.5	25.0	20.6	19.1	23.0
1979-80	20.4	21.4	23.7	22.9	22.6	15.2	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	21.0**

Table D-23 MONTHLY AND ANNUAL MAXIMUM TEMPREATURES AT GOKWE

ZIMBABWE 67861 GOKWE LAT: 18 13 LONG: 28 56 ELEV: 1282 M

MAX. TEMPERATURES (DEG. C)

		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
	1963-64	22.8	24.9	28.9	30.9	29.8	27.0	27.0	26.9	29.6	27.8	24.1	22.3	26.8
	1964-65	21.1	24.3	28.2	31.2	29.2	25.7	25.3	28.0	28.0	27.7	24.2	22.4	26.3
	1965-66	22.4	25.1	27.2	29.1	28.6	29.4	29.5	25.5	26.6	25.7	25.3	22.7	26.4
	1966-67	23.6	25.8	28.9	31.3	30.9	28.2	26.1	26.1	26.8	26.8	24.0	22.9	26.8
	1967-68	21.0	23.9	28.0	30.3	29.0	27.8	29.2	27.3	28.5	27.6	26.0	21.6	26.7
	1968-69	23.8	26.6	28.8	32.4	26.4	27.1	27.0	28.1	25.1	26.3	24.0	23.2	26.6
	1969-70	22.4	24.7	28.8	30.0	29.7	24.5	28.3	27.9	29.6	26.5	26.1	22.9	26.8
	1970-71	24.4	25.9	30.5	30.9	28.2	28.4	25.1	26.8	28.7	28.4	24.4	22.2	27.0
	1971-72	22.8	26.5	28.5	30.4	27.5	28.2	25.0	26.5	26.1	25.9	25.0	22.1	26.2
	1972-73	22.0	25.2	29.5	30.8	29.9	31.4	29.4	27.7	29.4	27.4	26.5	21.9	27.6
	1973-74	22.8	24.4	30.1	30.7	28.1	24.9	25.7	25.4	26.0	24.3	23.2	22.3	25.7
	1974-75	21.7	25.9	27.5	31.2	27.9	25.6	26.8	25.8	26.4	26.3	25.6	22.2	26.1
	1975-76	23.3	23.8	29.1	29.4	31.2	26.7	26.3	25.8	24.9	24.5	22.7	22.1	25.8
	1976-77	22.3	23.6	28.8	29.7	30.7	27.9	29.1	25.7	25.6	26.2	25.7	23.4	26.6
	1977-78	22.7	25.2	28.6	32.3	30.8	26.2	25.4	26.1	25.9	24.3	23.2	21.3	26.0
	1978-79	21.0	27.2	29.7	29.9	28.7	25.6	27.2	29.0	26.7	27.7	25.2	22.4	26.7
	1979-80	22.5	26.1	29.9	29.7	28.1	25.1	28.4	27.5	26.9	27.1	25.6	22.0	26.6
	1980-81	21.3	24.6	29.4	30.4	28.9	27.1	26.6	25.2	26.0	25.9	23.2	22.3	25.9
	1981-82	22.4	25.9	28.4	29.3	30.9	29.8	27.3	28.3	29.7	27.7	25.1	23.9	27.4
	1982-83	22.8	25.4	28.2	28.8	30.1	29.9	29.2	28.9	29.5	28.9	26.6	24.6	27.7
	1983-84	23.7	24.5	30.6	29.7	31.8	27.3	29.2	27.6	27.3	26.7	25.6	22.3	27.2
	1984-85	23.1	25.2	30.2	31.0	28.4	27.5	26.6	26.1	27.5	26.3	24.1	22.3	26.5
	1985-86	22.9	24.8	28.4	29.9	29.9	26.8	26.1	26.2	26.7	24.6	24.1	22.0	26.0
	1986-87	22.5	25.9	28.3	28.9	29.4	27.8	28.3	29.8	30.0	29.5	26.8	22.6	27.5
	1987-88	22.5	25.4	29.6	29.9	31.8	27.2	28.7	26.3	26.4	27.1	24.4	23.2	26.9
	1988-89	22.7	25.5	29.0	30.2	29.5	27.8	27.3	24.5	27.0	25.4	24.6	22.5	26.3
	1989-90	22.6	25.4	28.7	29.7	29.9	29.7	26.2	26.5	28.7	26.4	24.8	23.9	26.9
	1990-91	24.6	24.6	28.1	31.5	31.1	28.8	27.8	27.8	28.2	26.4	25.5	23.1	27.3
	1991-92	22.6	26.2	30.1	23.0	28.4	28.0	29.3	32.1	28.7	28.4	26.5	23.8	
	1992-93	22.7	25.0	30.3	32.2	30.5	27.3	27.2	26.4	26.7	27.0	26.8	23.3	
	1993-94	22.3	24.6	28.4	31.6	28.2	28.2	27.0	27.3	29.7	28.3	25.7		
MEAN	1963-92	22.6	25.2	28.9	30.3	29.5	27.5	27.3	26.9	27.4	26.6	24.8	22.6	26.6
STDV	1963-92	.9	.9	.9	.9	1.4	1.7	1.4	1.3	1.5	1.3	1.1	.7	.6

Table D-24 MONTHLY AND ANNUAL MINIMUM TEMPREATURES AT GOKWE

ZIMBABWE 67861 GOKWE LAT: 18 13 LONG: 28 56 ELEV: 1282 M

MIN. TEMPERATURES (DEG. C)

		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
	1963-64	9.2	10.6	14.6	18.1	17.9	16.7	17.0	17.2	16.7	13.6	10.9	6.6	14.1
	1964-65	6.2	9.7	13.0	17.3	17.8	17.0	16.7	16.7	16.0	14.2	10.7	7.9	13.6
	1965-66	7.8	10.7	13.9	15.2	18.0	17.8	17.8	17.4	15.5	13.7	10.2	10.0	14.0
	1966-67	7.8	11.1	13.9	17.0	18.3	18.2	18.0	17.0	16.3	15.6	12.0	10.5	14.6
	1967-68	7.4	10.1	14.2	17.9	17.7	16.7	17.3	16.7	16.1	14.8	11.8	5.9	13.9
	1968-69	8.8	11.3	13.5	17.7	16.7	17.2	17.8	17.5	16.8	14.9	10.8	8.7	14.3
	1969-70	8.9	12.0	13.9	18.2	18.0	17.0	17.7	17.1	16.4	14.6	10.9	8.8	14.5
	1970-71	8.8	12.2	16.4	17.4	18.0	17.5	16.8	16.5	16.9	16.0	10.7	8.4	14.6
	1971-72	8.3	11.5	14.7	16.7	16.7	17.4	17.1	16.4	16.5	14.8	11.6	7.4	14.1
	1972-73	8.3	10.3	14.6	18.0	16.8	19.1	18.4	17.5	17.7	14.7	11.4	10.2	14.8
	1973-74	9.0	10.3	14.9	17.7	17.5	16.8	17.0	17.3	16.4	13.5	11.1	7.5	14.1
	1974-75	8.0	11.7	14.0	17.7	17.5	16.9	16.7	17.1	16.2	15.0	12.2	8.9	14.3
	1975-76	8.1	10.1	15.1	15.9	18.2	17.3	17.0	16.7	16.7	14.4	10.3	8.4	14.0
	1976-77	6.8	8.2	14.7	16.8	18.1	17.4	17.6	17.4	16.5	13.4	12.1	7.4	13.9
	1977-78	8.0	10.9	15.3	18.8	18.6	17.8	17.8	17.9	17.0	14.3	10.8	8.0	14.6
	1978-79	8.3	11.1	15.8	17.9	17.2	16.7	16.7	17.9	16.5	14.7	11.7	9.0	14.5
	1979-80	8.4	11.8	15.8	17.8	17.8	16.9	17.6	17.9	16.6	14.8	11.1	7.8	14.5
	1980-81	8.4	11.4	15.1	17.0	18.2	17.4	17.7	17.6	16.7	14.1	10.4	7.7	14.3
	1981-82	7.7	10.7	13.8	15.7	18.6	17.8	17.9	17.8	17.0	15.4	11.4	9.8	14.5
	1982-83	9.8	12.0	15.1	17.0	18.4	18.7	19.1	18.2	18.1	16.9	13.6	11.4	15.7
	1983-84	9.9	10.6	16.3	17.4	19.8	17.9	17.8	17.3	17.1	15.4	13.1	9.5	15.2
	1984-85	10.7	11.4	16.3	18.8	17.5	17.6	17.8	16.9	16.9	13.8	11.7	8.8	14.9
	1985-86	9.0	11.6	14.8	17.1	17.0	17.0	17.0	16.4	16.1	14.8	10.5	8.7	14.2
	1986-87	8.4	11.4	14.7	17.5	18.3	17.6	17.9	18.6	18.7	16.8	14.5	9.5	15.3
	1987-88	9.4	13.1	17.4	17.5	19.9	18.4	18.6	17.9	17.7	16.7	12.4	10.0	15.7
	1988-89	9.9	12.0	15.6	18.0	17.3	17.8	17.8	17.4	16.9	15.0	12.5	10.4	15.1
	1989-90	9.3	13.1	16.0	17.5	18.4	18.0	17.7	17.2	17.6	16.5	13.1	11.3	15.5
	1990-91	10.7	11.7	14.0	18.5	18.7	18.3	18.1	18.4	17.8	14.7	13.4	10.5	15.4
	1991-92	9.7	12.4	17.3	17.8	17.8	17.9	18.3	19.6	18.6	17.3	14.4	10.9	
	1992-93	10.4	11.4	17.1	19.5	18.6	17.9	18.3	17.6	16.6	16.5	13.3	10.2	3
	1993-94	11.0	11.7	15.5	18.9	18.3	18.2	17.9	17.2	17.4	15.9	13.1		
MEAN	1963-92	8.6	11.2	14.9	17.4	18.0	17.5	17.6	17.4	16.8	14.9	11.7	8.9	14.6
STDV	1963-92	1.0	1.0	1.0	.8	.8	.6	.6	.6	.7	1.0	1.1	1.4	.6

Table D-25 MONTHLY AND ANNUAL AVERAGE WIND SPEED AT GOKWE

ZIMBABWE 67861 GOKWE LAT: 18 13 LONG: 28 56 ELEV: 1282 M

WIND SPEED (CUP, KNOTS/HR)

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
1963-64	4.1	4.2	4.6	4.6	4.3	3.9	3.6	3.6	3.6	4.0	4.1	3.9	4.0
1964-65	4.5	4.5	4.7	5.0	4.5	3.7	3.3	2.9	3.7	4.1	4.0	4.0	4.1
1965-66	3.7	4.1	5.1	4.9	4.5	3.2	3.6	2.9	3.6	3.6	3.4	4.1	3.9
1966-67	3.4	3.8	4.4	4.6	4.1	3.8	3.6	3.6	4.0	3.3	3.7	3.6	3.8
1967-68	4.1	4.3	4.7	4.8	4.1	3.5	2.8	3.1	3.7	3.4	3.6	4.1	3.8
1968-69	3.6	3.8	4.7	4.8	4.6	3.5	3.0	2.9	3.6	3.4	3.6	3.3	3.7
1969-70	4.2	4.3	4.5	4.4	4.2	3.8	3.3	3.6	4.0	3.7	3.3	3.4	3.9
1970-71	3.6	4.2	4.8	5.4	4.3	4.0	3.6	3.9	3.9	3.5	4.0	3.8	4.1
1971-72	3.8	4.0	5.0	5.2	4.3	3.6	3.0	3.6	3.8	3.8	4.1	4.2	4.0
1972-73	4.1	4.6	4.8	5.1	4.9	4.0	3.3	3.3	3.4	4.2	3.5	4.0	4.1
1973-74	4.2	4.2	4.6	5.7	4.7	4.0	3.5	3.8	4.6	4.6	3.8	4.0	4.3
1974-75	4.6	4.3	5.2	5.0	4.2	3.8	3.5	3.4	4.3	3.7	4.2	4.2	4.2
1975-76	3.8	4.7	4.9	5.1	4.5	3.4	3.4	3.8	3.8	4.8	4.0	3.7	4.2
1976-77	3.6	4.3	4.6	4.7	4.2	3.5	3.3	3.1	3.4	3.4	3.3	3.2	3.7
1977-78	3.7	4.0	4.4	4.6	4.2	3.6	3.2	3.3	3.9	4.1	3.6	4.8	4.0
1978-79	4.8	4.0	4.9	5.2	5.0	4.7	4.0	4.0	3.8	3.8	4.5	4.9	4.5
1979-80	5.2	4.8	5.5	5.2	4.3	4.3	3.6	3.4	4.2	4.0	4.2	4.1	4.4
1980-81	5.0	5.6	5.2	5.2	4.3	3.5	3.2	3.8	3.6	4.2	4.1	3.9	4.3
1981-82	4.0	4.4	5.2	5.5	4.4	4.1	3.2	3.6	3.7	3.6	3.7	3.7	4.1
1982-83	4.6	4.4	5.5	5.1	4.3	3.7	3.3	3.3	3.9	3.6	3.8	3.9	4.1
1983-84	4.2	9999.9	4.7	9999.9	4.6	3.7	3.6	3.7	9999.9	3.8	3.9	4.0	4.0**
1984-85	9999.9	4.5	9999.9	9999.9	4.5	9999.9	9999.9	3.7	9999.9	3.6	3.8	4.1	4.0**
1985-86	4.1	4.9	4.8	5.5	4.8	3.8	4.2	2.9	9999.9	3.5	3.0	3.6	4.1**
1986-87	3.6	3.4	4.7	4.0	4.1	3.9	3.2	2.9	3.2	4.4	4.0	4.5	3.8
1987-88	4.6	4.5	5.2	6.1	5.0	3.7	3.2	3.2	3.7	3.5	3.8	3.2	4.1
1988-89	3.4	4.6	4.9	4.9	5.1	4.0	3.6	4.0	3.0	4.4	3.8	4.0	4.1
1989-90	4.3	4.7	5.5	5.8	5.5	4.6	4.2	3.4	3.9	4.6	4.5	4.6	4.6
1990-91	5.0	5.5	7.0	6.0	5.6	3.9	3.6	2.7	3.8	6.1	5.2	4.6	4.9
1991-92	4.7	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	4.7**
MEAN 1963-92	4.2	4.4	5.0	5.1	4.5	3.8	3.4	3.4	3.8	4.0	3.9	4.0	4.1
STDV 1963-92	.5	.5	.5	.5	.4	.3	.3	.4	.3	.6	.4	.4	.3

Table D-26 MONTHLY AND ANNUAL CLOUD AMOUNT AT GOKWE

ZIMBABWE 67861 GOKWE LAT: 18 13 LONG: 28 56 ELEV: 1282 M

CLOUD AMOUNT (OKTAS)

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
1963-64	1.3	1.4	.6	2.5	3.5	5.1	5.1	4.9	2.0	1.5	2.9	1.4	2.7
1964-65	1.1	1.6	.9	2.3	4.6	6.3	5.9	4.4	3.5	2.0	1.3	1.5	2.9
1965-66	.6	.7	1.8	2.9	5.2	4.7	5.2	6.8	4.4	3.8	2.0	3.4	3.5
1966-67	.9	1.2	1.3	1.6	4.0	5.6	6.5	5.8	4.7	3.7	2.7	3.6	3.5
1967-68	3.2	2.0	1.2	2.5	4.4	4.6	5.0	4.7	3.8	3.4	2.1	1.2	3.2
1968-69	1.4	.2	.8	1.4	5.9	6.0	6.4	5.3	6.1	3.4	2.2	1.8	3.4
1969-70	1.6	2.3	1.3	4.0	4.5	7.3	5.1	4.5	2.6	3.4	1.1	2.6	3.4
1970-71	.5	1.4	1.1	2.5	6.0	5.1	6.7	4.5	3.1	2.3	2.1	1.3	3.1
1971-72	1.5	.3	1.2	2.1	5.5	5.9	7.0	4.8	4.9	3.6	2.1	.7	3.3
1972-73	1.8	.3	1.0	2.9	2.8	4.3	5.1	5.6	3.2	2.9	1.9	2.9	2.9
1973-74	1.4	1.0	.6	2.5	5.0	6.6	6.5	6.6	4.6	3.7	3.4	1.0	3.6
1974-75	2.0	1.4	1.9	1.5	5.8	6.4	5.6	5.4	4.6	3.6	1.7	2.0	3.5
1975-76	1.1	1.0	.4	1.5	2.6	6.1	5.0	5.2	5.4	4.2	2.6	1.9	3.1
1976-77	.6	.6	1.8	2.5	4.1	5.8	4.1	5.9	4.9	2.2	2.0	1.4	3.0
1977-78	1.4	1.3	1.8	1.3	3.5	6.4	6.8	5.8	5.0	3.8	2.6	1.2	3.4
1978-79	2.0	.4	.6	3.3	3.1	5.4	4.2	3.3	4.3	1.8	1.6	1.0	2.6
1979-80	1.4	.7	.7	3.9	5.4	5.3	3.5	4.5	3.3	2.8	.7	1.3	2.8
1980-81	.9	1.0	1.0	1.8	4.2	4.7	5.3	6.2	4.7	2.7	2.1	.5	2.9
1981-82	.9	.4	1.4	2.1	3.8	3.8	4.8	4.0	1.9	3.0	1.8	1.1	2.4
1982-83	1.6	.5	1.4	3.0	4.5	4.2	4.5	3.3	3.0	2.7	1.4	1.0	2.6
1983-84	1.2	1.0	.4	3.0	4.1	5.3	3.6	3.8	4.7	2.6	2.2	1.9	2.8
1984-85	2.5	.7	1.0	2.6	5.2	5.5	6.1	4.7	4.3	2.9	3.2	1.5	3.4
1985-86	2.7	1.4	2.0	2.8	4.2	6.2	5.7	4.7	4.5	4.4	1.8	1.0	3.5
1986-87	1.3	.8	1.7	4.4	4.2	4.7	5.0	4.0	3.7	1.7	2.5	1.0	2.9
1987-88	.5	1.4	2.3	3.4	3.9	6.7	5.1	6.0	5.1	3.7	2.4	2.2	3.6
1988-89	.7	.6	1.3	2.6	4.1	5.6	6.1	7.0	4.6	3.9	1.5	2.2	3.3
1989-90	1.8	1.3	1.2	2.9	4.5	5.5	6.5	5.4	3.9	3.9	2.5	2.2	3.5
1990-91	1.3	1.9	1.2	2.7	3.1	5.3	5.9	5.7	4.8	2.5	2.4	2.2	3.2
1991-92	1.4	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	1.6**
MEAN 1963-92	1.4	1.0	1.2	2.6	4.3	5.5	5.4	5.1	4.1	3.1	2.1	1.7	3.1
STDV 1963-92	.7	.5	.5	.8	.9	.8	1.0	1.0	1.0	.8	.6	.8	.3

Table D-27 MONTHLY AND ANNUAL SUNSHINE DURATION AT GOKWE

ZIMBABWE 67861 GOKWE LAT: 18 13 LONG: 28 56 ELEV: 1282 M

SUNSHINE DURATION (HRS)

		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
	1963-64	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
	1964-65	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
	1965-66	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9.4	10.0	8.3	9.2**
	1966-67	10.0	10.0	10.2	10.1	8.9	6.5	5.7	6.7	7.7	9.2	8.5	7.3	8.4
	1967-68	7.7	9.4	10.5	8.5	7.8	7.6	7.5	7.6	9.2	8.6	9.6	9.9	8.7
	1968-69	10.0	10.8	10.4	10.6	5.8	6.5	6.5	8.7	5.3	9.1	9.6	9.0	8.5
	1969-70	9.6	9.0	10.2	6.9	8.4	3.0	8.6	9.1	10.1	9.2	10.2	8.3	8.6
	1970-71	10.3	9.9	9.9	10.2	5.8	9.2	5.2	8.3	10.2	9.6	9.8	9.7	9.0
	1971-72	9.6	10.7	10.1	10.1	6.9	8.1	5.2	7.7	7.4	8.1	9.7	10.2	8.7
	1972-73	9.3	10.6	10.2	9.2	9.8	9.0	8.6	7.3	9.4	8.8	9.5	7.8	9.1
	1973-74	9.9	10.3	10.6	9.6	6.7	4.4	6.4	4.9	7.9	7.8	7.6	9.7	8.0
	1974-75	9.3	9.8	10.1	10.3	6.1	5.2	6.8	6.0	7.6	8.0	9.5	9.0	8.1
	1975-76	9.8	10.4	10.7	10.2	9.6	5.7	6.8	7.1	6.4	7.1	8.1	8.7	8.4
	1976-77	9.8	10.5	9.6	8.6	7.7	5.8	9.2	5.5	6.4	9.7	9.3	9.7	8.5
	1977-78	9.0	9.3	8.8	10.8	8.6	5.0	4.8	6.3	5.9	7.2	8.0	9.2	7.7
	1978-79	8.5	10.7	10.3	8.0	8.7	5.9	8.2	9.1	7.1	9.9	9.6	9.6	8.8
	1979-80	9.9	10.0	10.4	7.8	7.0	5.6	8.6	7.0	8.0	8.6	10.1	9.9	8.6
	1980-81	10.1	9.8	10.1	10.0	7.2	6.7	6.3	4.0	6.6	8.5	8.8	10.2	8.2
	1981-82	9.5	10.5	9.7	9.5	7.9	9.4	7.2	8.4	9.8	8.8	9.2	9.5	9.1
	1982-83	9.3	10.4	9.8	8.4	7.6	8.4	7.4	8.7	8.7	8.6	9.6	9.8	8.9
	1983-84	9.7	10.3	10.5	8.4	7.9	6.6	9.0	8.6	7.3	8.8	9.1	9.1	8.8
	1984-85	8.3	10.3	10.0	8.6	6.3	7.2	5.9	7.4	8.1	9.3	8.1	9.4	8.2
	1985-86	9.1	10.0	9.3	9.8	8.5	4.8	6.4	7.5	8.1	7.1	9.5	9.8	8.3
	1986-87	10.0	10.4	9.4	7.6	8.6	7.3	8.4	9.9	8.6	10.7	8.9	10.2	9.2
	1987-88	10.4	9.9	9.8	9.7	8.8	5.5	8.3	6.6	7.3	8.7	9.2	8.9	8.6
	1988-89	10.2	10.5	10.6	9.6	9.3	6.9	6.5	4.4	8.3	8.6	9.8	9.1	8.7
	1989-90	9.5	9.9	10.0	9.0	8.7	8.3	5.7	7.1	9.2	8.6	9.1	8.7	8.6
	1990-91	10.3	10.1	9.9	9.8	9.4	6.9	7.9	8.3	7.9	9.8	9.3	9.2	9.1
	1991-92	9.8	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9.8**
MEAN	1963-92	9.6	10.1	10.0	9.3	7.9	6.6	7.1	7.3	7.9	8.8	9.2	9.2	8.6
STDV	1963-92	.6	.5	.4	1.0	1.2	1.6	1.3	1.5	1.3	.9	.7	.7	.4

Table D-28 MONTHLY AND ANNUAL PAN EVAPORATION AT GOKWE

ZIMBABWE 67861 GOKWE LAT: 18 13 LONG: 28 56 ELEV: 1282 M

PAN EVAPORATION (MM)

		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
	1963-64	4.6	5.8	7.7	7.9	7.7	5.9	5.6	5.1	6.4	6.3	4.7	4.4	6.0
	1964-65	4.7	5.7	8.1	9.0	7.1	4.8	4.8	6.1	6.8	6.8	5.6	4.7	6.2
	1965-66	4.7	6.1	7.3	8.4	6.0	6.6	6.1	3.5	5.1	4.7	4.9	4.1	5.6
	1966-67	4.3	5.5	7.2	8.9	8.0	6.0	4.2	4.6	4.7	4.8	3.9	3.9	5.5
	1967-68	3.8	4.9	7.7	7.7	6.5	5.7	5.5	5.3	6.4	5.1	5.1	4.3	5.7
	1968-69	4.6	6.1	8.0	9.6	6.0	4.5	9999.9	5.7	3.8	4.8	4.5	4.2	5.6**
	1969-70	4.7	5.6	7.5	6.2	7.3	3.6	6.1	5.9	7.7	5.5	4.9	3.9	5.7
	1970-71	4.6	6.2	8.2	9.1	5.9	6.9	4.1	5.7	6.8	6.0	4.9	4.2	6.1
	1971-72	4.4	6.1	7.8	8.6	6.0	6.4	3.8	5.2	4.7	4.8	4.7	4.3	5.6
	1972-73	4.5	6.3	8.0	8.7	8.7	8.2	6.6	5.5	6.6	5.8	5.1	4.3	6.5
	1973-74	4.9	5.9	8.4	8.9	6.2	3.8	4.6	4.0	5.2	4.5	4.1	4.2	5.4
	1974-75	4.3	5.6	7.7	8.8	5.9	4.4	5.0	4.0	5.1	4.8	5.1	4.1	5.4
	1975-76	4.5	5.8	8.1	8.6	9.2	4.8	5.1	4.8	4.1	4.3	4.1	4.0	5.6
	1976-77	4.4	5.6	7.5	7.7	7.4	5.7	7.0	4.0	4.2	5.3	5.0	4.5	5.7
	1977-78	4.4	5.6	6.7	9.7	8.2	4.2	3.8	4.5	4.2	4.3	3.8	3.7	5.3
	1978-79	3.9	6.2	8.1	8.1	7.4	5.0	6.6	6.7	5.1	6.1	5.3	5.0	6.1
	1979-80	5.2	6.1	8.7	7.9	6.2	4.7	6.6	4.9	5.6	5.5	5.2	4.8	6.0
	1980-81	5.1	6.7	8.0	9.4	6.4	5.2	5.1	3.6	4.6	5.5	4.5	4.4	5.7
	1981-82	4.9	6.2	7.8	8.3	8.0	8.1	5.4	6.1	7.2	6.1	5.4	5.0	6.5
	1982-83	5.2	6.7	8.1	7.5	7.5	7.1	6.2	6.4	6.8	6.5	5.5	5.2	6.5
	1983-84	5.3	6.7	9.0	8.4	8.9	6.2	7.8	6.4	5.3	5.6	5.4	4.7	6.6
	1984-85	5.0	7.0	8.8	8.8	6.6	6.1	4.8	5.2	5.4	5.9	5.0	4.8	6.1
	1985-86	5.1	6.7	9.4	9.7	8.2	5.6	6.0	5.5	5.5	4.3	4.8	4.7	6.3
	1986-87	5.3	6.6	8.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	6.9**
	1987-88	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
	1988-89	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9**
	1989-90	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	6.5	5.0	5.2	5.0	5.4**
	1990-91	5.5	6.7	8.5	10.0	9.6	6.4	5.8	5.8	6.0	6.6	6.0	5.1	6.8
	1991-92	5.5	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	5.5**
MEAN	1963-92	4.7	6.1	8.0	8.6	7.3	5.7	5.5	5.2	5.6	5.4	4.9	4.5	6.0
STDV	1963-92	.5	.5	.6	.9	1.1	1.2	1.0	.9	1.1	.8	.5	.4	.4

Table D-29 MONTHLY AND ANNUAL RELATIVE HUMIDITY AT GOKWE

ZIMBABWE 67861 GOKWE LAT: 18 13 LONG: 28 56 ELEV: 1282 M

RELATIVE HUMIDITY (%)

		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
	1983-84	52.0	40.2	32.4	44.8	47.1	70.7	61.1	71.5	74.1	64.4	57.4	57.1	56.1
	1984-85	50.0	40.4	37.1	43.8	62.7	74.2	81.3	77.0	73.2	62.8	57.7	51.2	59.3
	1985-86	51.8	40.6	42.2	38.4	50.1	76.3	77.5	76.7	71.5	75.5	62.4	56.5	60.0
	1986-87	51.9	39.6	39.1	57.1	53.5	71.0	70.7	66.1	59.8	45.9	44.9	45.0	53.7
	1987-88	42.2	45.8	40.9	39.9	47.7	79.1	71.2	77.4	77.2	71.2	58.0	57.0	59.0
	1988-89	54.2	40.7	31.8	44.5	49.3	66.9	74.8	86.3	70.1	68.6	58.2	56.9	58.5
	1989-90	49.9	48.1	38.9	42.3	53.0	63.3	80.6	78.6	62.2	68.1	58.9	53.9	58.2
	1990-91	50.0	47.0	34.7	38.3	46.6	64.9	76.4	73.6	69.5	53.0	48.6	46.3	54.1
	1991-92	45.0	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	9999.9	45.0**
MEAN	1963-92	49.7	42.8	37.1	43.6	51.2	70.8	74.2	75.9	69.7	63.7	55.8	53.0	57.3
STDV	1963-92	3.8	3.5	3.8	6.0	5.3	5.6	6.5	5.8	5.9	9.8	5.9	5.0	2.4

Table D-30 CORRELATION COEFFICIENT AMONG THE METEOROLOGICAL DATA

	Station Name	① Rainfall Data mm/month					② Monthly River Flow 1,000 cu.m/month							
		Sanyati	Gokwe	Kadoma	Marowa	Ngwenya	C18	C20	C30	C36	C48	C8	C87	C9
①	Sanyati													
	Gokwe	0.871												
	Kadoma	0.811	0.881											
	Marowa	0.853	0.883	0.858										
	Ngwenya	0.834	0.857	0.820	0.844									
②	C18	0.567	0.600	0.537	0.592	0.554								
	C20	0.388	0.327	0.326	0.383	0.302	0.593							
	C30	0.452	0.479	0.389	0.500	0.398	0.814	0.780						
	C36	0.486	0.498	0.472	0.520	0.490	0.808	0.718	0.658					
	C48	0.433	0.468	0.459	0.495	0.451	0.887	0.617	0.780	0.781				
	C8	0.505	0.555	0.522	0.506	0.509	0.858	0.468	0.728	0.869	0.746			
	C87	0.484	0.484	0.424	0.504	0.419	0.894	0.742	0.881	0.809	0.938	0.893		
	C9	0.453	0.455	0.389	0.489	0.412	0.724	0.768	0.848	0.819	0.766	0.755	0.846	

Correlation Coefficient : $r = \dfrac{\Sigma(\Delta x_i \Delta y_i)}{\sqrt{\Sigma(\Delta x_i)^2 \Sigma(\Delta y_i)^2}}$

APPENDIX E WATER SOURCE AND UTILIZATION

APPENDIX E. WATER RESOURCES AND UTILIZATION

E.1 Water Balance Study of Kudu Dam

E.1.1 Meteorological and River Flow Data

In order to calculate the irrigation water requirement and the dam reservoir operation, Meteorological data of Gokwe which is near the Study Area was selected as a representative data in the Study Area.

And the gauging station of C8, C9, C36 and C48 were adopted to estimate the river flow of Munyati river at Kudu Dam site. If daily records are missing at these stations, specific runoff of C30 and C87 were substituted for these missing records because the correlation among the former 4 stations and that between the latter 2 stations are both very high and good. Correlation coefficient for river flows are shown in Appendix D (Table D-1).

E.1.2 Allocation of Kudu Dam Water

Water balance study shall be carried out with a premise that the development water in the dam would be allocated to urban water supply for Kadoma, Kwekwe and Gokwe Central (60 MCM/year), and the remaining water to be irrigation water.

Available irrigation water would be primarily allocated to the communal and resettlement areas and the remaining to the small and the large scale commercial farms, if any. These concept is tentatively set and shall be further discussed and concluded with Zimbabwean governmental officials concerned.

E.1.3 Proposed Cropping Pattern

As for the cropping pattern which is base for the water utilization planning, fundamental patterns to be introduced in the communal and the resettlement areas are shown in Figures E-1 and E-2. On the basis of the cropping pattern as shown in Figure E-1, water balance study shall be carried out.

E.1.4 Irrigation Method

Conveyance of water from Kudu Dam is planned basically by gravity system. The furrow method at on-farm level shall be applied in principle in the communal and the resettlement areas and the sprinkler method shall be applied to the small and the large scale commercial farms.

E.1.5 Irrigation Water Requirement

Effective Rainfall

The effective rainfall was decided using Daily Soil Moisture Balance Method (FAO Irrigation & Drainage Paper No.25, 1974) as below :

$$5\text{mm} \leqq \text{Effective Rainfall} \leqq \text{Daily rainfall} \times 0.80$$

And the maximum water holding capacity (WHC) was assumed to be 50 mm as calculated below:

a. Soil Type	b. Area(ha)	c. WHC(mm)	b x c
Sandy Soil	257,000	10	2,571,000
Clayey Soil	248,100	100	24,810,000
Total	505,200		27,381,000

Average=27,381,000 / 505,200 =54.2' = 50 mm

Crop Water Requirement

Based on the said meteorological data and the proposed cropping pattern, necessary irrigation water requirement for each crop is calculated by Modified Penman Method (FAO Irrigation and Drainage Paper No.24, 1985) as below. Monthly evapotranspiration and 5 days irrigation water requirement for crops are shown in Appendix G (Table G-2). Irrigation efficiency of 50 percent will be applied for the water balance study.

Summer season		Winter season	
Maize	610 mm	Wheat	345 mm
Cotton	740 mm	Green Maize	380 mm
Dry Beans	350 mm	Vegetable	400 mm
Groundnuts	620 mm		

Irrigation Efficiency

Irrigation efficiency was estimated to be 0.5 on the basis of the following parameters.

Conveyance Efficiency	0.9
Field Canal Efficiency	0.9
Field Application Efficiency	0.6
Irrigation Efficiency	0.49 ——›0.5

E.1.6 Criteria of Kudu Reservoir

Criteria of the reservoir for the water balance study was described as below.

Full Surface Level	947.0 m
Full Supply Capacity	1,551.4 MCM
Outlet Elevation	905.0 m
Dead Water Capacity	124.66 MCM
Live Capacity	1,426.90 MCM

E.1.7 Water Balance Study

Based on the above mentioned conditions and the design of Kudu Dam, water balance study in twenty (20) years between 1974 and 1993 was carried out using the following formula:

$$QC = QCP + Fin - Wr - Ws - Wl - Of$$

Where ; Qc : Storage Capacity
Qcp : Storage Capacity before
Fin : Inflow at dam site

Wr : Irrigation Water Requirement

Ws : Urban Water Supply

Wl : Storage Loss (evaporation + seepage loss)
seepage is estimated at 0.05 % of the storage capacity

Of : Outflow through spillway

Table E-1 SUMMARY OF WATER RIGHT(Umsweswe ~ Umnyati Confluence Point)

No.	NAME	PURPOSE	PRIORITY (Y.M.D)	ABSTRACT (m3/s)	PERIOD(Y.M.D) FROM	PERIOD(Y.M.D) TO	STORE (1000cum)	TOTAL (1000cum)
6863	REM OF KANYEMBA ESTATE	A	65. 7.22	0.057	10. 1	3.31	-	370.1
5021	REM OF KANYEMBA ESTATE	A	58. 2.27	-	10. 1	3.31	-	304.0
4859	REM BENTLEY OF KANYEMBA ESTATE	A	57. 6.17	-	-	-	153.0	-
4859	REM BENTLEY OF KANYEMBA ESTATE	A	69.11. 8	-	-	-	77.0	-
4859	REM BENTLEY OF KANYEMBA ESTATE	A	90.10.15	-	-	-	189.0	-
6788	REM OF BENTLEY	A	65. 5.11	0.057	10. 1	3.31	-	370.1
10241	PAMENE & REM RAILWAY FARM 8	A	73. 7.17	0.100	12.15	5.31	-	500.0
10242	LIDFORD AND CORYTON	A	73. 7.17	0.100	12.15	5.31	-	550.0
9887	LOT 6 BENTLEY KANYEMBA ESTATE	A	72. 9. 6	0.004	12.15	3.31	-	16.0
14035	KANYEMBA ESTATE	A	88. 2.29	-	-	-	230.0	-
10796	PIN A&B&REM S/D KANYEMBA EST.	A	74.11.15	0.047	12.15	3.31	-	192.0
10796	PIN A&B&REM S/D KANYEMBA EST.	A	75. 9.30	-	-	-	23.0	-
9367	LOT 1 BENTLEY KANYEMBA ESTATE	A	71. 5.12	0.004	12.15	3.31	-	18.5
9367	LOT 1 BENTLEY KANYEMBA ESTATE	A	71. 5.12	0.000	4. 1	12.14	-	2.0
15803	CARDIGAN FARM	A	-	0.020	-	-	-	630.7
M1479	BENTLEY FARM	M	-	0.000	10. 1	9.30	-	3.7
	TOTAL							2,957.1

Table E-2 SUMMARY OF WATER RIGHT(SebakeUmsweswe ~ Umnyati Confluence Point)

No.	NAME	PURPOSE	PRIORITY (Y.M.D)	ABSTRACT (m3/s)	PERIOD(Y.M.D) FROM	PERIOD(Y.M.D) TO	STORE (1000cum)	TOTAL (1000cum)
M1129	SEBAKWE MINE DUMPS	M	66. 8. 6	0.001	10. 1	9.30	-	17.3
9314	LOT 7 OF SHERWOOD BLOCK	E	71. 3.15	-	-	-	136.0	-
M1099	ANZAC MINE	M	65. 8.23	0.003	10. 1	9.30	11.4	99.6
12133	LOT 4A OF SHERWOOD BLOCK	A	81. 4.22	0.070	12.15	3.31	-	840.0
6653A	LOT1 OF LOT4 SHERWOOD BLOCK	A	65. 1.12	0.021	12.15	3.31	-	92.5
7629	LOT 4A OF SHERWOOD BLOCK	A	66. 9. 5	-	-	-	264.0	-
6653	LOT 4A OF SHERWOOD BLOCK	A	65. 1.12	0.022	12.15	3.31	-	93.0
11123	LOT 4A OF SHERWOOD BLOCK	A	76. 4.20	0.040	12.15	3.31	-	180.0
11451	LOT1 OF LOT4 SHERWOOD BLOCK	A	78. 1.18	0.058	12.15	3.31	-	261.0
5835	BROWNLANDS OF LINDALE	A	61. 1.30	-	-	-	120.0	-
2028	BROWNLANDS OF LINDALE	A	48. 1.10	0.001	10. 1	9.30	-	25.0
9440	DELVILLE WOOD & REM LINDALE	A	71. 7.14	-	-	-	68.2	-
9441	BONSTED	A	71. 7. 9	0.170	12.15	3.31	-	740.0
8636	LINDALE & DELVILLE WOOD	A	69. 2.15	0.057	12.15	3.31	-	246.7
8636	LINDALE & DELVILLE WOOD	A	71. 3.29	0.255	12.15	3.31	-	2,220.0
14450	DELVILLE WOOD ESTATES	A	89. 6.20	-	-	-	4,000.0	-
8781	IMPALA RANCH	A	69.10. 6	0.005	10. 1	9.30	-	49.0
TOTAL								4,864.1

NOTE) PURPOSE : A ---> AGRICULTURAL USE
M ---> MINING USE
E ---> GENERATION OF ELECTRICITY

Table E-3 SUMMARY OF WATER RIGHT(Nunyati ~ Umfuli Confluence Point)

No.	NAME	PURPOSE	PRIORITY (Y.M.D)	ABSTRACT (m3/s)	PERIOD(Y.M.D) FROM	PERIOD(Y.M.D) TO	STORE (1000cum)	TOTAL (1000cum)
1101	SELIMA	I	42. 6.16	0.012	10. 1	9.30	570.5	363.7
5095	KOPPIES	A	58. 5. 7	0.001	10. 1	9.30	-	12.3
R 63	SELIMA	R	39.12. 4	0.003	10. 1	9.30	-	68.2
R 97	SELIMA	R	56. 5. 5	0.003	10. 1	9.30	-	68.2
M1222	GLOVERS FARM FOR MID KENT	M	70. 9.14	0.000	10. 1	9.30	-	1.3
2187A	REM GLOVERS	A	49. 1.20	0.400	10. 1	9.30	159.1	123.4
M1176	GLOVERS FOR OLYMPUS CONS	M	68. 4. 8	0.000	10. 1	9.30	-	1.8
5949	KOPPIES	A	61.10. 9	-	-	-	95.5	-
5608	RICHMOND FARM	A	60. 5.14	0.003	10. 1	9.30	-	30.8
M1177	GLOVERS FOR OLYMPUS CONS	M	68. 4. 8	0.000	10. 1	9.30	-	1.8
1919	LORRAINE	A	48.10.22	0.003	10. 1	9.30	-	30.8
8607	REM GLOVERS	A	69. 1.13	0.071	12.15	3.31	909.0	308.0
M1080	JANET MINE	M	64. 9.29	0.001	10. 1	9.30	-	39.8
5193	RUNNIMEDE	A	58.10.28	0.004	10. 1	9.30	-	46.3
M1166	RUNNIMEDE	M	68. 1. 2	0.000	10. 1	9.30	-	5.0
7521	UMNIATI RANCH	A	66. 9.10	0.004	10. 1	9.30	454.6	46.3
	SUBTOTAL							1,147.7
M1347	BULLER MINE	M	80. 6.20	0.001	10. 1	9.30	-	17.0
	SUBTOTAL							17.0
CR717	ROAD RESERVE	CR	75. 7. 7	0.000	10. 1	9.30	-	0.6
M1353	UMSWESWE RANCH FOR LINDA	M	80. 7.14	0.001	10. 1	9.30	-	17.0
6695	KUDU RIVER RANCHI	A	65. 2.23	0.003	10. 1	9.30	-	50.0
6554	KUDU RIVER RANCHI	A	64. 9.16	0.005	12.15	3.31	-	28.0
7125	REM LODESTER RANCH	A	65.11. 5	0.015	4. 1	12.14	-	442.0
7125	REM LODESTER RANCH	A	65.11. 5	0.015	12.15	3.31	-	45.0
7125	REM LODESTER RANCH	A	74.12.23	0.010	12.15	3.31	-	30.0
12371	NJELELE OF CHISINA	A	82. 9.13	0.011	12.15	5.31	-	74.0
6011	SANYATI RANCH NO.3	A	62. 1.29	0.006	10. 1	9.30	-	61.7
12370	NJELELE OF CHISINA	A	82. 9.13	0.002	12.15	5.31	-	9.0
6894	SANYATI RANCH NO.3	A	65. 8. 2	0.047	10. 1	9.30	-	567.0
6562	MURISON RANCH	A	64. 9.22	-	-	-	455.0	-
6562	MURISON RANCH	A	73. 9.26	-	-	-	445.0	-
6562	MURISON RANCH	A	73. 9.26	0.000	12.15	3.31	-	440.0
6963	REM RHINTO RANCH	A	65. 9. 6	0.022	11.15	3.31	-	130.0
6963	REM RHINTO RANCH	A	65. 9. 6	0.005	4. 1	11.14	-	55.0
11299	CIRCLE K RANCH & GOKWE CL	G	77. 3.25	-	-	-	5,200.0	-
10578	GOKWE & SANYATI CL	G	74. 5.28	0.780	10. 1	9.30	5,270.0	6,980.0
7779	SANYATI CL	G	67. 4.14	2.000	10. 1	9.30	-	616.8
8499	COPPER QUEEN 91	A	68.10.16	0.002	10. 1	9.30	-	31.0
13148	CHISINA CL	A	85. 4.24	0.001	10. 1	9.30	-	12.0
M1463	COPPER QUEEN	M	92. 7.28	-	-	-	1,000.0	-
	SUBTOTAL							9,589.1
	TOTAL							10,753.8

NOTE) PURPOSE : A ---> AGRICULTURAL USE
I ---> INSTITUTIONAL USE (SCHOOL,ETC)
G ---> GOVERNMENTAL USE (WATER-SUPPLY,ETC)
M ---> MINING USE
R ---> RAILWAYS
CR ---> ROADS

Table E-4 WATER BALANCE STUDY ON KUDU DAM

Lisk Level 25 % Irrigation Area 35,000 Ha
Initial Water Level EL 923 m Storage Water 3,800 MCM

① Inflow (cu.m / sec)
② Irrigation W. : Water Requirement for Irrigation (cu.m / sec)
③ W. Supply : Water Requirement for Urban and Industry (cu.m / sec)
④ M. Flow : Maintenance Flow (Water Rights) (cu.m / sec)
⑤ Total = ①-(②+③+④) (cu.m /sec)
⑥ Dischargre : Water Volume of Reservoir (cu.m / sec)
⑦ Vol : Water Volume of Reservoir (MCM)
⑧ W Level : Water Level of Reservoir(EL. m)
⑨ Ineff. Dis : Spill Water (cu.m / sec)

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1974

MONTH	DATE	INFLOW (>k)	WATER USE(>k) IRRIG.W.	W.SUPPLY	M.FLOW	IRRIGATED AREA 25000.0 ha EFFECTIVE STORAGE TOTAL	DIS.(>k)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>k)
1	1	826.460	21.991	1.903	1.095	24.989	1239.488	107.1	918.1	0.000
2	1	282.105	0.000	1.903	1.095	2.998	15840.285	1368.6	946.2	0.000
3	1	440.064	0.000	1.903	1.095	2.998	16515.047	1426.9	947.0	421.097
4	30	15.809	5.787	1.903	0.418	8.108	16407.529	1417.6	946.9	0.000
5	31	3.714	6.944	1.903	0.418	9.265	16042.052	1386.0	946.5	0.000
6	30	3.336	10.417	1.903	0.340	12.660	15604.309	1350.9	945.7	0.000
7	31	2.781	12.153	1.903	0.340	14.396	14678.808	1268.2	944.9	0.000
8	31	1.926	0.000	1.903	0.340	2.243	13893.126	1200.4	943.8	0.000
9	30	1.818	4.051	1.903	0.340	6.294	13395.825	1156.5	943.2	0.000
10	31	0.998	6.944	1.903	0.407	9.254	12897.692	1114.4	942.5	0.000
11	20	7.498	0.000	1.903	0.415	2.318	12584.599	1087.3	942.1	0.000
12	1	84.001	0.000	1.903	0.415	2.318	12773.477	1103.6	942.4	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1975

MONTH	DATE	INFLOW (>k)	WATER USE(>k) IRRIG.W.	W.SUPPLY	M.FLOW	IRRIGATED AREA 25000.0 ha EFFECTIVE STORAGE TOTAL	DIS.(>k)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>k)
1	1	369.052	0.000	1.903	1.095	2.998	16515.047	1426.9	947.0	353.280
2	1	197.881	0.000	1.903	1.095	2.998	16515.047	1426.9	947.0	180.841
3	21	23.965	12.153	1.903	1.095	15.151	16450.924	1421.4	946.9	0.000
4	17	9.710	0.000	1.903	0.418	2.321	16283.588	1406.9	946.7	0.000
5	31	1.616	6.944	1.903	0.418	9.265	15826.149	1367.4	946.2	0.000
6	30	1.356	10.417	1.903	0.340	12.660	15155.759	1309.5	945.4	0.000
7	31	1.437	12.153	1.903	0.340	14.396	14387.036	1243.0	944.5	0.000
8	31	0.965	12.153	1.903	0.340	14.396	13568.684	1172.3	943.4	0.000
9	30	1.120	4.051	1.903	0.340	6.294	13010.289	1124.1	942.7	0.000
10	31	0.867	0.000	1.903	0.407	2.310	12493.164	1079.4	942.0	0.000
11	30	1.124	0.000	1.903	0.415	2.318	11950.766	1032.5	941.3	0.000
12	31	4.345	0.000	1.903	1.095	2.998	11673.452	1008.6	940.9	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1976

MONTH	DATE	INFLOW (>k)	WATER USE(>k) IRRIG.W.	W.SUPPLY	M.FLOW	IRRIGATED AREA 25000.0 ha EFFECTIVE STORAGE TOTAL	DIS.(>k)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>k)
1	31	2.223	0.000	1.903	1.095	2.998	11384.645	983.6	940.5	0.000
2	11	3.520	10.995	1.903	1.095	13.993	11253.148	972.3	940.3	0.000
3	13	10.519	0.000	1.903	1.095	2.998	11448.053	989.1	940.6	0.000
4	30	12.234	0.000	1.903	0.418	2.321	16464.230	1422.5	946.9	0.000
5	31	1.136	6.944	1.903	0.418	9.265	16138.975	1394.4	946.6	0.000
6	30	1.804	10.417	1.903	0.340	12.660	15463.617	1336.1	945.8	0.000
7	31	0.413	12.153	1.903	0.340	14.396	14677.399	1268.1	944.9	0.000
8	31	0.197	12.153	1.903	0.340	14.396	13828.181	1194.8	943.8	0.000
9	30	0.000	4.051	1.903	0.340	6.294	13256.965	1145.4	943.0	0.000
10	31	6.380	0.000	1.903	0.407	2.310	12773.386	1103.6	942.4	0.000
11	30	1.217	12.731	1.903	0.415	15.049	12198.477	1053.9	941.6	0.000
12	26	0.884	0.000	1.903	1.095	2.998	11680.758	1009.2	940.9	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1977

MONTH	DATE	INFLOW (>k)	WATER USE(>k) IRRIG.W.	W.SUPPLY	M.FLOW	IRRIGATED AREA 25000.0 ha EFFECTIVE STORAGE TOTAL	DIS.(>k)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>k)
1	31	3.398	0.000	1.903	1.095	2.998	11248.154	971.8	940.3	0.000
2	6	12.551	0.000	1.903	1.095	2.998	11237.573	970.9	940.3	0.000
3	1	44.844	0.000	1.903	1.095	2.998	15818.868	1366.8	946.2	0.000
4	30	8.452	5.787	1.903	0.418	8.108	16368.001	1414.2	946.8	0.000
5	31	1.627	6.944	1.903	0.418	9.265	15775.231	1363.0	946.2	0.000
6	30	1.500	10.417	1.903	0.340	12.660	15094.302	1304.1	945.4	0.000
7	31	0.707	12.153	1.903	0.340	14.396	14309.124	1236.3	944.4	0.000
8	31	0.477	12.153	1.903	0.340	14.396	13474.771	1164.2	943.3	0.000
9	30	0.704	0.000	1.903	0.340	2.243	12927.073	1116.9	942.6	0.000
10	31	0.358	6.944	1.903	0.407	9.254	12427.937	1073.8	941.9	0.000
11	30	1.171	0.000	1.903	0.415	2.318	11858.515	1024.6	941.2	0.000
12	17	2.915	0.600	1.903	1.095	2.998	11772.162	1017.1	941.0	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1978

MONTH	DATE	INFLOW (>k)	WATER USE(>k) IRRIG.W.	W.SUPPLY	M.FLOW	IRRIGATED AREA 25000.0 ha EFFECTIVE STORAGE TOTAL	DIS.(>k)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>k)
1	1	551.299	0.000	1.903	1.095	2.998	15551.712	1343.7	945.9	0.000
2	1	341.290	0.000	1.903	1.095	2.998	16515.047	1426.9	947.0	324.178
3	1	605.167	0.000	1.903	1.095	2.998	16515.047	1426.9	947.0	586.117
4	1	59.653	0.000	1.903	0.418	2.321	16515.047	1426.9	947.0	41.101
5	1	59.475	0.000	1.903	0.418	2.321	16515.047	1426.9	947.0	42.097
6	30	7.120	10.417	1.903	0.340	12.660	16256.022	1404.5	946.7	0.000
7	31	3.492	12.153	1.903	0.340	14.396	15582.399	1346.3	945.9	0.000
8	31	1.347	12.153	1.903	0.340	14.396	14766.679	1275.8	945.0	0.000
9	30	0.842	4.051	1.903	0.340	6.294	14187.106	1225.8	944.2	0.000
10	31	2.627	0.000	1.903	0.407	2.310	13836.826	1195.5	943.8	0.000
11	4	3.078	0.000	1.903	0.407	2.310	13796.593	1191.9	943.7	0.000
12	7	9.664	0.000	1.903	0.415	2.318	13747.648	1187.8	943.7	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1979

MONTH	DATE	INFLOW (>k)	WATER USE(>k) IRRIG.W.	W.SUPPLY	M.FLOW	IRRIGATED AREA 25000.0 ha EFFECTIVE STORAGE TOTAL	DIS.(>k)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>k)
1	14	13.412	0.000	1.903	1.095	2.998	16042.013	1386.0	946.5	0.000
2	28	5.521	0.000	1.903	1.095	2.998	15576.069	1345.8	945.9	0.000
3	31	1.729	0.000	1.903	1.095	2.998	15080.094	1302.9	945.4	0.000
4	30	0.695	5.787	1.903	0.418	8.108	14393.823	1243.6	944.5	0.000
5	31	2.383	6.944	1.903	0.418	9.265	13816.476	1193.7	943.7	0.000
6	30	1.032	10.417	1.903	0.340	12.660	13180.612	1138.8	942.9	0.000
7	31	0.919	12.153	1.903	0.340	14.396	12442.642	1075.0	941.9	0.000
8	31	0.597	12.153	1.903	0.340	14.396	11648.197	1006.4	940.9	0.000
9	30	1.127	4.051	1.903	0.340	6.294	11112.338	960.1	940.2	0.000
10	31	0.109	0.000	1.903	0.407	2.310	10748.783	928.7	939.6	0.000
11	27	5.450	0.000	1.903	0.415	2.318	10490.191	906.4	939.2	0.000
12	4	8.385	0.000	1.903	0.415	2.318	10508.468	907.9	939.2	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1980

MONTH	DATE	INFLOW (%)	WATER USE(%) IRRIG.W.	W.SUPPLY	M.FLOW	IRRIGATED AREA 25000.0 ha EFFECTIVE STORAGE TOTAL	DIS.(%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(%)
1	24	25.308	17.361	1.903	1.095	20.359	12560.897	1085.3	942.1	0.000
2	22	23.923	30.671	1.903	1.095	33.669	12373.378	1069.1	941.8	0.000
3	1	176.039	0.000	1.903	1.095	2.998	14672.047	1287.7	944.9	0.000
4	30	1.620	5.787	1.903	0.418	8.108	14425.007	1246.3	944.6	0.000
5	31	0.349	6.944	1.903	0.418	9.265	13776.061	1190.3	943.7	0.000
6	30	0.353	10.417	1.903	0.340	12.660	13123.199	1133.8	942.8	0.000
7	31	0.408	12.153	1.903	0.340	14.396	12377.547	1069.4	941.8	0.000
8	31	0.668	12.153	1.903	0.340	14.396	11584.750	1000.9	940.8	0.000
9	30	0.377	4.051	1.903	0.340	6.294	11058.549	955.5	940.1	0.000
10	31	0.199	0.000	1.903	0.407	2.310	10625.629	917.9	939.4	0.000
11	24	4.443	0.000	1.903	0.415	2.318	10387.820	897.5	939.1	0.000
12	1	24.025	0.000	1.903	0.415	2.318	10441.554	902.2	939.1	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1981

MONTH	DATE	INFLOW (%)	WATER USE(%) IRRIG.W.	W.SUPPLY	M.FLOW	IRRIGATED AREA 25000.0 ha EFFECTIVE STORAGE TOTAL	DIS.(%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(%)
1	7	10.164	0.000	1.903	1.095	2.998	10885.414	940.5	939.8	0.000
2	1	691.398	0.000	1.903	1.095	2.998	16515.047	1426.9	947.0	674.111
3	1	238.966	0.000	1.903	1.095	2.998	16515.047	1426.9	947.0	220.099
4	26	18.702	4.051	1.903	0.418	6.372	16303.209	1408.6	946.8	0.000
5	31	4.119	6.944	1.903	0.418	9.265	15929.650	1376.3	946.3	0.000
6	30	1.808	10.417	1.903	0.340	12.660	15294.432	1321.4	945.6	0.000
7	31	1.657	12.153	1.903	0.340	14.396	14525.149	1255.0	944.7	0.000
8	31	0.346	12.153	1.903	0.340	14.396	13688.619	1182.7	943.6	0.000
9	30	0.755	4.051	1.903	0.340	6.294	13112.386	1132.9	942.8	0.000
10	31	0.144	6.944	1.903	0.407	9.254	12555.904	1084.7	942.1	0.000
11	26	4.447	0.000	1.903	0.415	2.318	12164.654	1051.0	941.6	0.000
12	31	1.788	0.000	1.903	1.095	2.998	12124.995	1047.6	941.5	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1982

MONTH	DATE	INFLOW (%)	WATER USE(%) IRRIG.W.	W.SUPPLY	M.FLOW	IRRIGATED AREA 25000.0 ha EFFECTIVE STORAGE TOTAL	DIS.(%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(%)
1	31	1.378	28.935	1.903	1.095	31.933	11953.831	1032.8	941.3	0.000
2	28	3.503	30.093	1.903	1.095	33.091	11217.861	969.2	940.3	0.000
3	31	0.172	17.940	1.903	1.095	20.938	10114.948	873.9	938.6	0.000
4	30	0.107	0.000	1.903	0.418	2.321	9637.874	832.7	937.9	0.000
5	31	0.125	6.944	1.903	0.418	9.265	9165.722	791.9	937.1	0.000
6	30	0.381	10.417	1.903	0.340	12.660	8611.083	744.0	936.2	0.000
7	31	0.252	12.153	1.903	0.340	14.396	7958.358	687.6	935.2	0.000
8	31	0.330	12.153	1.903	0.340	14.396	7259.775	627.2	933.9	0.000
9	30	0.722	4.051	1.903	0.340	6.294	6815.624	588.9	933.0	0.000
10	31	0.646	0.000	1.903	0.407	2.310	6523.681	563.6	932.5	0.000
11	30	0.370	0.000	1.903	0.415	2.318	6299.017	544.2	932.0	0.000
12	31	1.841	19.097	1.903	1.095	22.095	6024.918	520.6	931.5	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1983

MONTH	DATE	INFLOW (%)	WATER USE(%) IRRIG.W.	W.SUPPLY	M.FLOW	IRRIGATED AREA 25000.0 ha EFFECTIVE STORAGE TOTAL	DIS.(%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(%)
1	31	0.868	0.000	1.903	1.095	2.998	5490.520	474.4	930.4	0.000
2	28	0.569	30.093	1.903	1.095	33.091	5107.001	441.2	929.6	0.000
3	31	0.227	17.940	1.903	1.095	20.938	4271.514	369.1	927.4	0.000
4	30	0.118	0.000	1.903	0.418	2.321	3845.401	332.2	926.2	0.000
5	31	0.061	6.944	1.903	0.418	9.265	3597.516	310.8	925.6	0.000
6	30	0.098	10.417	1.903	0.340	12.660	3153.724	272.5	924.4	0.000
7	31	0.151	12.153	1.903	0.340	14.396	2616.640	226.1	922.8	0.000
8	31	0.151	12.153	1.903	0.340	14.396	2020.801	174.6	921.0	0.000
9	30	0.053	4.051	1.903	0.340	6.294	1682.688	145.4	919.9	0.000
10	31	0.089	0.000	1.903	0.407	2.310	1455.589	125.8	919.0	0.000
11	30	1.753	0.000	1.903	0.415	2.318	1214.159	104.9	918.0	0.000
12	2	2.859	0.000	1.903	0.415	2.318	1212.443	104.8	918.0	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1984

MONTH	DATE	INFLOW (%)	WATER USE(%) IRRIG.W.	W.SUPPLY	M.FLOW	IRRIGATED AREA 25000.0 ha EFFECTIVE STORAGE TOTAL	DIS.(%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(%)
1	31	0.424	0.000	1.903	1.095	2.998	830.233	71.7	916.4	0.000
2	29	0.052	28.356	1.903	1.095	31.354	669.944	56.2	915.4	0.000
3	31	0.485	0.000	1.903	1.095	2.998	154.627	13.4	911.3	0.000
4	30	0.070	0.000	1.903	0.418	2.321	119.473	10.3	911.0	0.000
5	31	0.086	6.944	1.903	0.418	9.265	-54.696	-4.7	910.0	0.000
6	30	0.125	10.417	1.903	0.340	12.660	-395.688	-34.2	910.0	0.000
7	31	0.282	12.153	1.903	0.340	14.396	-834.002	-72.1	910.0	0.000
8	31	0.415	12.153	1.903	0.340	14.396	-1338.888	-115.7	910.0	0.000
9	30	0.253	4.051	1.903	0.340	6.294	-1587.975	-137.2	910.0	0.000
10	31	2.076	6.944	1.903	0.407	9.254	-1750.859	-151.3	910.0	0.000
11	30	0.550	0.000	1.903	0.415	2.318	-1890.186	-163.3	910.0	0.000
12	1	13.668	0.000	1.903	0.415	2.318	-1878.835	-162.3	910.0	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1985

MONTH	DATE	INFLOW (%)	WATER USE(%) IRRIG.W.	W.SUPPLY	M.FLOW	IRRIGATED AREA 25000.0 ha EFFECTIVE STORAGE TOTAL	DIS.(%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(%)
1	6	0.560	0.000	1.903	1.095	2.998	-1355.072	-117.1	910.0	0.000
2	1	308.417	0.000	1.903	1.095	2.998	4515.779	390.2	928.0	0.000
3	23	21.044	20.833	1.903	1.095	23.831	7495.676	647.6	934.4	0.000
4	30	1.330	5.787	1.903	0.418	8.108	7319.582	632.4	934.0	0.000
5	31	0.255	6.944	1.903	0.418	9.265	6871.750	593.7	933.1	0.000
6	30	0.151	10.417	1.903	0.340	12.660	6358.675	549.4	932.1	0.000
7	31	0.108	12.153	1.903	0.340	14.396	5746.315	496.5	930.9	0.000
8	31	0.019	12.153	1.903	0.340	14.396	5077.577	438.7	929.5	0.000
9	30	0.038	4.051	1.903	0.340	6.294	4669.371	403.4	928.4	0.000
10	31	0.481	0.000	1.903	0.407	2.310	4296.592	371.1	927.4	0.000
11	30	0.368	12.731	1.903	0.415	15.049	3894.731	336.5	926.4	0.000
12	19	4.803	0.000	1.903	1.095	2.998	3635.962	314.1	925.7	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1986

IRRIGATED AREA 25000.0 ha

MONTH	DATE	INFLOW (>%)	IRRIG.W.	WATER USE(>%) W.SUPPLY	M.FLOW	TOTAL	EFFECTIVE STORAGE DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	1	196.673	0.000	1.903	1.095	2.998	5002.785	432.2	929.3	0.000
2	1	230.244	0.000	1.903	1.095	2.998	9159.307	791.4	937.1	0.000
3	31	3.018	0.000	1.903	1.095	2.998	9245.333	798.8	937.2	0.060
4	20	2.308	0.000	1.903	0.418	2.321	9041.957	781.2	936.9	0.000
5	31	1.156	0.000	1.903	0.418	2.321	8813.835	761.5	936.6	0.000
6	30	1.002	10.417	1.903	0.340	12.660	8361.877	722.5	935.9	0.000
7	31	0.140	12.153	1.903	0.340	14.396	7711.522	666.3	934.8	0.000
8	31	0.290	12.153	1.903	0.340	14.396	7005.118	605.2	933.4	0.000
9	30	0.158	4.051	1.903	0.340	6.294	6558.659	566.7	932.5	0.000
10	31	0.201	0.000	1.903	0.407	2.310	6264.519	541.3	932.0	0.000
11	30	0.301	12.731	1.903	0.415	15.049	5982.351	516.9	931.4	0.000
12	7	4.967	0.000	1.903	0.415	2.318	5924.508	511.9	931.3	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1987

IRRIGATED AREA 25000.0 ha

MONTH	DATE	INFLOW (>%)	IRRIG.W.	WATER USE(>%) W.SUPPLY	M.FLOW	TOTAL	EFFECTIVE STORAGE DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	16	6.458	0.000	1.903	1.095	2.998	6231.783	538.4	931.9	0.000
2	28	0.335	30.093	1.903	1.095	33.091	6595.166	569.8	932.6	0.000
3	31	2.738	0.000	1.903	1.095	2.998	5756.923	497.4	931.0	0.000
4	30	0.000	5.787	1.903	0.418	8.108	5283.110	456.5	930.0	0.000
5	31	0.253	6.944	1.903	0.418	9.265	4848.159	418.9	928.9	0.000
6	30	3.738	10.417	1.903	0.340	12.660	4405.133	380.6	927.7	0.000
7	31	1.958	12.153	1.903	0.340	14.396	3897.604	336.8	926.4	0.000
8	31	1.728	12.153	1.903	0.340	14.396	3314.002	286.3	924.8	0.000
9	30	1.868	0.000	1.903	0.340	2.243	3010.242	260.1	924.0	0.000
10	1	59.344	0.000	1.903	0.407	2.310	3063.959	264.7	924.1	0.000
11	1	71.668	11.574	1.903	0.407	13.884	4994.128	431.5	929.3	0.000
12	1	85.453	0.000	1.903	0.415	2.318	7233.486	625.0	933.9	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1988

IRRIGATED AREA 25000.0 ha

MONTH	DATE	INFLOW (>%)	IRRIG.W.	WATER USE(>%) W.SUPPLY	M.FLOW	TOTAL	EFFECTIVE STORAGE DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	1	163.639	0.000	1.903	1.095	2.998	9949.440	859.6	938.4	0.000
2	1	197.456	0.000	1.903	1.095	2.998	14529.578	1255.4	944.7	0.000
3	31	7.712	0.000	1.903	1.095	2.998	16487.506	1424.5	947.0	0.000
4	30	2.068	0.000	1.903	0.418	2.321	15981.291	1380.8	946.4	0.000
5	31	2.726	6.944	1.903	0.418	9.265	15392.336	1329.9	945.7	0.000
6	30	0.492	0.000	1.903	0.340	2.243	14754.966	1274.8	945.0	0.000
7	31	1.949	12.153	1.903	0.340	14.396	14112.658	1219.3	944.1	0.000
8	31	5.671	12.153	1.903	0.340	14.396	13359.230	1152.5	943.1	0.000
9	30	1.423	4.051	1.903	0.340	6.294	12832.808	1108.8	942.4	0.000
10	31	2.047	0.000	1.903	0.407	2.310	12391.068	1070.6	941.9	0.000
11	30	1.667	0.000	1.903	0.415	2.318	11987.633	1035.7	941.3	0.000
12	31	2.058	19.097	1.903	1.095	22.095	11597.661	1002.0	940.8	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1989

IRRIGATED AREA 25000.0 ha

MONTH	DATE	INFLOW (>%)	IRRIG.W.	WATER USE(>%) W.SUPPLY	M.FLOW	TOTAL	EFFECTIVE STORAGE DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	31	2.427	0.000	1.903	1.095	2.998	11210.223	968.6	940.3	0.000
2	20	12.123	0.000	1.903	1.095	2.998	11015.205	951.7	940.0	0.000
3	31	1.004	0.000	1.903	1.095	2.998	12178.297	1052.2	941.6	0.000
4	30	0.924	5.787	1.903	0.418	8.108	11640.555	1005.7	940.9	0.000
5	31	0.424	6.944	1.903	0.418	9.265	11084.060	957.7	940.1	0.000
6	30	1.916	10.417	1.903	0.340	12.660	10545.370	911.1	939.3	0.000
7	31	1.428	12.153	1.903	0.340	14.396	9887.402	854.3	938.3	0.000
8	31	1.813	12.153	1.903	0.340	14.396	9185.392	793.6	937.2	0.000
9	30	1.527	4.051	1.903	0.340	6.294	8734.985	754.7	936.4	0.000
10	31	1.478	0.000	1.903	0.407	2.310	8348.153	721.3	935.8	0.000
11	30	0.807	0.000	1.903	0.415	2.318	8156.205	704.7	935.5	0.000
12	31	1.383	19.097	1.903	1.095	22.095	7791.354	673.2	934.9	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1990

IRRIGATED AREA 25000.0 ha

MONTH	DATE	INFLOW (>%)	IRRIG.W.	WATER USE(>%) W.SUPPLY	M.FLOW	TOTAL	EFFECTIVE STORAGE DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	11	1.793	0.000	1.903	1.095	2.998	7678.239	663.4	934.7	0.000
2	1	322.686	0.000	1.903	1.095	2.998	10353.063	894.5	939.0	0.000
3	31	6.803	0.000	1.903	1.095	2.998	13312.143	1150.2	943.1	0.000
4	30	3.895	0.000	1.903	0.418	2.321	13020.150	1124.9	942.7	0.000
5	31	1.678	0.000	1.903	0.418	2.321	12654.685	1093.4	942.2	0.000
6	30	2.148	10.417	1.903	0.340	12.660	12107.371	1046.1	941.5	0.000
7	31	0.921	12.153	1.903	0.340	14.396	11406.587	985.5	940.6	0.000
8	31	1.467	12.153	1.903	0.340	14.396	10655.672	920.6	939.5	0.000
9	30	1.640	4.051	1.903	0.340	6.294	10174.789	879.1	938.7	0.000
10	31	0.686	6.944	1.903	0.407	9.254	9721.820	840.0	938.0	0.000
11	30	0.997	0.000	1.903	0.415	2.318	9240.421	798.4	937.2	0.000
12	31	0.198	0.000	1.903	1.095	2.998	8793.512	759.8	936.5	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1991

IRRIGATED AREA 25000.0 ha

MONTH	DATE	INFLOW (>%)	IRRIG.W.	WATER USE(>%) W.SUPPLY	M.FLOW	TOTAL	EFFECTIVE STORAGE DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	31	3.188	28.935	1.903	1.095	31.933	8302.101	717.3	935.8	0.000
2	16	3.715	32.986	1.903	1.095	35.984	7974.014	689.0	935.2	0.000
3	16	6.524	0.000	1.903	1.095	2.998	7592.296	656.0	934.6	0.000
4	30	0.617	5.787	1.903	0.418	8.108	7810.617	674.8	935.0	0.000
5	31	1.452	6.944	1.903	0.418	9.265	7336.528	633.9	934.1	0.000
6	30	1.371	10.417	1.903	0.340	12.660	6848.662	591.7	933.1	0.000
7	31	1.014	12.153	1.903	0.340	14.396	6260.895	540.9	932.0	0.000
8	31	1.584	12.153	1.903	0.340	14.396	5619.803	485.6	930.7	0.000
9	30	0.699	4.051	1.903	0.340	6.294	5244.990	453.2	930.0	0.000
10	31	1.169	0.000	1.903	0.407	2.310	4986.664	430.8	929.5	0.000
11	30	1.128	0.000	1.903	0.415	2.318	4760.544	411.3	928.7	0.000
12	31	0.163	0.000	1.903	1.095	2.998	4410.938	381.1	927.7	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM

MINIMUM STORAGE BY EVERY MONTH ------- 1992

IRRIGATED AREA 25000.0 ha

MONTH	DATE	INFLOW (%)	WATER USE(%) IRRIG.W.	W.SUPPLY	M.FLOW	TOTAL	EFFECTIVE STORAGE DIS.(%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(%)
1	31	6.836	28.935	1.903	1.095	31.933	4098.778	354.1	926.9	0.000
2	29	0.099	30.093	1.903	1.095	33.091	3105.467	268.3	924.2	0.000
3	31	4.045	0.000	1.903	1.095	2.998	2615.166	226.0	922.8	0.000
4	30	0.053	5.787	1.903	0.418	8.108	2387.316	206.3	922.1	0.000
5	31	0.000	6.944	1.903	0.418	9.265	2027.764	175.2	921.0	0.000
6	30	0.000	10.417	1.903	0.360	12.660	1616.963	139.7	919.7	0.000
7	31	0.000	12.153	1.903	0.340	14.396	1112.066	96.1	917.6	0.000
8	31	0.000	12.153	1.903	0.340	14.396	550.054	47.5	914.7	0.000
9	30	0.000	4.051	1.903	0.340	6.294	248.114	21.4	912.1	0.000
10	31	0.318	6.944	1.903	0.407	9.254	0.452	0.0	910.0	0.000
11	30	0.018	12.731	1.903	0.415	15.049	-207.184	-17.9	910.0	0.000
12	8	0.076	0.000	1.903	0.415	2.318	-307.528	-26.6	910.0	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM

MINIMUM STORAGE BY EVERY MONTH ------- 1993

IRRIGATED AREA 25000.0 ha

MONTH	DATE	INFLOW (%)	WATER USE(%) IRRIG.W.	W.SUPPLY	M.FLOW	TOTAL	EFFECTIVE STORAGE DIS.(%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(%)
1	1	31.553	0.000	1.903	1.095	2.998	608.184	52.5	915.1	0.000
2	1	16.845	0.000	1.903	1.095	2.998	1221.153	105.5	918.0	0.000
3	25	4.022	0.000	1.903	1.095	2.998	2189.451	189.2	921.5	0.000
4	30	1.042	0.000	1.903	0.418	2.321	2078.718	179.6	921.2	0.000
5	31	1.517	6.944	1.903	0.418	9.265	1902.070	164.3	920.6	0.000
6	30	1.606	10.417	1.903	0.360	12.660	1552.058	134.1	919.4	0.000
7	31	3.359	12.153	1.903	0.340	14.396	1109.475	95.9	917.6	0.000
8	31	1.697	12.153	1.903	0.360	14.396	607.765	52.5	915.1	0.000
9	30	0.825	0.000	1.903	0.360	2.243	361.964	31.3	913.1	0.000
10	31	1.774	6.944	1.903	0.407	9.254	158.520	13.7	911.4	0.000
11	10	1.420	0.000	1.903	0.407	2.310	105.104	9.1	910.9	0.000
12	1	5.597	0.000	1.903	0.415	2.318	368.395	31.8	913.2	0.000

RESERVOIR OPERATION STUDY ON KUDU DAM

YEAR	INFLOW (MCM)	IRRIG.W (MCM)	W.SUPPLY (MCM)	M.FLOW (MCM)	W.USE (MCM)	W.LOSS (MCM)	INEFF.DIS. (MCM)
1974	3982.815	165.550	59.860	18.554	244.182	390.102	1959.692
1975	1272.460	228.950	59.860	18.554	307.586	390.665	992.589
1976	783.821	208.700	60.024	18.649	287.596	368.244	115.587
1977	2029.510	192.550	59.860	18.554	271.187	375.282	1106.628
1978	4369.529	131.650	59.860	18.554	210.291	412.124	3642.410
1979	406.399	246.500	59.860	18.556	325.133	357.095	27.954
1980	538.128	273.900	60.024	18.649	352.795	342.604	0.000
1981	3530.588	218.250	59.860	18.554	296.882	388.492	2738.812
1982	80.140	277.500	59.860	18.554	356.136	251.104	0.000
1983	41.105	250.600	59.860	18.554	329.231	116.739	0.000
1984	91.305	221.350	60.024	18.649	300.246	22.950	0.000
1985	1036.627	251.200	59.860	18.554	329.834	174.893	0.000
1986	680.161	222.050	59.860	18.554	300.692	232.056	0.000
1987	794.195	264.000	59.860	18.554	342.633	168.559	0.000
1988	1031.136	190.000	60.024	18.649	268.891	377.566	229.140
1989	258.461	221.650	59.860	18.554	300.283	287.099	0.000
1990	699.135	224.050	59.860	18.554	302.692	309.920	0.000
1991	181.311	278.850	59.860	18.554	357.483	202.536	0.000
1992	104.412	280.400	60.024	18.649	359.296	76.093	0.000
1993	342.235	226.900	59.860	18.554	305.536	66.768	0.000

Table E-5 WATER BALANCE STUDY ON KUDU DAM

Lisk Level 25 % Irrigation Area 25,000 Ha
Initial Water Level EL 923 m Storage Water 3,800 MCM

① Inflow (cu.m / sec)
② Irrigation W. : Water Requirement for Irrigation (cu.m / sec)
③ W. Supply : Water Requirement for Urban and Industry (cu.m / sec)
④ M. Flow : Maintenance Flow (Water Rights) (cu.m / sec)
⑤ Total = ①-(②+③+④) (cu.m /sec)
⑥ Dischargre : Water Volume of Reservoir (cu.m / sec)
⑦ Vol : Water Volume of Reservoir (MCM)
⑧ W Level : Water Level of Reservoir(EL. m)
⑨ Ineff. Dis : Spill Water (cu.m / sec)

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1974

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	EFFECTIVE STORAGE TOTAL	DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	1	826.460	30.787	1.903	1.095	33.785	1230.699	106.3	918.1	0.000
2	1	262.105	0.000	1.903	1.095	2.998	15822.225	1367.0	946.2	0.000
3	1	440.064	0.000	1.903	1.095	2.998	16515.047	1426.9	947.0	421.097
4	30	15.809	8.102	1.903	0.418	10.423	16373.725	1414.7	946.8	0.000
5	31	3.714	9.722	1.903	0.418	12.043	15936.355	1376.9	946.3	0.000
6	30	3.334	14.583	1.903	0.340	16.826	15194.890	1312.8	945.5	0.000
7	31	2.781	17.014	1.903	0.340	19.257	14327.797	1237.9	944.4	0.000
8	31	1.926	0.000	1.903	0.340	2.243	13378.046	1155.9	943.2	0.000
9	30	1.818	5.671	1.903	0.340	7.914	12814.492	1107.2	942.4	0.000
10	31	0.998	9.722	1.903	0.407	12.032	12290.645	1061.9	941.7	0.000
11	20	7.498	0.000	1.903	0.415	2.318	11942.488	1031.8	941.3	0.000
12	1	84.001	0.000	1.903	0.415	2.318	12136.093	1048.6	941.5	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1975

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	EFFECTIVE STORAGE TOTAL	DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	1	369.052	0.000	1.903	1.095	2.998	16515.047	1426.9	947.0	355.280
2	1	197.881	0.000	1.903	1.095	2.998	16515.047	1426.9	947.0	180.861
3	21	23.965	17.014	1.903	1.095	20.012	16363.937	1413.8	946.8	0.000
4	17	9.710	0.000	1.903	0.418	2.321	16174.760	1397.5	946.6	0.000
5	31	1.616	9.722	1.903	0.418	12.043	15654.601	1352.6	946.0	0.000
6	30	1.356	14.583	1.903	0.340	16.826	14881.937	1285.8	945.1	0.000
7	31	1.437	17.014	1.903	0.340	19.257	13973.041	1207.3	944.0	0.000
8	31	0.965	17.014	1.903	0.340	19.257	12986.791	1122.1	942.6	0.000
9	30	1.120	5.671	1.903	0.340	7.914	12360.993	1068.0	941.8	0.000
10	31	0.867	0.000	1.903	0.407	2.310	11798.779	1019.4	941.1	0.000
11	30	1.124	0.000	1.903	0.415	2.318	11178.776	965.8	940.3	0.000
12	31	4.345	0.000	1.903	1.095	2.998	10917.149	943.2	939.9	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1976

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	EFFECTIVE STORAGE TOTAL	DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	31	2.223	0.000	1.903	1.095	2.998	10621.300	917.7	939.4	0.000
2	11	3.520	15.394	1.903	1.095	18.392	10653.147	903.2	939.2	0.000
3	13	10.519	0.000	1.903	1.095	2.998	10531.298	909.9	939.3	0.000
4	1	58.929	0.000	1.903	0.418	2.321	15680.523	1354.8	946.0	0.000
5	31	1.136	9.722	1.903	0.418	12.043	16122.813	1393.0	946.6	0.000
6	30	1.804	14.583	1.903	0.340	16.826	15361.764	1325.5	945.7	0.000
7	31	0.413	17.014	1.903	0.340	19.257	14411.930	1245.2	944.5	0.000
8	31	0.197	17.014	1.903	0.340	19.257	13391.984	1157.1	943.2	0.000
9	30	0.000	5.671	1.903	0.340	7.914	12750.185	1101.6	942.3	0.000
10	31	6.380	0.000	1.903	0.407	2.310	12232.340	1056.9	941.6	0.000
11	30	1.217	17.824	1.903	0.415	20.142	11572.602	999.9	940.8	0.000
12	26	0.884	0.000	1.903	1.095	2.998	10975.455	948.3	940.0	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1977

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	EFFECTIVE STORAGE TOTAL	DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	31	3.398	0.000	1.903	1.095	2.998	10446.602	902.6	939.1	0.000
2	5	5.946	0.000	1.903	1.095	2.998	10439.463	902.0	939.1	0.000
3	1	44.844	0.000	1.903	1.095	2.998	15034.525	1299.0	945.3	0.000
4	30	8.452	8.102	1.903	0.418	10.423	16344.280	1412.1	946.8	0.000
5	31	1.627	9.722	1.903	0.418	12.043	15679.360	1354.7	946.0	0.000
6	30	1.500	14.583	1.903	0.340	16.826	14894.497	1286.9	945.2	0.000
7	31	0.707	17.014	1.903	0.340	19.257	13967.431	1206.8	943.9	0.000
8	31	0.477	17.014	1.903	0.340	19.257	12963.861	1120.1	942.6	0.000
9	30	0.704	0.000	1.903	0.340	2.243	12355.886	1067.5	941.8	0.000
10	31	0.358	9.722	1.903	0.407	12.032	11815.693	1020.9	941.1	0.000
11	30	1.171	0.000	1.903	0.415	2.318	11168.048	964.9	940.2	0.000
12	17	2.915	0.000	1.903	1.095	2.998	11089.421	958.1	940.1	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1978

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	EFFECTIVE STORAGE TOTAL	DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	1	551.299	0.000	1.903	1.095	2.998	14875.776	1285.3	945.1	0.000
2	1	341.290	0.000	1.903	1.095	2.998	16515.047	1426.9	947.0	324.178
3	1	605.167	0.000	1.903	1.095	2.998	16515.047	1426.9	947.0	586.117
4	1	59.653	0.000	1.903	0.418	2.321	16515.047	1426.9	947.0	41.101
5	1	59.475	0.000	1.903	0.418	2.321	16515.047	1426.9	947.0	42.097
6	30	7.120	14.583	1.903	0.340	16.826	16202.824	1399.9	946.6	0.000
7	31	3.492	17.014	1.903	0.340	19.257	15383.985	1329.2	945.7	0.000
8	31	1.347	17.014	1.903	0.340	19.257	14396.400	1243.8	944.5	0.000
9	30	0.842	5.671	1.903	0.340	7.914	13745.122	1187.6	943.7	0.000
10	31	2.627	0.000	1.903	0.407	2.310	13385.298	1156.5	943.2	0.000
11	4	3.078	0.000	1.903	0.407	2.310	13344.278	1152.9	943.1	0.000
12	7	9.664	0.000	1.903	0.415	2.318	13306.497	1149.7	943.1	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1979

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	EFFECTIVE STORAGE TOTAL	DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	14	13.412	0.000	1.903	1.095	2.998	15561.282	1342.8	945.9	0.000
2	28	5.521	0.000	1.903	1.095	2.998	15115.266	1306.0	945.4	0.000
3	31	1.729	0.000	1.903	1.095	2.998	14556.085	1257.6	944.7	0.000
4	30	0.695	8.102	1.903	0.418	10.423	13798.320	1192.2	943.7	0.000
5	31	2.383	9.722	1.903	0.418	12.043	13162.227	1137.2	942.9	0.000
6	30	1.032	14.583	1.903	0.340	16.826	12433.957	1074.3	941.9	0.000
7	31	0.919	17.014	1.903	0.340	19.257	11565.530	999.3	940.8	0.000
8	31	0.597	17.014	1.903	0.340	19.257	10613.147	917.0	939.4	0.000
9	30	1.127	5.671	1.903	0.340	7.914	10019.451	865.7	938.5	0.000
10	31	0.109	0.000	1.903	0.407	2.310	9658.056	834.5	937.9	0.000
11	27	5.450	0.000	1.903	0.415	2.318	9419.680	813.9	937.5	0.000
12	4	8.385	0.000	1.903	0.415	2.318	9443.085	815.9	937.6	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH -------- 1980

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	EFFECTIVE STORAGE TOTAL	DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	24	25.308	24.306	1.903	1.095	27.304	11345.889	980.3	940.5	0.000
2	22	23.923	42.940	1.903	1.095	45.938	10932.459	944.6	939.9	0.000
3	1	176.039	0.000	1.903	1.095	2.998	13237.552	1143.7	943.0	0.000
4	30	1.620	8.102	1.903	0.418	10.423	12867.083	1111.7	942.5	0.000
5	31	0.349	9.722	1.903	0.418	12.043	12182.094	1052.5	941.6	0.000
6	30	0.553	14.583	1.903	0.340	16.826	11456.495	989.8	940.6	0.000
7	31	0.408	17.014	1.903	0.340	19.257	10600.242	915.9	939.4	0.000
8	31	0.668	17.014	1.903	0.340	19.257	9668.911	835.4	937.9	0.000
9	30	0.377	5.671	1.903	0.340	7.914	9103.551	786.5	937.0	0.000
10	31	0.199	0.000	1.903	0.407	2.310	8673.753	749.4	936.3	0.000
11	24	4.443	0.000	1.903	0.415	2.318	8461.139	731.0	936.0	0.000
12	1	24.025	0.000	1.903	0.415	2.318	8524.171	736.5	936.1	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH -------- 1981

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	EFFECTIVE STORAGE TOTAL	DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	7	10.164	0.000	1.903	1.095	2.998	9015.884	779.0	936.9	0.000
2	1	691.398	0.000	1.903	1.095	2.998	15953.310	1378.4	946.4	0.000
3	1	238.966	0.000	1.903	1.095	2.998	16515.047	1426.9	947.0	220.099
4	26	18.702	5.671	1.903	0.418	7.992	16236.834	1402.9	946.7	0.000
5	31	4.119	9.722	1.903	0.418	12.043	15783.411	1363.7	946.2	0.000
6	30	1.808	14.583	1.903	0.340	16.826	15045.365	1299.9	945.3	0.000
7	31	1.657	17.014	1.903	0.340	19.257	14135.401	1221.3	944.2	0.000
8	31	0.346	17.014	1.903	0.340	19.257	13130.680	1134.5	942.8	0.000
9	30	0.755	5.671	1.903	0.340	7.914	12486.364	1078.8	942.0	0.000
10	31	0.144	9.722	1.903	0.407	12.032	11868.441	1025.4	941.2	0.000
11	26	4.447	0.000	1.903	0.415	2.318	11451.353	989.4	940.6	0.000
12	31	1.788	0.000	1.903	1.095	2.998	11356.399	981.2	940.5	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH -------- 1982

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	EFFECTIVE STORAGE TOTAL	DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	31	1.378	40.509	1.903	1.095	43.507	11089.049	958.1	940.1	0.000
2	28	3.503	42.130	1.903	1.095	45.128	10141.117	876.2	938.7	0.000
3	31	0.172	25.116	1.903	1.095	28.114	8786.628	759.2	936.5	0.000
4	30	0.107	0.000	1.903	0.418	2.321	8303.022	717.4	935.8	0.000
5	31	0.125	9.722	1.903	0.418	12.043	7815.226	675.2	935.0	0.000
6	30	0.381	14.583	1.903	0.340	16.826	7183.734	620.7	933.8	0.000
7	31	0.252	17.014	1.903	0.340	19.257	6416.937	554.4	932.3	0.000
8	31	0.380	17.014	1.903	0.340	19.257	5576.639	481.8	930.6	0.000
9	30	0.722	5.671	1.903	0.340	7.914	5089.602	439.7	929.5	0.000
10	31	0.646	0.000	1.903	0.407	2.310	4814.664	416.0	928.8	0.000
11	30	0.370	0.000	1.903	0.415	2.318	4626.185	399.7	928.3	0.000
12	31	1.841	26.736	1.903	1.095	29.734	4357.816	376.5	927.6	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH -------- 1983

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	EFFECTIVE STORAGE TOTAL	DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	31	0.868	0.000	1.903	1.095	2.998	3734.051	322.6	925.9	0.000
2	28	0.569	42.130	1.903	1.095	45.128	3285.024	283.8	924.8	0.000
3	31	0.227	25.116	1.903	1.095	28.114	2271.989	196.3	921.7	0.000
4	30	0.118	0.000	1.903	0.418	2.321	1823.789	157.6	920.4	0.000
5	31	0.061	9.722	1.903	0.418	12.043	1615.422	139.6	919.7	0.000
6	30	0.098	14.583	1.903	0.340	16.826	1112.503	96.1	917.6	0.000
7	31	0.151	17.014	1.903	0.340	19.257	480.713	41.5	914.1	0.000
8	31	0.151	17.014	1.903	0.340	19.257	-234.807	-20.3	910.0	0.000
9	30	0.053	5.671	1.903	0.340	7.914	-595.501	-51.5	910.0	0.000
10	31	0.089	0.000	1.903	0.407	2.310	-803.571	-69.4	910.0	0.000
11	30	1.753	0.000	1.903	0.415	2.318	-1044.655	-90.3	910.0	0.000
12	1	3.468	0.000	1.903	0.415	2.318	-1043.634	-90.2	910.0	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH -------- 1984

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	EFFECTIVE STORAGE TOTAL	DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	31	0.424	0.000	1.903	1.095	2.998	-1488.763	-128.6	910.0	0.000
2	29	0.052	39.699	1.903	1.095	42.697	-1689.568	-146.0	910.0	0.000
3	31	0.485	0.000	1.903	1.095	2.998	-2281.738	-197.1	910.0	0.000
4	30	0.070	0.000	1.903	0.418	2.321	-2273.882	-196.5	910.0	0.000
5	31	0.086	9.722	1.903	0.418	12.043	-2448.322	-211.5	910.0	0.000
6	30	0.125	14.583	1.903	0.340	16.826	-2877.157	-248.6	910.0	0.000
7	31	0.282	17.014	1.903	0.340	19.257	-3451.072	-298.2	910.0	0.000
8	31	0.415	17.014	1.903	0.340	19.257	-4130.983	-356.9	910.0	0.000
9	30	0.253	5.671	1.903	0.340	7.914	-4460.626	-385.4	910.0	0.000
10	31	2.076	9.722	1.903	0.407	12.032	-4667.024	-403.2	910.0	0.000
11	30	0.550	0.000	1.903	0.415	2.318	-4862.604	-420.1	910.0	0.000
12	1	13.668	0.000	1.903	0.415	2.318	-4851.253	-419.1	910.0	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH -------- 1985

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	EFFECTIVE STORAGE TOTAL	DIS.(>%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(>%)
1	6	0.560	0.000	1.903	1.095	2.998	-4327.490	-373.9	910.0	0.000
2	1	306.417	0.000	1.903	1.095	2.998	1580.854	136.6	919.5	0.000
3	23	21.064	29.167	1.903	1.095	32.165	4419.329	381.8	927.8	0.000
4	30	1.330	8.102	1.903	0.418	10.423	4257.898	367.9	927.3	0.000
5	31	0.255	9.722	1.903	0.418	12.043	3822.169	330.7	926.2	0.000
6	30	0.151	14.583	1.903	0.340	16.826	3277.014	283.1	924.7	0.000
7	31	0.108	17.014	1.903	0.340	19.257	2590.314	223.8	922.7	0.000
8	31	0.019	17.014	1.903	0.340	19.257	1817.654	157.0	920.4	0.000
9	30	0.038	5.671	1.903	0.340	7.914	1403.908	121.3	918.8	0.000
10	31	0.461	0.000	1.903	0.407	2.310	1039.022	89.8	917.3	0.000
11	30	0.568	17.824	1.903	0.415	20.142	615.954	53.2	915.2	0.000
12	18	2.556	0.000	1.903	1.095	2.998	337.367	29.1	912.9	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1986

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	TOTAL	EFFECTIVE STORAGE DIS.(>%)	VOL.(MCM)	W.LEVEL (EL. m)	INEFF. DIS.(>%)
1	1	196.673	0.000	1.903	1.095	2.998	1736.542	150.0	920.1	0.000
2	1	230.244	0.000	1.903	1.095	2.998	5879.400	508.0	931.2	0.000
3	31	3.018	0.000	1.903	1.095	2.998	5747.178	496.6	931.0	0.000
4	20	2.308	0.000	1.903	0.418	2.321	5600.259	483.9	930.7	0.000
5	31	1.156	0.000	1.903	0.418	2.321	5488.058	474.2	930.4	0.000
6	30	1.002	14.583	1.903	0.340	16.826	5030.069	434.6	929.4	0.000
7	31	0.140	17.014	1.903	0.340	19.257	4309.713	372.4	927.5	0.000
8	31	0.290	17.014	1.903	0.340	19.257	3503.537	302.7	925.3	0.000
9	30	0.158	5.671	1.903	0.340	7.914	3055.117	264.0	924.1	0.000
10	31	0.201	0.000	1.903	0.407	2.310	2821.973	243.8	923.4	0.000
11	30	0.301	17.824	1.903	0.415	20.142	2588.555	223.7	922.7	0.000
12	7	4.967	0.000	1.903	0.415	2.318	2542.534	219.7	922.6	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1987

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	TOTAL	EFFECTIVE STORAGE DIS.(>%)	VOL.(MCM)	W.LEVEL (EL. m)	INEFF. DIS.(>%)
1	15	3.816	0.000	1.903	1.095	2.998	2830.917	244.6	923.4	0.000
2	28	0.335	42.130	1.903	1.095	45.128	3126.401	270.1	924.3	0.000
3	31	2.738	0.000	1.903	1.095	2.998	2161.880	186.8	921.4	0.000
4	30	0.000	8.102	1.903	0.418	10.423	1704.086	147.2	920.0	0.000
5	31	0.253	9.722	1.903	0.418	12.043	1292.275	111.7	918.3	0.000
6	30	3.738	14.583	1.903	0.340	16.826	827.359	71.5	916.3	0.000
7	31	1.958	17.014	1.903	0.340	19.257	263.333	22.8	912.3	0.000
8	31	1.728	17.014	1.903	0.340	19.257	-405.330	-35.0	910.0	0.000
9	30	1.868	0.000	1.903	0.340	2.243	-693.038	-59.9	910.0	0.000
10	1	59.344	0.000	1.903	0.407	2.310	-636.370	-55.0	910.0	0.000
11	1	71.668	16.204	1.903	0.407	18.514	1343.344	116.1	918.5	0.000
12	1	85.453	0.000	1.903	0.415	2.318	3644.760	314.9	925.7	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1988

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	TOTAL	EFFECTIVE STORAGE DIS.(>%)	VOL.(MCM)	W.LEVEL (EL. m)	INEFF. DIS.(>%)
1	1	163.639	0.000	1.903	1.095	2.998	6437.538	556.2	932.3	0.000
2	1	197.456	0.000	1.903	1.095	2.998	11011.392	951.4	940.0	0.000
3	1	64.160	0.000	1.903	1.095	2.998	13243.470	1144.2	943.0	0.000
4	30	2.068	0.000	1.903	0.418	2.321	15119.914	1306.4	945.4	0.000
5	31	2.726	9.722	1.903	0.418	12.043	14505.249	1253.3	944.7	0.000
6	30	0.492	0.000	1.903	0.340	2.243	13789.816	1191.4	943.7	0.000
7	31	1.949	17.014	1.903	0.340	19.257	13067.733	1129.1	942.8	0.000
8	31	5.671	17.014	1.903	0.340	19.257	12139.833	1048.9	941.5	0.000
9	30	1.423	5.671	1.903	0.340	7.914	11578.477	1000.4	940.8	0.000
10	31	2.047	0.000	1.903	0.407	2.310	11123.491	961.1	940.2	0.000
11	30	1.667	0.000	1.903	0.415	2.318	10705.547	925.0	939.6	0.000
12	31	2.058	26.736	1.903	1.095	29.734	10272.474	887.5	938.9	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1989

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	TOTAL	EFFECTIVE STORAGE DIS.(>%)	VOL.(MCM)	W.LEVEL (EL. m)	INEFF. DIS.(>%)
1	31	2.427	0.000	1.903	1.095	2.998	9833.909	849.6	938.2	0.000
2	19	10.805	0.000	1.903	1.095	2.998	9666.762	835.5	937.9	0.000
3	31	1.004	0.000	1.903	1.095	2.998	10727.814	926.9	939.6	0.000
4	30	0.924	8.102	1.903	0.418	10.423	10166.792	878.4	938.7	0.000
5	31	0.424	9.722	1.903	0.418	12.043	9573.330	827.1	937.8	0.000
6	30	1.916	14.583	1.903	0.340	16.826	8961.247	774.3	936.8	0.000
7	31	1.428	17.014	1.903	0.340	19.257	8192.014	707.8	935.6	0.000
8	31	1.813	17.014	1.903	0.340	19.257	7350.239	635.1	934.1	0.000
9	30	1.527	5.671	1.903	0.340	7.914	6859.516	592.7	933.1	0.000
10	31	1.478	0.000	1.903	0.407	2.310	6463.925	558.5	932.4	0.000
11	30	0.807	0.000	1.903	0.415	2.318	6271.190	541.8	932.0	0.000
12	31	1.383	26.736	1.903	1.095	29.734	5878.024	507.9	931.2	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1990

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	TOTAL	EFFECTIVE STORAGE DIS.(>%)	VOL.(MCM)	W.LEVEL (EL. m)	INEFF. DIS.(>%)
1	11	1.793	0.000	1.903	1.095	2.998	5767.777	498.3	931.0	0.000
2	1	322.686	0.000	1.903	1.095	2.998	8452.246	730.3	936.0	0.000
3	31	6.803	0.000	1.903	1.095	2.998	11208.340	968.4	940.3	0.000
4	30	3.895	0.000	1.903	0.418	2.321	10967.263	947.6	940.0	0.000
5	31	1.678	0.000	1.903	0.418	2.321	10650.378	920.2	939.5	0.000
6	30	2.148	14.583	1.903	0.340	16.826	10059.782	869.2	938.5	0.000
7	31	0.921	17.014	1.903	0.340	19.257	9257.485	799.8	937.3	0.000
8	31	1.467	17.014	1.903	0.340	19.257	8376.640	723.7	935.9	0.000
9	30	1.640	5.671	1.903	0.340	7.914	7864.382	679.5	935.1	0.000
10	31	0.686	9.722	1.903	0.407	12.032	7399.944	639.4	934.2	0.000
11	30	0.997	0.000	1.903	0.415	2.318	6877.719	594.2	933.2	0.000
12	31	0.198	0.000	1.903	1.095	2.998	6412.313	554.0	932.3	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1991

IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (>%)	WATER USE(>%) IRRIG.W.	W.SUPPLY	M.FLOW	TOTAL	EFFECTIVE STORAGE DIS.(>%)	VOL.(MCM)	W.LEVEL (EL. m)	INEFF. DIS.(>%)
1	31	3.188	40.509	1.903	1.095	43.507	5830.796	503.8	931.1	0.000
2	16	3.715	46.181	1.903	1.095	49.179	5390.778	465.8	930.3	0.000
3	16	6.524	0.000	1.903	1.095	2.998	4809.197	415.5	928.8	0.000
4	30	0.617	8.102	1.903	0.418	10.423	5094.921	440.2	929.6	0.000
5	31	1.452	9.722	1.903	0.418	12.043	4617.455	398.9	928.3	0.000
6	30	1.371	14.583	1.903	0.340	16.826	4084.688	352.9	926.9	0.000
7	31	1.014	17.014	1.903	0.340	19.257	3414.698	295.0	925.1	0.000
8	31	1.584	17.014	1.903	0.340	19.257	2661.911	230.0	922.9	0.000
9	30	0.699	5.671	1.903	0.340	7.914	2274.037	196.5	921.7	0.000
10	31	1.169	0.000	1.903	0.407	2.310	2058.804	177.9	921.1	0.000
11	30	1.126	0.000	1.903	0.415	2.318	1875.352	162.0	920.5	0.000
12	31	0.163	0.000	1.903	1.095	2.998	1524.022	131.7	919.3	0.000

SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1992
IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (%)	WATER USE(%) IRRIG.W.	W.SUPPLY	M.FLOW	TOTAL	EFFECTIVE STORAGE DIS.(%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(%)
1	31	6.836	40.509	1.903	1.095	43.507	1196.684	103.4	917.9	0.000
2	29	0.099	42.130	1.903	1.095	45.128	-47.201	-4.1	910.0	0.000
3	29	1.311	0.000	1.903	1.095	2.998	-549.792	-47.5	910.0	0.000
4	30	0.053	8.102	1.903	0.418	10.423	-695.165	-60.1	910.0	0.000
5	31	0.000	9.722	1.903	0.418	12.043	-1035.179	-89.4	910.0	0.000
6	30	0.000	14.583	1.903	0.340	16.826	-1479.320	-127.8	910.0	0.000
7	31	0.000	17.014	1.903	0.340	19.257	-2067.346	-178.6	910.0	0.000
8	31	0.000	17.014	1.903	0.340	19.257	-2761.502	-238.6	910.0	0.000
9	30	0.000	5.671	1.903	0.340	7.914	-3110.708	-268.8	910.0	0.000
10	31	0.318	9.722	1.903	0.407	12.032	-3393.183	-293.2	910.0	0.000
11	30	0.018	17.824	1.903	0.415	20.142	-3657.245	-316.0	910.0	0.000
12	8	0.076	0.000	1.903	0.415	2.318	-3785.192	-327.0	910.0	0.000

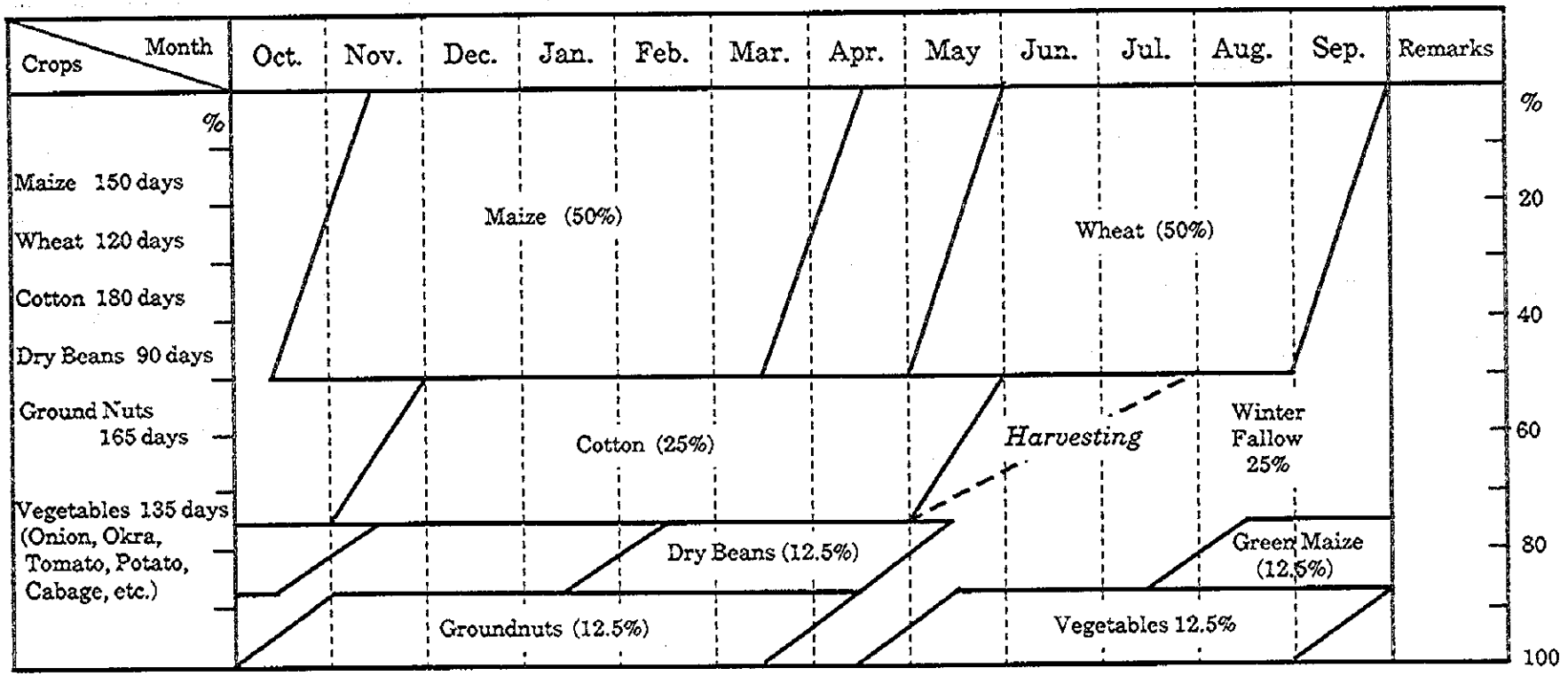
SUMMARY OF RESERVOIR OPERATION STUDY ON KUDU DAM
MINIMUM STORAGE BY EVERY MONTH ------- 1993
IRRIGATED AREA 35000.0 ha

MONTH	DATE	INFLOW (%)	WATER USE(%) IRRIG.W.	W.SUPPLY	M.FLOW	TOTAL	EFFECTIVE STORAGE DIS.(%)	VOL.(MCM)	W.LEVEL (EL.m)	INEFF. DIS.(%)
1	1	31.553	0.000	1.903	1.095	2.998	-2852.755	-246.5	910.0	0.000
2	1	16.845	0.000	1.903	1.095	2.998	-2355.563	-203.5	910.0	0.000
3	24	2.203	0.000	1.903	1.095	2.998	-1451.719	-125.4	910.0	0.000
4	9	2.002	0.000	1.903	0.418	2.321	-1482.410	-128.1	910.0	0.000
5	31	1.517	9.722	1.903	0.418	12.043	-1569.251	-135.6	910.0	0.000
6	30	1.606	14.583	1.903	0.340	16.826	-1953.187	-168.8	910.0	0.000
7	31	3.359	17.014	1.903	0.340	19.257	-2479.817	-214.3	910.0	0.000
8	31	1.697	17.014	1.903	0.340	19.257	-3112.858	-269.0	910.0	0.000
9	30	0.825	0.000	1.903	0.340	2.243	-3396.860	-293.5	910.0	0.000
10	31	1.774	9.722	1.903	0.407	12.032	-3627.927	-313.5	910.0	0.000
11	10	1.420	0.000	1.903	0.407	2.310	-3687.991	-318.6	910.0	0.000
12	1	5.597	0.000	1.903	0.415	2.318	-3404.885	-294.2	910.0	0.000

RESERVOIR OPERATION STUDY ON KUDU DAM

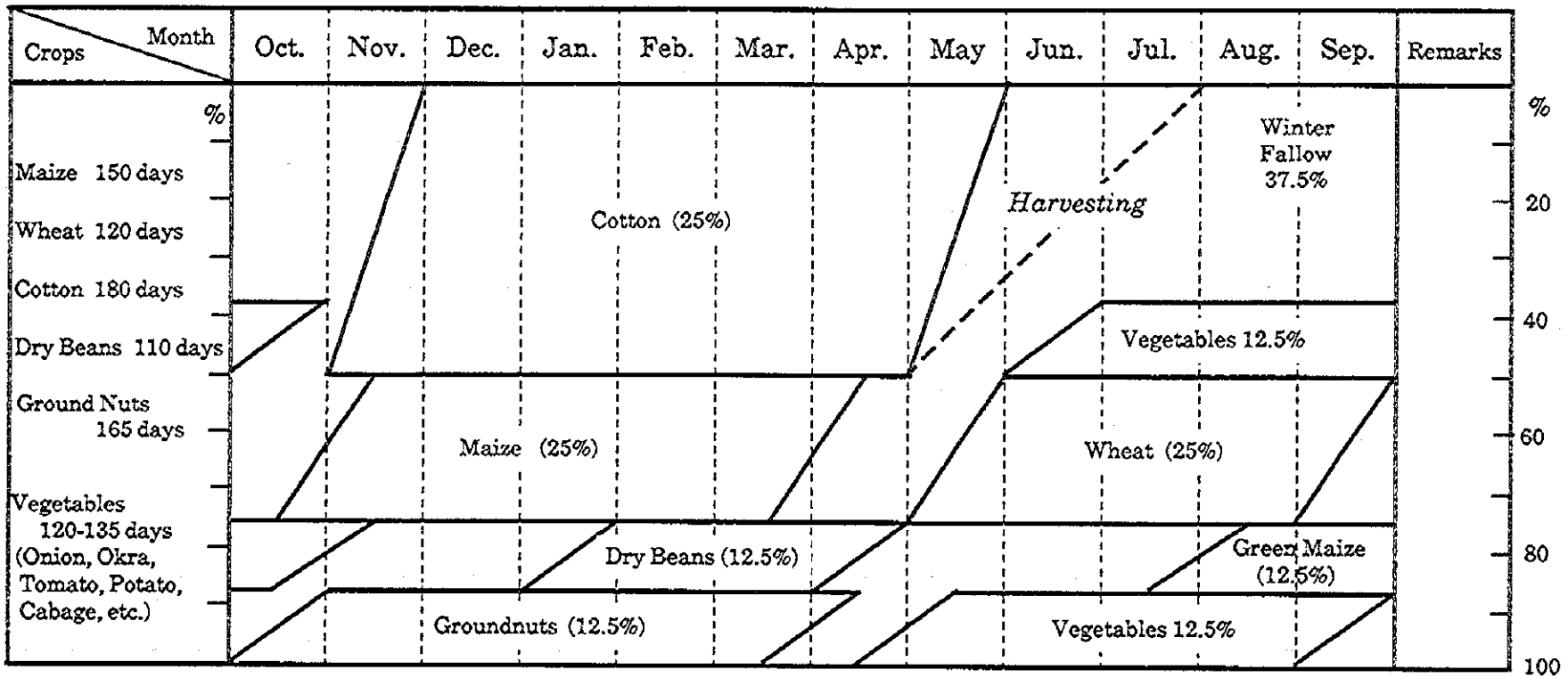
YEAR	INFLOW (MCM)	IRRIG.W (MCM)	W.SUPPLY (MCM)	M.FLOW (MCM)	W.USE (MCM)	W.LOSS (MCM)	INEFF.DIS. (MCM)
1974	3982.815	231.770	59.860	18.554	310.410	384.306	1899.254
1975	1272.460	320.530	59.860	18.554	399.171	382.993	974.003
1976	783.821	292.180	60.024	18.649	371.081	357.649	38.089
1977	2029.310	269.570	59.860	18.554	348.210	366.059	1036.517
1978	4369.529	184.310	59.860	18.554	262.952	407.888	3573.767
1979	406.399	345.100	59.860	18.554	423.739	339.403	0.000
1980	538.128	383.460	60.024	18.649	462.360	304.182	0.000
1981	3530.588	305.550	59.860	18.554	384.190	377.962	2568.135
1982	80.140	388.500	59.860	18.554	467.141	217.758	0.000
1983	41.105	350.840	59.860	18.554	429.481	63.355	0.000
1984	91.305	309.890	60.024	18.649	388.791	0.348	0.000
1985	1036.627	351.680	59.860	18.554	430.322	100.005	0.000
1986	680.161	310.870	59.860	18.554	389.512	149.921	0.000
1987	794.195	369.600	59.860	18.554	448.240	77.495	0.000
1988	1031.136	266.000	60.024	18.649	344.898	341.555	0.000
1989	258.461	310.310	59.860	18.554	388.950	249.245	0.000
1990	699.135	313.470	59.860	18.554	392.312	260.706	0.000
1991	181.311	390.390	59.860	18.554	469.030	136.691	0.000
1992	104.412	392.560	60.024	18.649	471.460	13.648	0.000
1993	362.235	317.660	59.860	18.554	396.302	0.279	0.000

Figure E - 1 PROPOSED CROPPING PATTERN No.1
(MAIN CROP ; MAIZE)



Note : Proportion of the Cropped Area in Winter Season shall be decided by Kudu Dam Reservoir Operation.

Figure E - 2 PROPOSED CROPPING PATTERN No.2
(MAIN CROP ; COTTON)



Note : Proportion of the Cropped Area in Winter Season shall be decided by Kudu Dam Reservoir Operation.

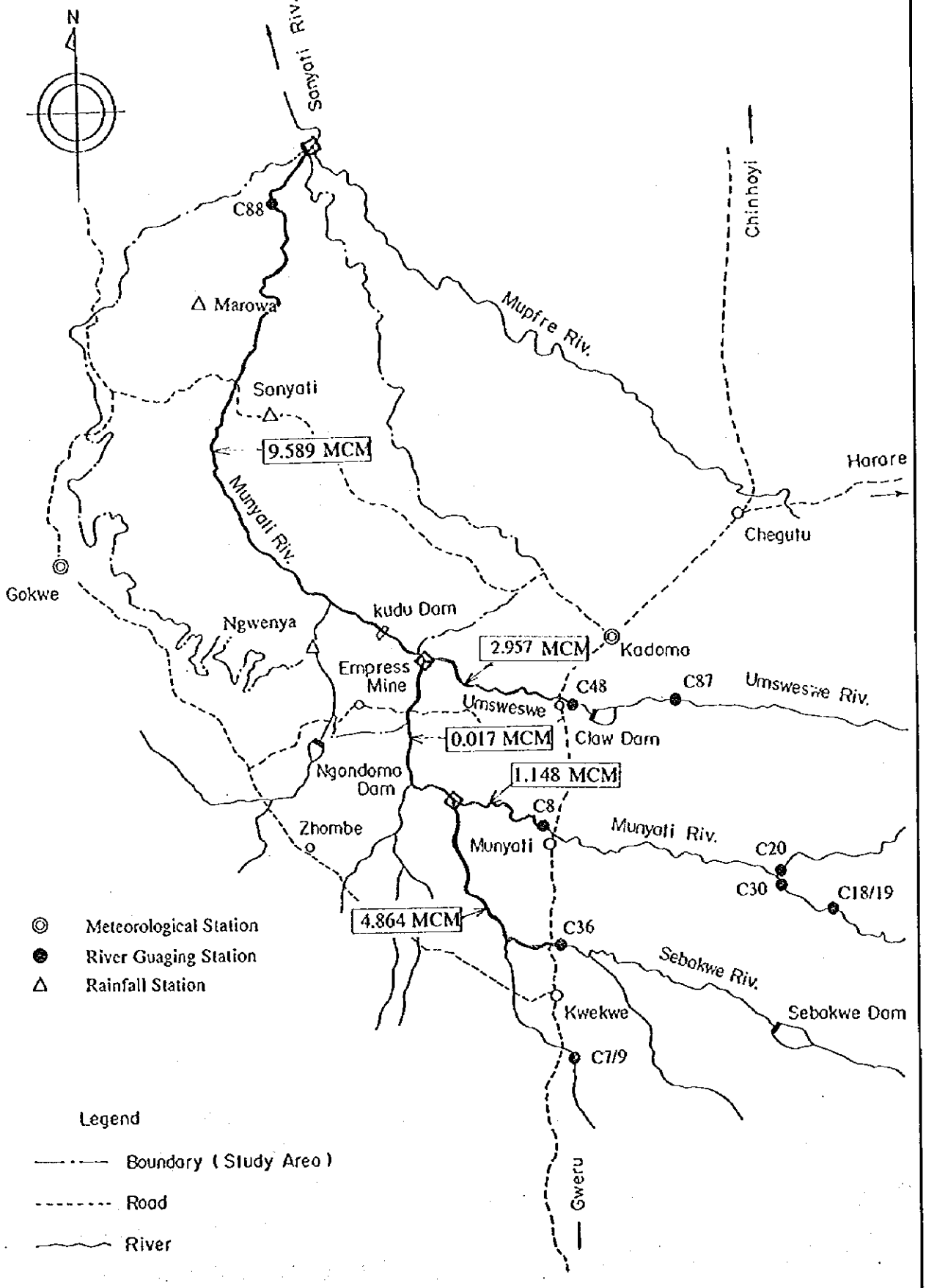


Figure E - 3 WATER RIGHTS IN RELATED STUDY AREA

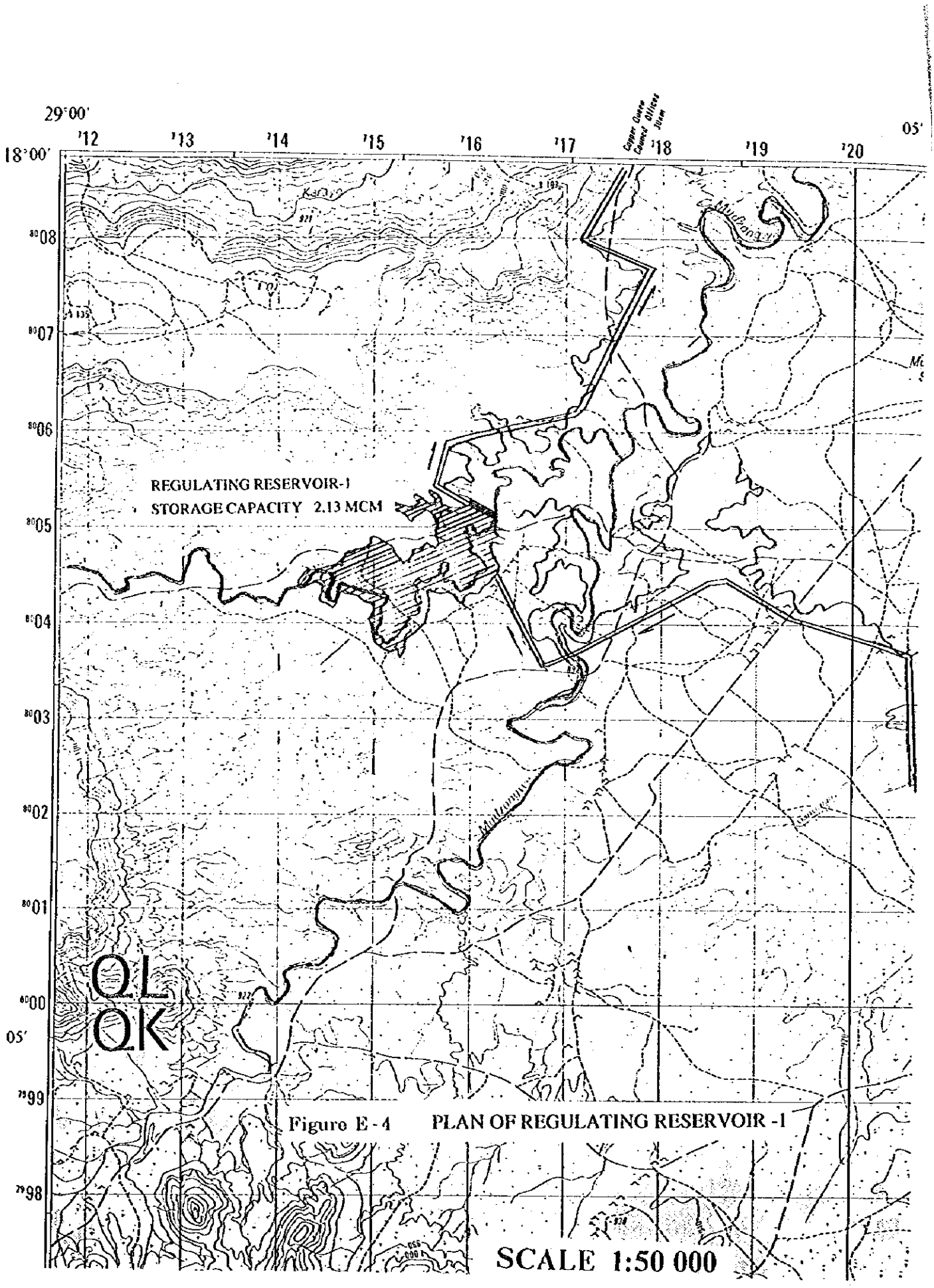


Figure E - 4 PLAN OF REGULATING RESERVOIR -1

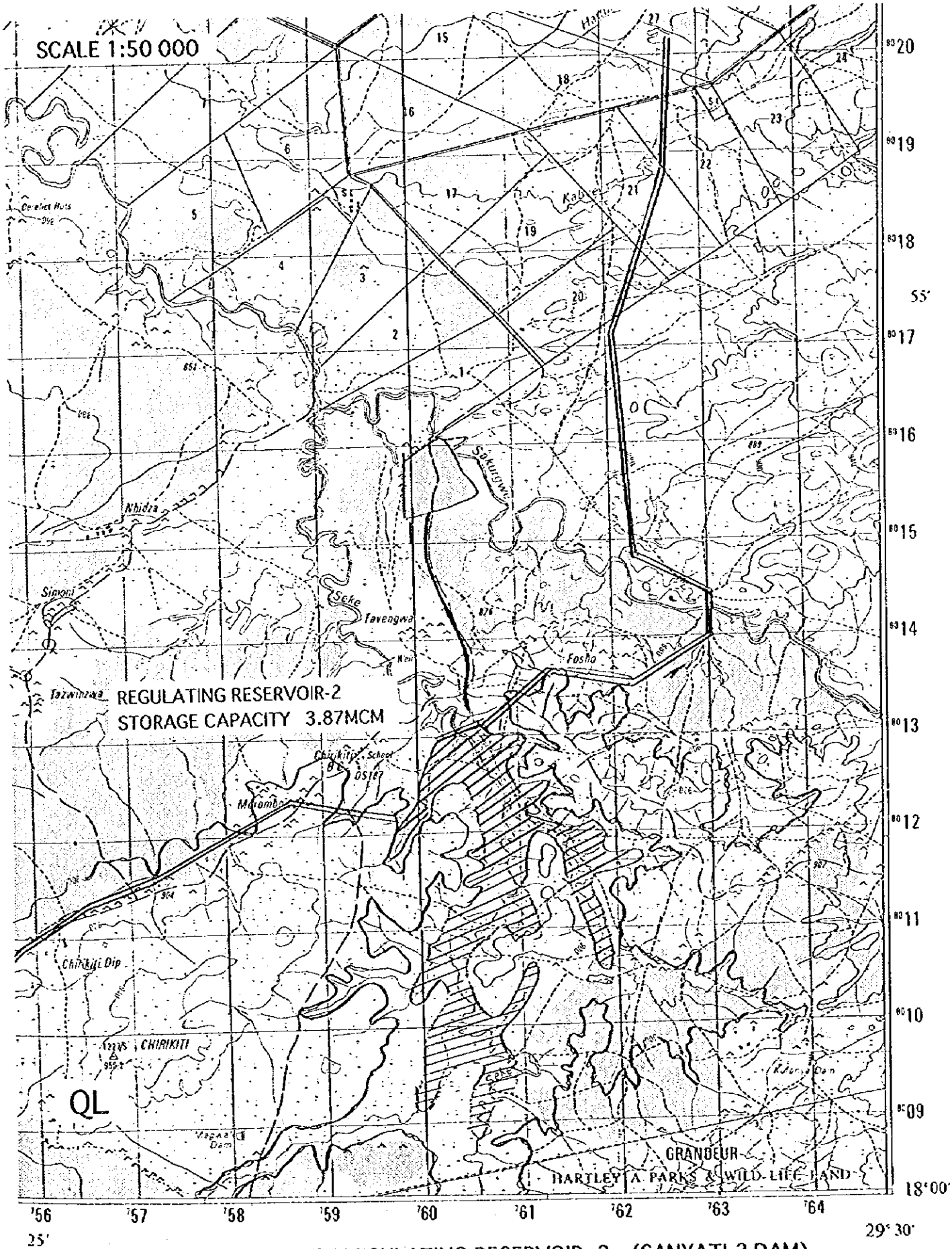


Figure E-5 PLAN OF REGULATING RESERVOIR -2 (SANYATI-2 DAM)

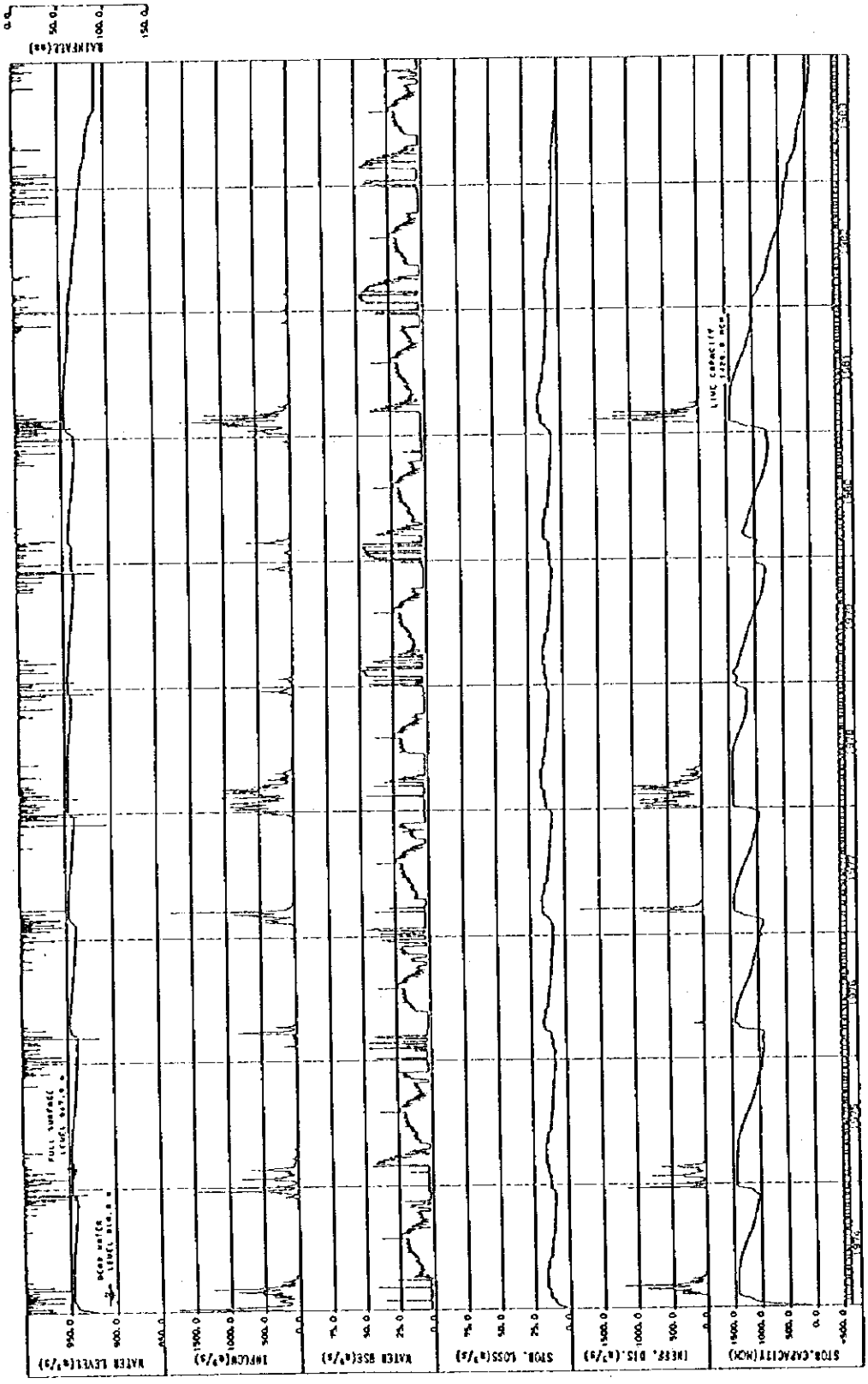


Figure E-6(1) WATER BALANCE STUDY ON KUDU DAM (1974 - 1983: 25% RISK)

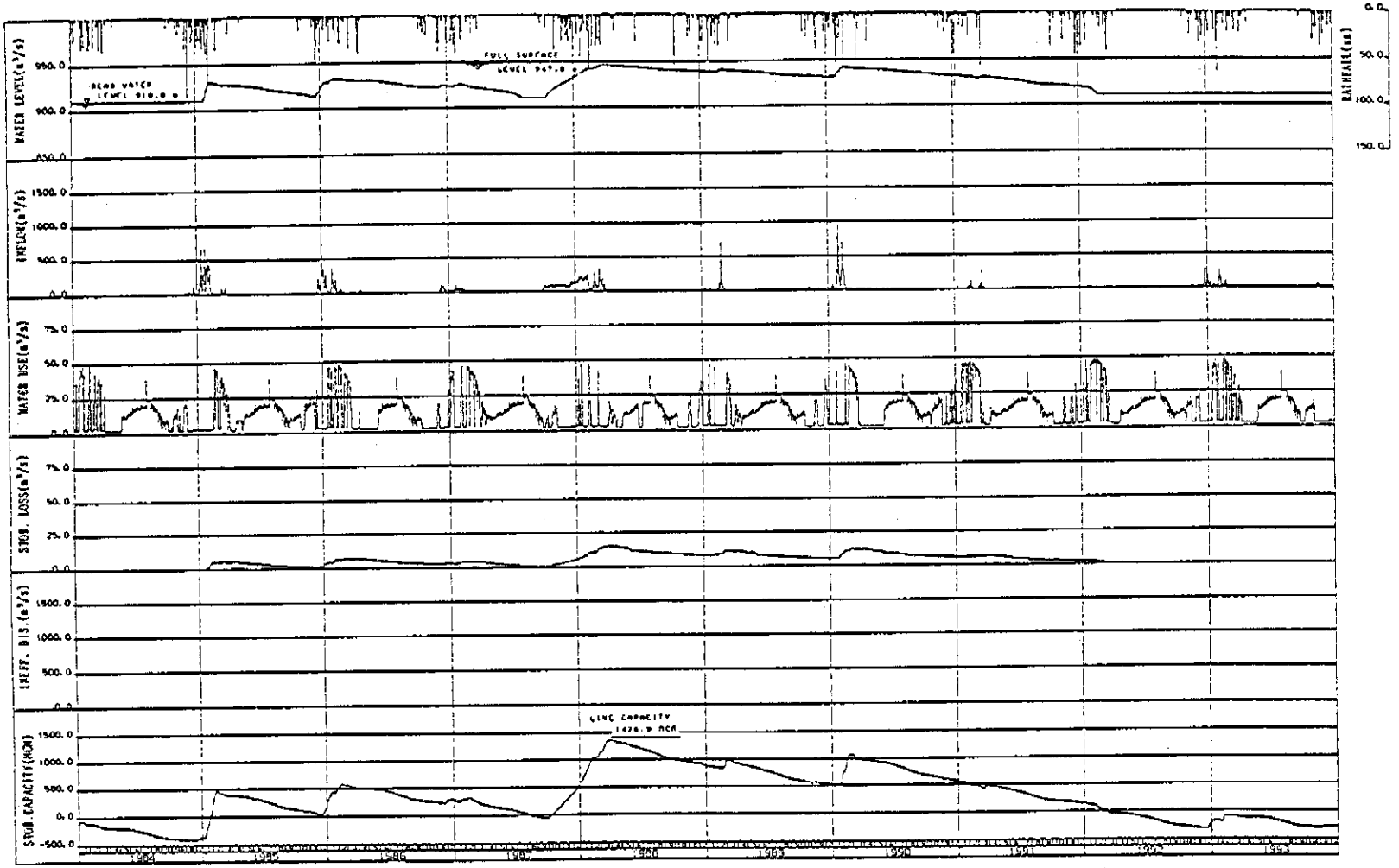


Figure E-6(2) WATER BALANCE STUDY ON KUDU DAM (1984 - 1993: 25% RISK)

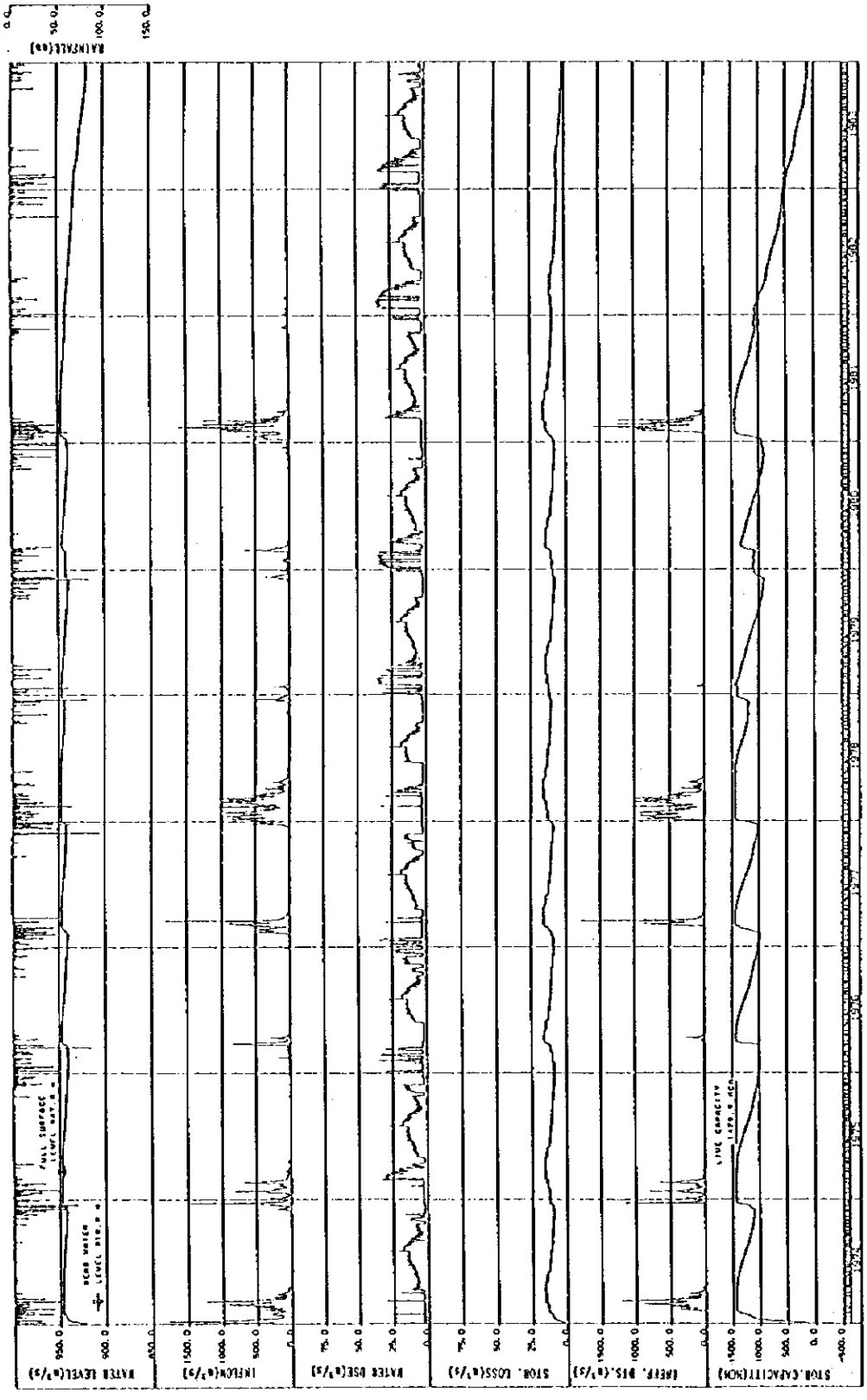


Figure E-7(1) WATER BALANCE STUDY ON KUDU DAM (1974 - 1983: 10% RISK)

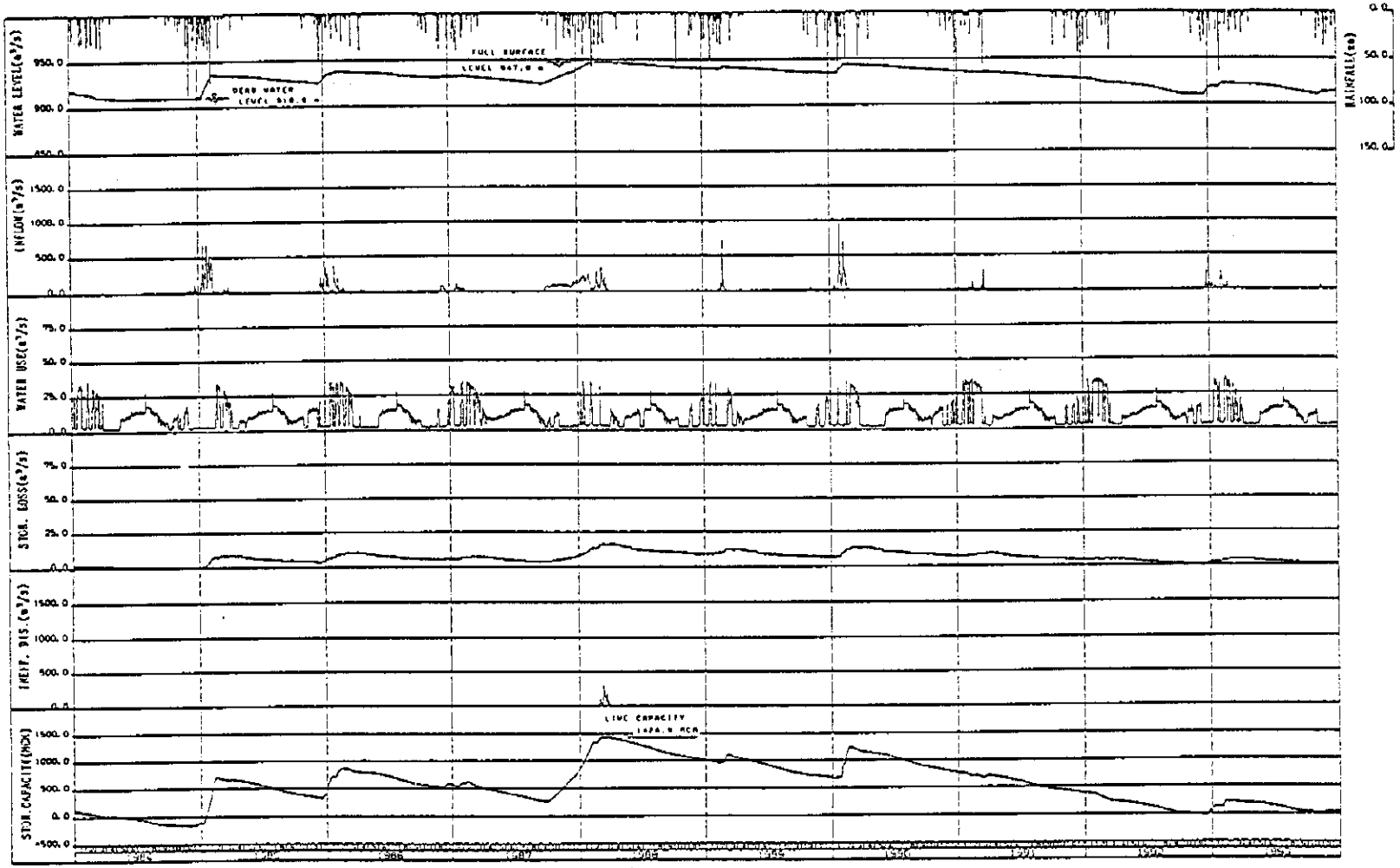


Figure E-7(2) WATER BALANCE STUDY ON KUDU DAM (1984 - 1993: 10% RISK)

APPENDIX F PRESENT AGRICULTURE

APPENDIX F. PRESENT AGRICULTURE

F.1 General Review

F.1.1 Introduction

As stated in Zimbabwe's Irrigation Policy and Strategy (1994), the Government recognizes the important role that irrigation can play in agricultural development. Starting in the 1940s, high priority was placed on water development, particularly dam construction for large scale commercial farmers. The resultant water and irrigation development has been a decisive factor in the success of large scale commercial agriculture since the 1950s. Today, these farmers enjoy the benefits of this strategic long term investment and are able to minimize the effects of drought and improve returns to high value crops such as tobacco, cotton and horticultural products.

After independence in 1980, the country also increasingly sought to exploit the potential role of irrigation for smallholder development, particularly given the drought proneness of communal areas, 74 percent of which lie in natural regions IV & V. These areas receives less than 650 mm of rainfall per annum on average. The impact of recent droughts in 1981/82, 1982/83, 1983/84, 1986/87 and 1991/92 had their most devastating effect on communal areas where, in spite of high population densities, water and irrigation development are at a rudimentary stage of development.

F.1.2 Current Status of Irrigation Development

The Irrigation Policy and Strategy document estimates that 119,038 hectares of land are developed for irrigation in Zimbabwe, as of 1994. Approximately 82 percent of this area is on large scale private farms and plantation estates, 11 percent on small scale commercial farms and estates and only about 7 percent in communal and resettlement areas. Large scale farms own about 5,700 dams and in addition, most Government dams are more accessible to these farmers. The irrigated area in this sector is growing at about 2,000 hectares per year.

The production of strategic crops has been wholly dependant on

irrigation. Virtually all wheat and sugar-cane grown in Zimbabwe are under irrigation, as is approximately 70 percent of coffee, 55 percent of tea and 45 percent of cotton. More recently, the economic impact of irrigation has been on the production of high value crops, particularly horticultural produce and tobacco. Through supplementary irrigation, farmers are able to plant tobacco early and thereby stagger the planting, harvesting and curing processes. Horticultural production, on the other hand, has grown considerably over the last decade into a multi-million dollar export industry serving the export market for flowers, fruit and vegetables. Large scale commercial farmers, with an average 60 hectares of irrigated land on each farm, also grow some of the summer rainfed crops with supplementary irrigation to reduce the effects of frequent mid-season droughts. This is usually the case for maize, tobacco, cotton, groundnuts and soyabeans.

The 13 500 hectares of irrigation on state farms comprises 26 estates farmed by the Agricultural and Rural Development Authority (ARDA). In the communal and resettlement areas, an estimated 8,461 hectares are currently irrigated by smallholders on 141 irrigation schemes scattered throughout the country but mainly in the drought prone areas of Natural Regions IV & V. Some of these schemes are not operational at present. Farmers on these schemes irrigate areas ranging from 0.1-1.0 hectares on which they grow a variety of food and cash crops including maize, cotton, and vegetable crops. These farmers are able to achieve higher incomes than their counterparts on dryland. Irrigation schemes in communal areas also play a major role at a local level by providing extra food and a nutritionally more diverse diet to the rural population.

In addition to the schemes described above, there are many small vegetable gardens which use shallow groundwater wells and boreholes with approximately 20 000 hectares under this type of irrigation. Agritex promote these in order to improve family nutrition.

F.1.3 Irrigation Methods by Smallholder Farmers

According to data reviewed by Makhado (1992) and in the Irrigation Policy and Strategy (1994), the main physical systems used for irrigation in Zimbabwe are surface and sprinkler irrigation systems. On large scale

commercial farmers, 70 percent of irrigation systems are sprinkler with the remaining 30 percent being surface systems. Localized irrigation systems, e.g. drip and micro-jet, are still an insignificant portion of irrigation technologies in Zimbabwe.

In the smallholder areas only 11 percent of the irrigated area is under sprinkler while the rest is under surface irrigation. There is limited use of localized irrigation under this farming sector.

Abstraction methods in operating schemes vary. According to Makhado (1992), of the 54 operating schemes analysed by Agritex, 50 percent were fed by gravity only, 10 percent combined gravity with diesel or electric pumps, 20 percent were supplied only by diesel powered pumps and the rest, 20 percent, by electric pumps. About a third of the non-operational schemes examined were pumped sand abstraction schemes, an indication of the problems associated with pumping, particularly from river sand beds. Problems with spare parts for pumps, diesel engines and clogged or perforated underground pipes are very common.

The actual methods of irrigation used include furrow irrigation in Masvingo and Midlands provinces, and the border strip method in Matebeleland and Midlands. The latter method is also common in Manicaland while a few schemes combine border strip with furrow irrigation and a few more combine it with overhead irrigation.

F.1.4 Management Systems

Large scale irrigation farms are operated by a single proprietor in the form of an individual farmer, a private company or a parastatal. The smallholder irrigation schemes are operated by a group of individual irrigators who are allocated plots on the scheme. They share common irrigation infrastructure down to the plot level and also share irrigation schedules. Sometimes they may grow different crops on the same scheme with a common water supply. Procurement of inputs and marketing of produce may or may not be done cooperatively on a smallholder scheme.

Thus, smallholder irrigators are sometimes constrained by lack of solidarity or insufficient group cohesion, lack of transport, draught

power and/or tillage equipment, and easily accessible credit facilities. On some schemes, improper design and unreliable water delivery schedules have led to insufficient water to the tail-enders on surface systems. However, the smallholders operate under an Irrigation Management Committee (IMC) for each scheme. These committees are not legally constituted into water users associations (WUA). Large scale irrigators, on the other hand, voluntarily constitute themselves into river boards which are legal entities constituted under the provisions of the Water Act (1976) and are responsible for water management problems for portions of their river basin. The same set-up is needed for smallholder irrigators such as in the proposed Kudu Dam Irrigation Project. Thereafter these WUAs or riverboards need training on leadership, group dynamics, main system and on-farm water management so as to improve their effectiveness.

In the Irrigation Policy and Strategy (1994), it is emphasized that in future irrigation development, priority will be placed on farmer managed and operated systems where government may assist with development by providing for farmers to be responsible for the operation and maintenance of the irrigation systems. Irrigation farmers will also be involved in the management of river basins and systems.

F.2 Productivity of Smallholder Irrigation Schemes

F.2.1 Background Information

This section reviews crop productivity at six AGRITEX administered smallholder irrigation schemes in Natural Regions III - V. These schemes were developed, like all other smallholder schemes, to help raise the living standards of rural households through improved food security, higher incomes, and better employment opportunities amid recurring droughts.

Information on natural region, size and method of water abstraction at the reviewed schemes is presented in Table F-1. Senkwazi, Ngondoma and Exchange Block Schemes are in Kwekwe District the north of which (Sidakeni and Mabura Wards) is in the study area of the Kudu Dam Irrigation Project. They are therefore quite typical of conditions in the study area.

F.2.2 Present Cropping Patterns

Plotholders at the six schemes meet their objectives for food security and income generation by growing crops such as maize, groundnuts and okra in summer; and beans and vegetables in winter. In 1992/93, maize and beans were the predominant crops grown in summer and winter respectively (See Table F-2). Cropping intensity was generally higher in summer, largely because of better water availability than in the winter period.

Surprisingly cotton, a popular cash crop under rainfed conditions in Kwekwe district and elsewhere in the study area, is hardly grown in any of the six schemes. As explained later this is mainly because of the limited plot sizes and lack of adequate cash for input purchases (seed, fertilizer and insecticide for pest control).

F.2.3 Crop Performance

The yields of the two main crops, maize and beans, at the schemes in 1992/93 are presented in Table F-3.

The maize yield is a combination of green cobs sold for boiling and roasting and maize grain harvested before the winter cropping programme. Average maize yields ranged from 2.7 tonnes/hectare at Chilonga to 7.4 t/ha at Exchange Block. Poor performance at Chilonga (which is in NR V) was attributed to unreliable irrigation water supply and limited use of inorganic fertilizers. Despite this, however, these yields are, on average, about five times higher than those obtained under rainfed conditions in communal areas.

Average bean yields were highest at Ngondoma (2.5 t/ha) and lowest at Senkwazi (0.4 t/ha). Once again, unreliable water supply contributed to the low bean performance at the latter site.

There was a considerable gap between the lower and higher producing plotholders for the two crops at each scheme. For example, maize and bean yields ranged from 3.2 to 9.7 t/ha and 0.5-2.0 t/ha respectively at

Exchange Block. Such productivity gaps demonstrate tremendous potential for improving output at the schemes. Some of the major problems responsible for the differences in performance are presented in Table F-4.

The most important and commonest constraint was limited cash for purchase of inputs and the least common one was unreliability in water supplies. Other problems included small plot size and poor road access. In addition, and as mentioned in section 1.4, lack of group cohesion or solidarity is also an important constraint since farmers are unable to tackle scheme management as a group despite the existence of IMCs.

Cash constraints limit the ability of some farmers to purchase fertilizer and other related inputs. Furthermore, the majority of plotholders do not use the Agricultural Finance Corporation credit facility mainly because of loan repayment problems. Consequently such farmers are often unable to afford the recommended input levels and hence the low yields achieved.

Farmers with plots of 0.2 ha or less did not always achieve their subsistence production requirements. Total maize production from 0.1 ha plots ranged from 0.27 tonnes at Chilonga to 0.74 tonnes at Exchange Block. The former production figure is unlikely to meet the full requirements of a household of about eight members.

The generally poor road systems increase the difficulty of transporting inputs to the schemes. This results in the late delivery and use of the inputs which consequently reduces crop performance. Furthermore, the resultant high transport costs for the inputs has an adverse effect on enterprise profitability. The same applies to delivery of produce to market.

Unreliable water supplies adversely affect crop performance at half the schemes and was mostly attributed to the chronic malfunctioning of the pumping systems.

Despite the constraints mentioned above, the food security situation of plotholders has substantially improved although their incomes remain generally low as illustrated below.

F.2.4 Scheme Profit Margins

The effect of plot size on household annual profit at four of the schemes is shown in Table F-5. Households with plots of 0.2 ha or less realized less profit than those with larger plots. In fact, farmers with the smaller plot sizes earned less than Z$ 223 per month, which is almost equivalent to the government recommended minimum wage for agricultural workers.

Average profits realized at each scheme in 1992/93 are presented in Table F-6.

The subsidized household profit margins at four of the schemes were below the recommended government minimum wage of Z$ 223 per month for agricultural workers. The "without subsidy" scheme profit is the income earned by households after paying for overhead costs currently met by government.

Overall profitability fell by between 5% at Panganai and 67% at Manjinji when the government subsidy on scheme overheads was removed. A major component of this subsidy was due to labour and water conveyance with gravity schemes being the least expensive. At Senkwazi, the removal of government subsidy rendered the scheme uneconomic. These scenarios would have been worse if the cost of water had been included in the analysis.

F.2.5 General Conclusions

Although performance varied markedly at each of the schemes studied all performed better than they would have without irrigation.

The productivity of some smallholder irrigation schemes has been relatively low largely due to limited and untimely use of inputs such as fertilizer and unreliable water supplies especially in winter. Furthermore, low crop productivity, small plot size, high input costs and limited marketing opportunities for high value crops such as vegetables have adversely affected scheme performance especially in NR V.

Ways of improving scheme productivity and profitability include:

- improving the plotholders' access to inputs such as fertilizer at affordable prices;

- upgrading the road network in order to improve accessibility to the schemes by input and output transporters;

- increasing plot sizes in some schemes to at least 0.5 ha; and

- encouraging greater group cohesion and solidarity among the farmers and improving coordination among the various agencies involved in scheme rehabilitation and maintenance in order to guarantee a regular supply of water.

F.3 Cropping Patterns Recommended for Kudu Dam Irrigation Project

Plotholders in the schemes discussed above concentrate on maize and beans as the predominant crops grown in summer and winter respectively. In other schemes, particularly in Manicaland, the alternative summer crop is cotton, with wheat or vegetables being the alternatives in winter. Smallholders are technically capable of growing these crops as evidenced by high yields which can reach the following under irrigation:

Maize:	8 t/ha
Wheat:	5 t/ha
Vegetables:	40 t/ha
Cotton:	3 t/ha

These yields, quoted in the Irrigation Policy and Strategy (1994), show that productivity and profitability can certainly be improved.

In the Lower Munyati Basin, cotton is grown under dryland conditions with yields averaging about 750 kg/ha in the communal, resettlement and small scale commercial farming areas. The doubling or tripling of these yields through either supplementary or full scale irrigation would lead to drastic improvements in farm incomes and livelihoods provided

simultaneous action is also taken to solve the problems raised in section 2.5 above. The province of Manicaland, for example, accounts for about 85% of all the cotton grown on smallholder schemes, with the two largest schemes, Nyamaropa and Nyanyadzai, producing about 60% between them (Makahodo, 1992). Farmers in the study area could therefore emulate their Manicaland counterparts and uplift their cotton yields through irrigation.

Agritex records also show that under normal conditions the smallholder schemes as a whole cultivate about 500 ha of wheat and between 1,600 and 1,800 ha of beans. Vegetables, mainly tomatoes, cabbage, chommolier, onions and okra cover about 500 ha in winter and are also grown to a smaller extent in summer. Marketing of these crops can be a serious problem in remote areas not adequately serviced by reasonable road networks or if they are close to moderately large markets where there is stiff competition. Vegetable processing, in one form or another, therefore needs serious consideration if these are to be recommended for reasonably large production in the study area. The current Growth Points of Sanyati, Gokwe, etc, can only absorb small amounts of vegetables.

Table F-1 Background Information on Six Smallholder Irrigation Schemes

SCHEME	NR	IRRIGATION ha	No. OF PLOTHOLDERS	WATER ABSTRACTION METHOD
Senkwazi	III	19.3	65	Pumping (diesel)
Ngonoma	III	18.2	64	Gravity
Panganai A	IV	9.7	48	Gravity
Exchange Block	IV	164.4	750	Pumping (electricity)
Manjinji	V	8.0	80	Pumping (diesel)
Chilonga	V	141.7	294	Pumping (electricity)

Source: Price Waterhouse (1993)

Table F-2 Cropping Programme at the Six Schemes in 1992/93

SCHEME	SUMMER			WINTER		
	MAIZE	OTHER*	CROPPING INTENSITY %	BEANS ha	VEGETABLES ha	CROPPING INTENSITY %
Senkwazi	0.28	0.18	78	0.36	-	100
Ngondoma	0.30	0.08	100	0.36	0.02	100
Panganai A	0.16	0.03	95	0.07	0.08	75
Ex. Block	0.32	0.06	100	0.36	-	95
Manjinji	0.10	-	100	0.07	0.03	100
Chilonga	0.50	0.29	92	0.28	0.11	45

* Includes okra, groundnuts and vegetables grown by a proportion of sample farmers
Source: Price Waterhouse (1993)

Table F-3 Maize and Bean Yields at the Six Schemes in 1992/93

SCHEME	NR	MAIZE		BEANS	
		Range t/ha	Mean t/ha	Range t/ha	Mean t/ha
Senkwazi	III	3.6-9.1	6.8	0-1.1	0.4
Ngondoma	III	4.0-8.2	6.8	1.8-3.3	2.4
Panganai A	IV	2.7-9.0	5.7	0.5-2.5	1.7
Ex. Block	IV	3.2-9.7	7.4	0.5-2.0	1.0
Manjinji	V	1.4-4.6	2.9	1.2-3.6	2.0
Chilonga	V	0.4-4.2	2.7	0.9-1.8	1.5
Mean		-	5.4	-	1.5

Source: Price Waterhouse (1993)

Table F-4 Constraints to Scheme Performance

SCHEME	CONSTRAINT*				
	1	2	3	4	5
Senkwazi	x	x	x	x	x
Ngondoma	x	-	-	-	x
Panganai A	-	-	x	x	x
Ex. Block	x	-	-	-	x
Manjinji	x	x	x	x	x
Chilonga	-	x	x	x	x

* Constraint key

1. Small plot size
2. Unreliable water supply especially for winter cropping
3. Poor road system resulting in transport problems for inputs and produce
4. Limited cash/credit for input purchases
5. Lack of solidary/group cohesion in management of the scheme

Table F-5 Effect of Plot Size on Householder Annual Profit

SCHEME	ANNUAL PROFIT ZWD		
	0.1-0.2 ha	0.3-0.4 ha	0.5 + ha
Senkwazi	118	1 540	1 927
Ngondoma	1 657	5 752	9 185
Ex. Block	808	2 988	4 837
Chilonga	-	968	3 806

* Gross margin less annual plot rental charge of ZWD 145
Source: Price Waterhouse (1993)

Table F-6 Annual Scheme Profitability in 1992/93

SCHEME	AVERAGE HOUSEHOLD PROFIT* (with subsidy) ZWD	SCHEME PROFIT		
		With subsidy* ZWD	Without** subsidy ZWD	Reduction %
Senkwazi	1 195	18 412	-14 729	-
Ngondoma	5 531	205 898	178 880	13.1
Panganai A	751	36 048	34 320	4.8
Ex. Block	2 878	1 289 755	964 774	25.2
Manjinji	1 586	126 880	41 760	67.1
Chilonga	2 387	438 867	201 897	54.0

* Gross margin less plot rental charge
** Gross margin less plot rental charge and scheme level overhead costs
Source: Price Waterhouse (1993)

Table F-7 Background Information on Six Smallholder Irrigation Schemes

SCHEME	NR	IRRIGATION ha	No. OF PLOTHOLDERS	WATER ABSTRACTION METHOD
Senkwazi	III	19.3	65	Pumping (diesel)
Ngonoma	III	16.2	64	Gravity
Panganai A	IV	9.7	48	Gravity
Exchange Block	IV	164.4	750	Pumping (electricity)
Manjinji	V	8.0	80	Pumping (diesel)
Chilonga	V	141.7	294	Pumping (electricity)

Source: Price Waterhouse (1993)

Table F-8 Cropping Programme at the Six Schemes in 1992/93

SCHEME	SUMMER			WINTER		
	MAIZE	OTHER*	CROPPING INTENSITY %	BEANS ha	VEGETABLES ha	CROPPING INTENSITY %
Senkwazi	0.28	0.18	78	0.36	-	100
Ngondoma	0.30	0.08	100	0.36	0.02	100
Panganai A	0.16	0.03	95	0.07	0.08	75
Ex. Block	0.32	0.06	100	0.36	-	95
Manjinji	0.10	-	100	0.07	0.03	100
Chilonga	0.50	0.29	92	0.28	0.11	45

* Includes okra, groundnuts and vegetables grown by a proportion of sample farmers

Source: Price Waterhouse (1993)

Table F-9 Maize and Bean Yields at the Six Schemes in 1992/93

SCHEME	NR	MAIZE		BEANS	
		Range t/ha	Mean t/ha	Range t/ha	Mean t/ha
Senkwazi	III	3.6-9.1	6.8	0-1.1	0.4
Ngondoma	III	4.0-8.2	6.8	1.8-3.3	2.4
Panganai A	IV	2.7-9.0	5.7	0.5-2.5	1.7
Ex. Block	IV	3.2-9.7	7.4	0.5-2.0	1.0
Manjinji	V	1.4-4.6	2.9	1.2-3.6	2.0
Chilonga	V	0.4-4.2	2.7	0.9-1.8	1.5
Mean		-	5.4	-	1.5

Source: Price Waterhouse (1993)

Table F-10 Constraints to Scheme Performance

SCHEME	CONSTRAINT*				
	1	2	3	4	5
Senkwazi	x	x	x	x	x
Ngondoma	x	-	-	-	x
Panganai A	-	-	x	x	x
Ex. Block	x	-	-	-	x
Manjinji	x	x	x	x	x
Chilonga	-	x	x	x	x

* Constraint key

1. Small plot size
2. Unreliable water supply especially for winter cropping
3. Poor road system resulting in transport problems for inputs and produce
4. Limited cash/credit for input purchases
5. Lack of solidary/group cohesion in management of the scheme

Table F-11 Effect of Plot Size on Householder Annual Profit

SCHEME	ANNUAL PROFIT ZWD		
	0.1-0.2 ha	0.3-0.4 ha	0.5 + ha
Senkwazi	118	1 540	1 927
Ngondoma	1 657	5 752	9 185
Ex. Block	808	2 988	4 837
Chilonga	-	968	3 806

* Gross margin less annual plot rental charge of ZWD 145
Source: Price Waterhouse (1993)

Table F-12 Annual Scheme Profitability in 1992/93

SCHEME	AVERAGE HOUSEHOLD PROFIT* (with subsidy) ZWD	SCHEME PROFIT		
		With subsidy* ZWD	Without** subsidy ZWD	Reduction %
Senkwazi	1 195	18 412	-14 729	-
Ngondoma	5 531	205 898	178 880	13.1
Panganai A	751	36 048	34 320	4.8
Ex. Block	2 878	1 289 755	964 774	25.2
Manjinji	1 586	126 880	41 760	67.1
Chilonga	2 387	438 867	201 897	54.0

* Gross margin less plot rental charge
** Gross margin less plot rental charge and scheme level overhead costs
Source: Price Waterhouse (1993)

APPENDIX G IRRIGATION AND DRAINAGE

APPENDIX G. IRRIGATION AND DRAINAGE

Table G-1 CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

	ITEM	UNIT	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEPT.
1	Tmax	°C	30.3	29.5	27.5	27.3	26.9	27.4	26.6	24.8	22.6	22.6	25.2	28.9
2	Tmin	°C	16.7	17.5	17.8	17.7	17.3	16.2	14.5	11.4	8.8	8.4	10.4	13.7
3	Tmean	°C	23.5	23.5	22.7	22.5	22.1	21.8	20.6	18.1	15.7	15.5	17.8	21.3
4	ea	mbar	29.0	29.0	27.6	27.3	26.6	26.1	24.3	20.7	17.8	17.6	20.4	25.4
5	RHmean	%	43.6	51.2	70.8	74.2	75.9	69.7	63.7	55.8	53.0	49.7	42.8	37.1
6	ed	mbar	12.6	14.8	19.5	20.3	20.2	18.2	15.5	11.6	9.4	8.7	8.7	9.4
7	ea-ed	mbar	16.4	14.2	8.1	7.0	6.4	7.9	8.8	9.1	8.4	8.9	11.7	16.0
8	U	km/day	66	58	49	44	44	49	52	51	52	54	57	65
9	f(u)		0.45	0.43	0.40	0.39	0.39	0.40	0.41	0.41	0.41	0.42	0.42	0.45
10	1-W		0.26	0.26	0.26	0.27	0.27	0.27	0.28	0.31	0.34	0.35	0.31	0.28
11	(1-W)f(u)(ea-ed)		1.91	1.57	0.84	0.74	0.67	0.86	1.01	1.16	1.17	1.29	1.53	1.99
12	Ra	mm/day	15.8	16.8	17.1	17.1	16.5	15.1	13.2	11.4	10.4	10.8	12.3	14.1
13	n/N		0.74	0.60	0.50	0.54	0.57	0.64	0.75	0.82	0.84	0.87	0.88	0.83
14	0.25+0.5n/N		0.62	0.55	0.50	0.52	0.54	0.57	0.63	0.66	0.67	0.69	0.69	0.67
15	Rs=(12)*(14)	mm/day	9.78	9.27	8.52	8.87	8.83	8.62	8.26	7.53	6.99	7.41	8.48	9.40
16	Rns=0.75Rs	mm/day	7.34	6.95	6.39	6.66	6.62	6.47	6.20	5.65	5.24	5.56	6.36	7.05
17	f(T)		15.3	15.3	15.1	15.1	15.0	15.0	14.7	14.2	13.8	13.7	14.2	14.9
18	f(ed)		0.18	0.17	0.15	0.14	0.14	0.15	0.17	0.19	0.20	0.21	0.21	0.20
19	f(n/N)		0.76	0.64	0.55	0.58	0.61	0.68	0.78	0.84	0.86	0.89	0.89	0.85
20	Rnl=(17)*(18)*(19)	mm/day	2.15	1.68	1.20	1.25	1.31	1.55	1.91	2.27	2.43	2.55	2.66	2.60
21	Rn=Rns-Rnl	mm/day	5.19	5.27	5.19	5.40	5.31	4.92	4.29	3.38	2.81	3.01	3.70	4.45
22	W		0.74	0.74	0.74	0.73	0.73	0.73	0.72	0.69	0.66	0.65	0.69	0.72
23	W*Rn	mm/day	3.84	3.90	3.84	3.94	3.88	3.59	3.09	2.33	1.86	1.96	2.55	3.21
24	(11)+(23)	mm/day	5.75	5.47	4.68	4.68	4.55	4.45	4.10	3.49	3.02	3.25	4.09	5.20
25	c		0.91	0.95	1.03	1.04	1.05	1.03	1.00	0.93	0.92	0.90	0.87	0.79
26	ETO	mm/day	5.2	5.2	4.8	4.9	4.8	4.6	4.1	3.2	2.8	2.9	3.6	4.1
27	ETO	mm/month	162.1	145.5	149.5	146.1	148.2	137.5	127.2	100.6	83.4	90.6	106.7	127.4

Table G-2(1) IRRIGATION WATER REQUIREMENT(from OCT. to MAR.)

	OCT.						NOV.						DEC.						JAN.						FEB.						MAR.					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Ref. Crop ETo(mm/day)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	4.8	4.8	4.8	4.8	4.8	4.8	4.9	4.9	4.9	4.9	4.9	4.9	4.8	4.8	4.8	4.8	4.8	4.8	4.6	4.6	4.6	4.6	4.6	4.6
(1) MAIZE																																				
Crop Coeff.																																				
MAIZE 1				0.47	0.47	0.47	0.47	0.47	0.47	0.51	0.58	0.65	0.72	0.79	0.86	0.93	1.06	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.07	0.94	0.87	0.79	0.72	0.64			
MAIZE 2					0.47	0.47	0.47	0.47	0.47	0.47	0.51	0.58	0.65	0.72	0.79	0.86	0.93	1.06	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.07	0.94	0.87	0.79	0.72	0.64			
MAIZE 3						0.47	0.47	0.47	0.47	0.47	0.47	0.53	0.58	0.65	0.72	0.79	0.86	0.93	1.06	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.07	0.94	0.87	0.79	0.72	0.64		
MAIZE 4							0.47	0.47	0.47	0.47	0.47	0.47	0.51	0.58	0.65	0.72	0.79	0.86	0.93	1.06	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.07	0.94	0.87	0.79	0.72	0.64
MAIZE 5								0.47	0.47	0.47	0.47	0.47	0.47	0.51	0.58	0.65	0.72	0.79	0.86	0.93	1.06	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.07	0.94	0.87	0.79	0.72
MAIZE 6									0.47	0.47	0.47	0.47	0.47	0.47	0.51	0.58	0.65	0.72	0.79	0.86	0.93	1.06	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.07	0.94	0.87	0.79
MAIZE 7										0.47	0.47	0.47	0.47	0.47	0.47	0.51	0.58	0.65	0.72	0.79	0.86	0.93	1.06	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.07	0.94	0.87	
AVERAGE				0.07	0.13	0.20	0.27	0.34	0.40	0.48	0.49	0.52	0.55	0.60	0.65	0.72	0.80	0.88	0.95	1.01	1.06	1.11	1.14	1.15	1.15	1.15	1.15	1.14	1.11	1.07	1.02	0.96	0.88	0.78	0.67	0.55
ETc(mm/day)				0.3	0.7	1.0	1.4	1.7	2.1	2.5	2.6	2.7	2.7	2.9	3.1	3.5	3.8	4.2	4.7	5.0	5.2	5.4	5.6	5.6	5.5	5.5	5.5	5.5	5.3	5.1	4.7	4.4	4.1	3.7	2.6	2.0
(2) WHEAT																																				
Crop Coeff.																																				
WHEAT 1																																				
WHEAT 2																																				
WHEAT 3																																				
WHEAT 4																																				
WHEAT 5																																				
WHEAT 6																																				
WHEAT 7																																				
AVERAGE																																				
ETc(mm/day)																																				
(3) CUTTON																																				
Crop Coeff.																																				
CUTTON 1							0.47	0.47	0.47	0.47	0.47	0.47	0.51	0.58	0.65	0.73	0.76	0.87	0.94	1.02	1.09	1.16	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.17	1.11	1.05
CUTTON 2								0.47	0.47	0.47	0.47	0.47	0.47	0.51	0.58	0.65	0.73	0.76	0.87	0.94	1.02	1.09	1.16	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.17	1.11	
CUTTON 3									0.47	0.47	0.47	0.47	0.47	0.47	0.51	0.58	0.65	0.73	0.76	0.87	0.94	1.02	1.09	1.16	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.17		
CUTTON 4										0.47	0.47	0.47	0.47	0.47	0.47	0.51	0.58	0.65	0.73	0.76	0.87	0.94	1.02	1.09	1.16	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	
CUTTON 5											0.47	0.47	0.47	0.47	0.47	0.47	0.51	0.58	0.65	0.73	0.76	0.87	0.94	1.02	1.09	1.16	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
CUTTON 6												0.47	0.47	0.47	0.47	0.47	0.47	0.51	0.58	0.65	0.73	0.76	0.87	0.94	1.02	1.09	1.16	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
CUTTON 7													0.47	0.47	0.47	0.47	0.47	0.47	0.51	0.58	0.65	0.73	0.76	0.87	0.94	1.02	1.09	1.16	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
AVERAGE							0.07	0.13	0.20	0.27	0.34	0.40	0.48	0.49	0.52	0.55	0.60	0.65	0.72	0.79	0.87	0.94	1.01	1.07	1.12	1.15	1.18	1.19	1.20	1.20	1.20	1.20	1.20	1.18	1.16	
ETc(mm/day)							0.3	0.7	1.0	1.4	1.7	2.1	2.3	2.4	2.5	2.7	2.9	3.1	3.5	3.9	4.2	4.6	4.9	5.2	5.4	5.5	5.7	5.7	5.8	5.8	5.5	5.5	5.5	5.5	5.4	5.3
(4) DRY BEANS																																				
Crop Coeff.																																				
DRY BEANS 1																																				
DRY BEANS 2																																				
DRY BEANS 3																																				
DRY BEANS 4																																				
DRY BEANS 5																																				
DRY BEANS 6																																				
DRY BEANS 7																																				
AVERAGE																			0.07	0.14	0.21	0.28	0.36	0.50	0.63	0.72	0.82	0.91	1.00	1.07	1.11	1.14	1.13	1.09	1.00	0.89
ETc(mm/day)																			0.3	0.7	1.0	1.4	1.9	2.4	3.0	3.5	3.9	4.4	4.8	5.1	5.4	5.3	5.2	5.0	4.6	4.1
(5) GROUND NUTS																																				
Crop Coeff.																																				
GROUND NUTS 1	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.50	0.56	0.62	0.67	0.73	0.79	0.85	0.91	0.96	1.02	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.01	0.94	0.86	0.79	0.71	0.64			
GROUND NUTS 2		0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.50	0.56	0.62	0.67	0.73	0.79	0.85	0.91	0.96	1.02	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.01	0.94	0.86	0.79	0.71	0.64		
GROUND NUTS 3			0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.50	0.56	0.62	0.67	0.73	0.79	0.85	0.91	0.96	1.02	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.01	0.94	0.86	0.79	0.73	0.64	
GROUND NUTS 4				0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.50	0.56	0.62	0.67	0.73	0.79	0.85	0.91	0.96	1.02	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.01	0.94	0.86	0.79	0.71	0.64
GROUND NUTS 5					0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.50	0.56	0.62	0.67	0.73	0.79	0.85	0.91	0.96	1.02	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.01	0.94	0.86	0.79	0.71
GROUND NUTS 6						0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.50	0.56	0.62	0.67	0.73	0.79	0.85	0.91	0.96	1.02	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.01	0.94	0.86	0.79
GROUND NUTS 7							0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.50	0.56	0.62	0.67	0.73	0.79	0.85	0.91	0.96	1.02	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.01	0.94	0.86	0.79
AVERAGE	0.07	0.13	0.20	0.27	0.34	0.40	0.47	0.47	0.47	0.49	0.54	0.54	0.57	0.62	0.67	0.73	0.79	0.85	0.90	0.95	0.98	1.01	1.03	1.05	1.05	1.05	1.05	1.04	1.03	1.00	0.96	0.92	0.86	0.78	0.66	0.51
ETc(mm/day)	0.3	0.7	1.0	1.4	1.7	2.1	2.4	2.4	2.5	2.5	2.6	2.8	2.8	3.0	3.2	3.5	3.8	4.1	4.4	4.6	4.8	5.0	5.1	5.1	5.0	5.0	5.0	5.0	4.9	4.8	4.4	4.2	3.9	3.3	2.6	2.0
(6) VEGETABLE																																				
Crop Coeff.																																				
VEGETABLE 1																																				
VEGETABLE 2																																				
VEGETABLE 3																																				
VEGETABLE 4																																				
VEGETABLE 5																																				
VEGETABLE 6																																				
VEGETABLE 7																																				
AVERAGE																																				
ETc(mm/day)																																				
(7) GREEN MAIZE																																				
Crop Coeff.																																				
GREEN MAIZE 1	0.15	0.13	1.08																																	
GREEN MAIZE 2	0.15	0.15	0.13	1.08																																
GREEN MAIZE 3	0.15	0.15	0.15	0.13	1.08																															
GREEN MAIZE 4	0.15	0.15	0.15	0.15	0.13	1.08																														
GREEN MAIZE 5	0.15	0.15	0.15	0.15	0.15	0.13	1.06																													
GREEN MAIZE 6	0.15	0.15	0.15	0.15	0.15	0.15	0.13	1.08																												
GREEN MAIZE 7	0.10	0.15	0.15	0.15	0.15	0.15	0.15	0.13	1.08																											
AVERAGE	0.14	0.15	0.14	0.97	0.81	0.54	0.48	0.32	0.15																											
ETc(mm/day)	5.9	6.0	5.9	5.4	4.2	3.4	2.5	1.6	0.8																											
TOTAL(mm/day)	0.6	0.8	0.9	1.0	1.1	1.2	1.4	1.5	1.7	1.9	2.1	2.2	2.3	2.4	2.6	2.9	3.1	3.4	3.8	4.1	4.4	4.7	4.9	5.0	5.1	5.2	5.3	5.4	5.3	5.2	4.9	4.8	4.6	4.1	3.6	3.1

NOTE) CROPPING RATIO

MAIZE	50.0	%
WHEAT	50.0	%
CUTTON	25.0	%
DRY BEANS	12.5	%
GROUND NUTS	12.5	%
VEGETABLES	12.5	%
GREEN MAIZE	12.5	%

Table G-2(2) IRRIGATION WATER REQUIREMENT(from APR. to SEP.)

	APR.						MAY						JUN.						JUL.						AUG.						SEP.					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Ref. Crop ETo(mm/day)	4.1	4.1	4.1	4.1	4.1	4.1	3.2	3.2	3.2	3.2	3.2	3.2	2.8	2.8	2.8	2.8	2.8	2.8	2.9	2.9	2.9	2.9	2.9	2.9	3.6	3.6	3.6	3.6	3.6	3.6	4.1	4.1	4.1	4.1	4.1	4.1
(1) MAIZE																																				
Crop Coeff.																																				
MAIZE 1																																				
MAIZE 2																																				
MAIZE 3																																				
MAIZE 4																																				
MAIZE 5	0.64																																			
MAIZE 6	0.72	0.64																																		
MAIZE 7	0.79	0.72	0.64																																	
AVERAGE	0.31	0.19	0.09																																	
ETc(mm/day)	1.3	0.8	0.4																																	
(2) WHEAT																																				
Crop Coeff.																																				
WHEAT 1							0.57	0.57	0.57	0.63	0.74	0.86	0.97	1.09	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.05	0.97	0.90	0.74	0.59	0.43	0.28						
WHEAT 2								0.57	0.57	0.57	0.63	0.74	0.86	0.97	1.09	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.05	0.97	0.90	0.74	0.59	0.43	0.28						
WHEAT 3									0.57	0.57	0.57	0.63	0.74	0.86	0.97	1.09	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.05	0.97	0.90	0.74	0.59	0.43	0.28						
WHEAT 4										0.57	0.57	0.57	0.63	0.74	0.86	0.97	1.09	1.15	1.15	1.15	1.15	1.15	1.15	1.05	0.97	0.90	0.74	0.59	0.43	0.28						
WHEAT 5											0.57	0.57	0.57	0.63	0.74	0.86	0.97	1.09	1.15	1.15	1.15	1.15	1.15	1.05	0.97	0.90	0.74	0.59	0.43	0.28						
WHEAT 6												0.57	0.57	0.57	0.63	0.74	0.86	0.97	1.09	1.15	1.15	1.15	1.15	1.05	0.97	0.90	0.74	0.59	0.43	0.28						
WHEAT 7													0.57	0.57	0.57	0.63	0.74	0.86	0.97	1.09	1.15	1.15	1.15	1.05	0.97	0.90	0.74	0.59	0.43	0.28						
AVERAGE							0.08	0.16	0.24	0.31	0.44	0.56	0.70	0.78	0.90	0.94	1.02	1.07	1.12	1.14	1.15	1.15	1.15	1.05	1.14	1.10	1.04	0.96	0.86	0.74	0.57	0.42	0.29	0.19	0.10	0.04
ETc(mm/day)							0.3	0.5	0.8	1.1	1.4	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.3	3.3	3.3	3.3	3.3	4.1	4.0	3.8	3.5	3.1	2.7	2.3	1.7	1.2	0.8	0.4	0.2
(3) COTTON																																				
Crop Coeff.																																				
COTTON 1	0.99	0.93	0.86	0.80	0.74	0.68																														
COTTON 2	1.05	0.99	0.93	0.86	0.80	0.74	0.68																													
COTTON 3	1.11	1.05	0.99	0.93	0.86	0.80	0.74	0.68																												
COTTON 4	1.17	1.11	1.05	0.99	0.93	0.86	0.80	0.74	0.68																											
COTTON 5	1.20	1.17	1.11	1.05	0.99	0.93	0.86	0.80	0.74	0.68																										
COTTON 6	1.20	1.20	1.17	1.11	1.05	0.99	0.93	0.86	0.80	0.74	0.68																									
COTTON 7	1.20	1.20	1.20	1.17	1.11	1.05	0.99	0.93	0.86	0.80	0.74	0.68																								
AVERAGE	1.13	1.09	1.04	0.99	0.93	0.86	0.71	0.57	0.44	0.32	0.20	0.10																								
ETc(mm/day)	4.6	4.5	4.3	4.0	3.8	3.5	2.3	1.8	1.4	1.0	0.6	0.3																								
(4) DRY BEANS																																				
Crop Coeff.																																				
DRY BEANS 1																																				
DRY BEANS 2	0.36																																			
DRY BEANS 3	0.58	0.36																																		
DRY BEANS 4	0.81	0.58	0.36																																	
DRY BEANS 5	1.04	0.81	0.58	0.36																																
DRY BEANS 6	1.15	1.04	0.81	0.58	0.36																															
DRY BEANS 7	1.15	1.15	1.04	0.81	0.58	0.36																														
AVERAGE	0.73	0.56	0.40	0.25	0.13	0.05																														
ETc(mm/day)	3.0	2.3	1.6	1.0	0.6	0.2																														
(5) GROUND NUTS																																				
Crop Coeff.																																				
GROUND NUTS 1																																				
GROUND NUTS 2																																				
GROUND NUTS 3																																				
GROUND NUTS 4																																				
GROUND NUTS 5	0.64																																			
GROUND NUTS 6	0.71	0.64																																		
GROUND NUTS 7	0.79	0.71	0.64																																	
AVERAGE	0.31	0.19	0.09																																	
ETc(mm/day)	1.3	0.8	0.4																																	
(6) VEGETABLE																																				
Crop Coeff.																																				
VEGETABLE 1			0.54	0.54	0.54		0.54	0.54	0.54	0.60	0.71	0.82	0.39	1.04	1.15	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.15	1.06	0.97	0.88	0.79	0.70						
VEGETABLE 2				0.54	0.54		0.54	0.54	0.54	0.54	0.60	0.71	0.82	0.39	1.04	1.15	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.15	1.06	0.97	0.88	0.79	0.70					
VEGETABLE 3					0.54		0.54	0.54	0.54	0.54	0.54	0.60	0.71	0.82	0.39	1.04	1.15	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.15	1.06	0.97	0.88	0.79	0.70			
VEGETABLE 4							0.54	0.54	0.54	0.54	0.54	0.54	0.60	0.71	0.82	0.39	1.04	1.15	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.15	1.06	0.97	0.88	0.79	0.70		
VEGETABLE 5								0.54	0.54	0.54	0.54	0.54	0.54	0.60	0.71	0.82	0.39	1.04	1.15	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.15	1.06	0.97	0.88	0.79	0.70	
VEGETABLE 6									0.54	0.54	0.54	0.54	0.54	0.54	0.60	0.71	0.82	0.39	1.04	1.15	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.15	1.06	0.97	0.88	0.79	0.70
VEGETABLE 7										0.54	0.54	0.54	0.54	0.54	0.54	0.60	0.71	0.82	0.39	1.04	1.15	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.06	0.97	0.88	0.79	0.70
AVERAGE			0.08	0.15	0.23		0.31	0.39	0.46	0.55	0.57	0.61	0.59	0.66	0.75	0.84	0.93	1.00	1.05	1.17	1.19	1.20	1.20	1.20	1.19	1.17	1.14	1.09	1.04	0.96	0.79	0.63	0.48	0.34	0.21	0.10
ETc(mm/day)			0.3	0.6	0.9		1.0	1.2	1.5	1.8	1.8	2.0	1.7	1.9	2.1	2.4	2.6	2.8	3.1	3.4	3.5	3.5	3.5	3.5	4.3	4.2	4.1	3.9	3.7	3.5	3.3	2.6	2.0	1.4	0.9	0.4
(7) GREEN MAIZE																																				
Crop Coeff.																																				
GREEN MAIZE 1																																				
GREEN MAIZE 2																																				
GREEN MAIZE 3																																				
GREEN MAIZE 4																																				
GREEN MAIZE 5																																				
GREEN MAIZE 6																																				
GREEN MAIZE 7																																				
AVERAGE																																				
ETc(mm/day)																																				
TOTAL(mm/day)	2.3	1.6	1.5	1.2	1.1	1.0	0.9	0.9	0.9	1.0	1.1	1.2	1.2	1.3	1.5	1.6	1.7	1.9	2.0	2.1	2.1	2.1	2.2	2.2	2.7	2.7	2.7	2.5	2.3	2.1	2.0	1.6	1.4	1.1	0.9	0.7

Table G-3 SUMMARY OF HYDRAURIC CACULATION
FOR MAIN/SECONDARY CANAL

ITEM	M	L-1	L-2	L-3	L-4	R-1
1. Design Discharge (m3/s)	25.750	15.845	10.931	7.800	5.713	9.909
2. Ruoghness Coefficient	0.015	0.015	0.015	0.015	0.015	0.015
3. Bed Slope of Canal (1:XXX)	6000	6000	6000	6000	6000	6000
4. Canal Width (m)	6.600	5.500	4.800	4.200	3.800	4.800
5. Water Depth (m)	3.260	2.718	2.358	2.092	1.831	2.370
6. Cross Section (m2)	21.516	14.949	11.318	8.786	6.958	11.376
7. Wetted Perimeter (m)	13.120	10.936	9.516	8.384	7.462	9.540
8. Hydraulic Mean Depth (m)	1.640	1.367	1.189	1.048	0.932	1.192
9. Velocity (m/s)	1.197	1.060	0.966	0.888	0.821	0.968
10. Calculated Discharge (m3/s)	25.755	15.846	10.933	7.802	5.713	11.012
11. Velocity Head (m)	0.073	0.057	0.048	0.040	0.034	0.048
12. Freeboard (m)	0.440	0.382	0.342	0.308	0.269	0.330
13. Canal Depth (m)	3.700	3.100	2.700	2.400	2.100	2.700
14. Froude Number	0.212	0.205	0.201	0.196	0.194	0.201

ITEM	R-2	R-3	R-4	LLC	RLC	
1. Design Discharge (m3/s)	7.361	3.097	2.413	0.990	0.826	
2. Ruoghness Coefficient	0.015	0.015	0.015	0.015	0.015	
3. Bed Slope of Canal (1:XXX)	6000	6000	6000	600	600	
4. Canal Width (m)	4.200	3.000	2.700	1.300	1.200	
5. Water Depth (m)	2.003	1.465	1.350	0.606	0.573	
6. Cross Section (m2)	8.413	4.395	3.645	0.788	0.688	
7. Wetted Perimeter (m)	8.206	5.930	5.400	2.512	2.346	
8. Hydraulic Mean Depth (m)	1.025	0.741	0.675	0.314	0.293	
9. Velocity (m/s)	0.875	0.705	0.662	1.257	1.201	
10. Calculated Discharge (m3/s)	7.361	3.098	2.413	0.991	0.826	
11. Velocity Head (m)	0.039	0.025	0.022	0.081	0.074	
12. Freeboard (m)	0.297	0.235	0.250	0.194	0.227	
13. Canal Depth (m)	2.300	1.700	1.600	0.800	0.800	
14. Froude Number	0.197	0.186	0.182	0.516	0.507	

Table G-3 SUMMARY OF HYDRAURIC CACULATION FOR MAIN/SECONDARY CANAL

ITEM	M	L-1	L-2	L-3	L-4	R-1
1. Design Discharge (m3/s)	25.750	15.845	10.931	7.800	5.713	9.909
2. Ruoghness Coefficient	0.015	0.015	0.015	0.015	0.015	0.015
3. Bed Slope of Canal (1:XXX)	6000	6000	6000	6000	6000	6000
4. Canal Width (m)	6.600	5.500	4.800	4.200	3.800	4.800
5. Water Depth (m)	3.260	2.718	2.358	2.092	1.831	2.370
6. Cross Section (m2)	21.516	14.949	11.318	8.786	6.958	11.376
7. Wetted Perimeter (m)	13.120	10.936	9.516	8.384	7.462	9.540
8. Hydraulic Mean Depth (m)	1.640	1.367	1.189	1.048	0.932	1.192
9. Velocity (m/s)	1.197	1.060	0.966	0.888	0.821	0.968
10. Calculated Discharge (m3/s)	25.755	15.846	10.933	7.802	5.713	11.012
11. Velocity Head (m)	0.073	0.057	0.048	0.040	0.034	0.048
12. Freeboard (m)	0.440	0.382	0.342	0.308	0.269	0.330
13. Canal Depth (m)	3.700	3.100	2.700	2.400	2.100	2.700
14. Froude Number	0.212	0.205	0.201	0.196	0.194	0.201

ITEM	R-2	R-3	R-4	LLC	RLC
1. Design Discharge (m3/s)	7.361	3.097	2.413	0.990	0.826
2. Ruoghness Coefficient	0.015	0.015	0.015	0.015	0.015
3. Bed Slope of Canal (1:XXX)	6000	6000	6000	600	600
4. Canal Width (m)	4.200	3.000	2.700	1.300	1.200
5. Water Depth (m)	2.003	1.465	1.350	0.606	0.573
6. Cross Section (m2)	8.413	4.395	3.645	0.788	0.688
7. Wetted Perimeter (m)	8.206	5.930	5.400	2.512	2.346
8. Hydraulic Mean Depth (m)	1.025	0.741	0.675	0.314	0.293
9. Velocity (m/s)	0.875	0.705	0.662	1.257	1.201
10. Calculated Discharge (m3/s)	7.361	3.098	2.413	0.991	0.826
11. Velocity Head (m)	0.039	0.025	0.022	0.081	0.074
12. Freeboard (m)	0.297	0.235	0.250	0.194	0.227
13. Canal Depth (m)	2.300	1.700	1.600	0.800	0.800
14. Froude Number	0.197	0.186	0.182	0.516	0.507

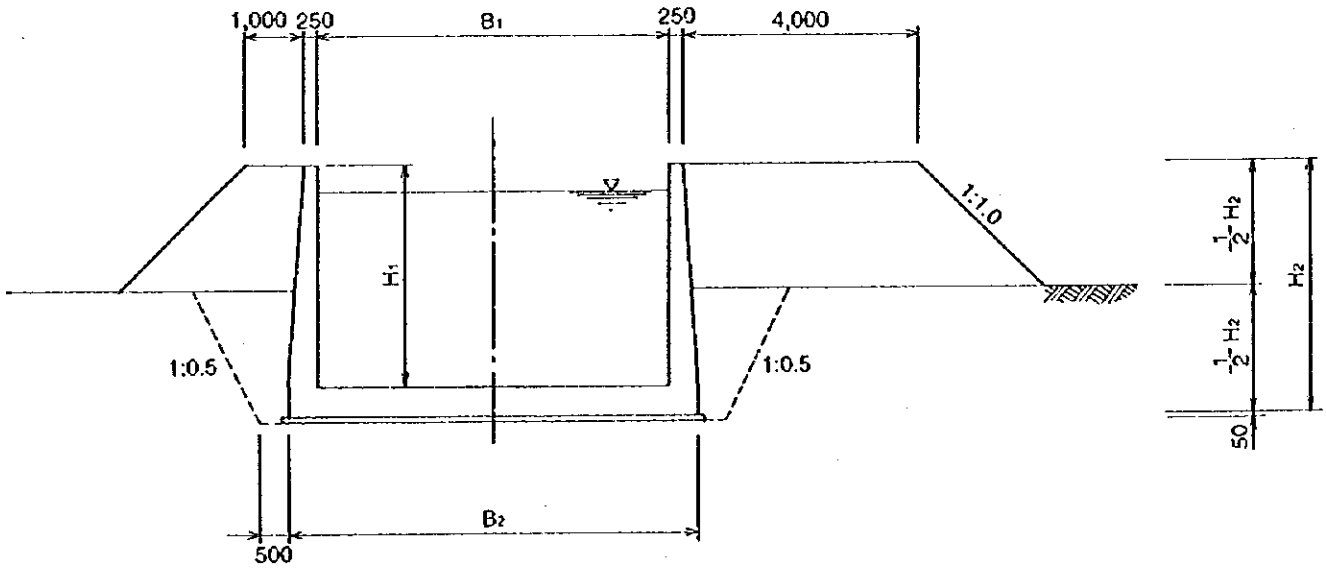


Figure G-1 TYPICAL CROSS SECTION OF MAIN & LATERAL CANAL

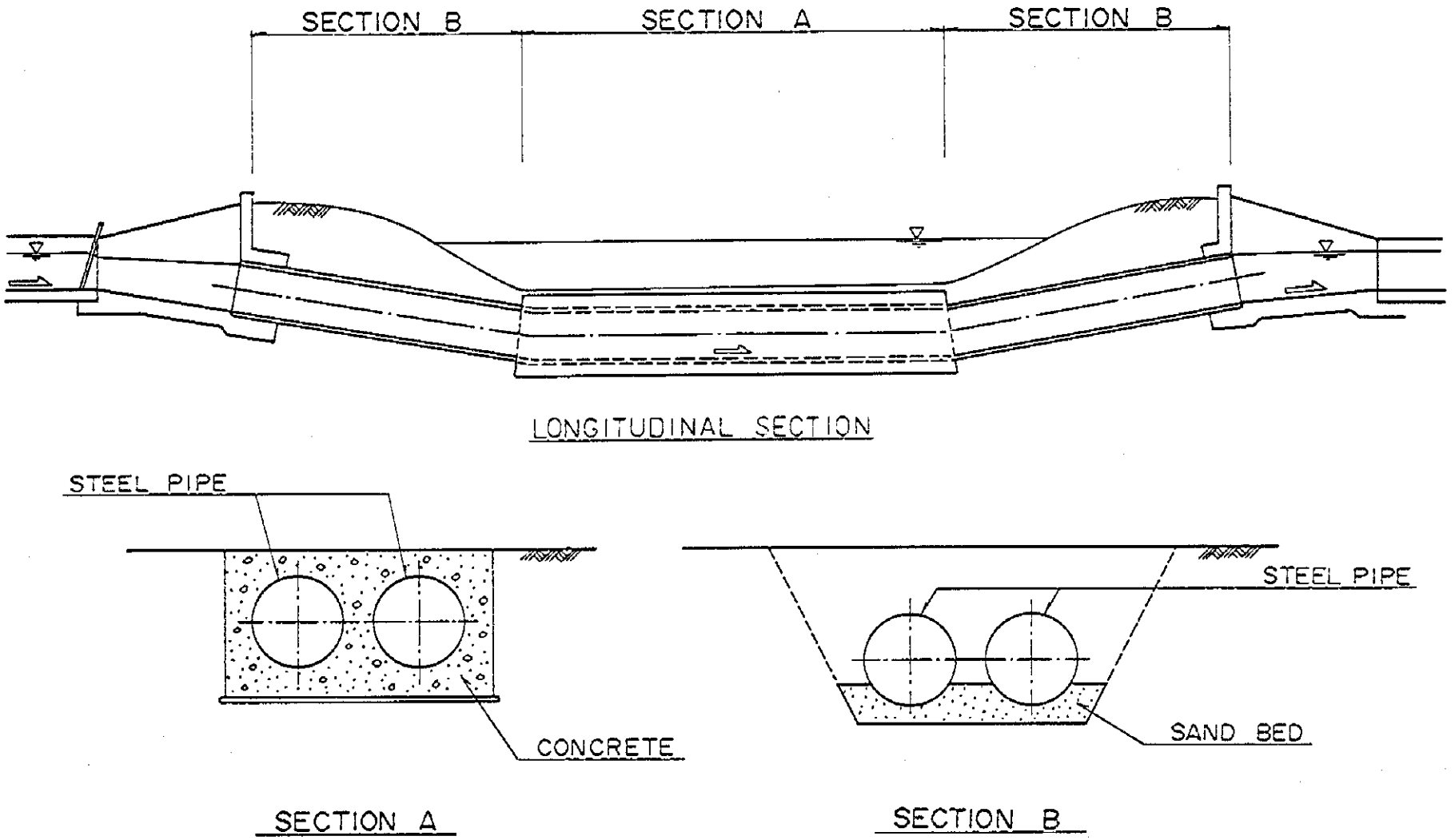
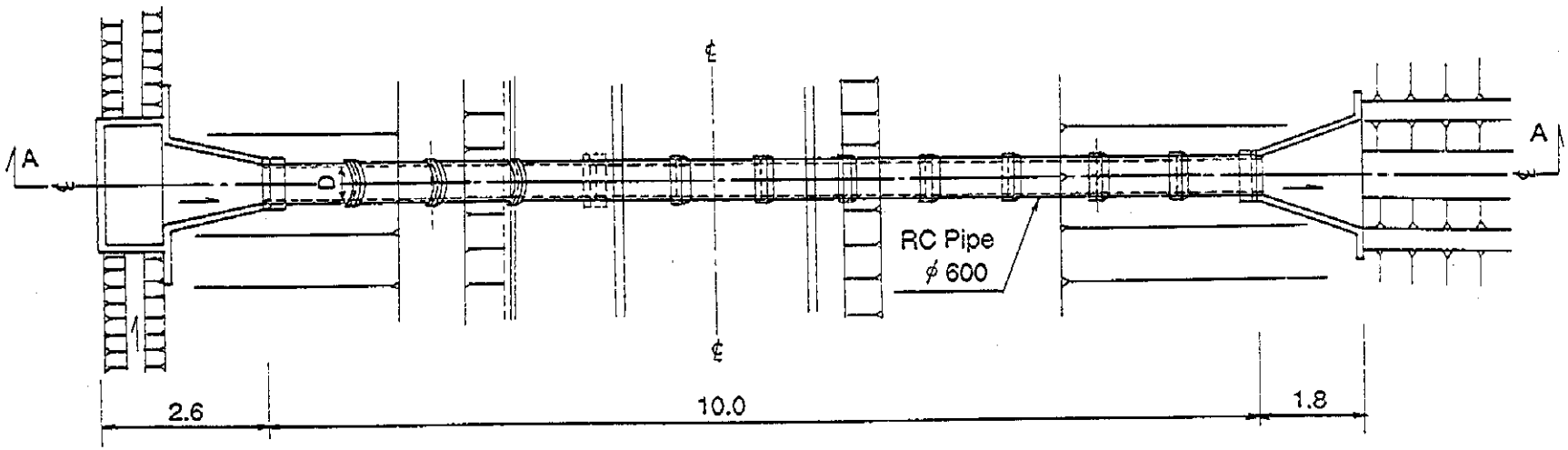
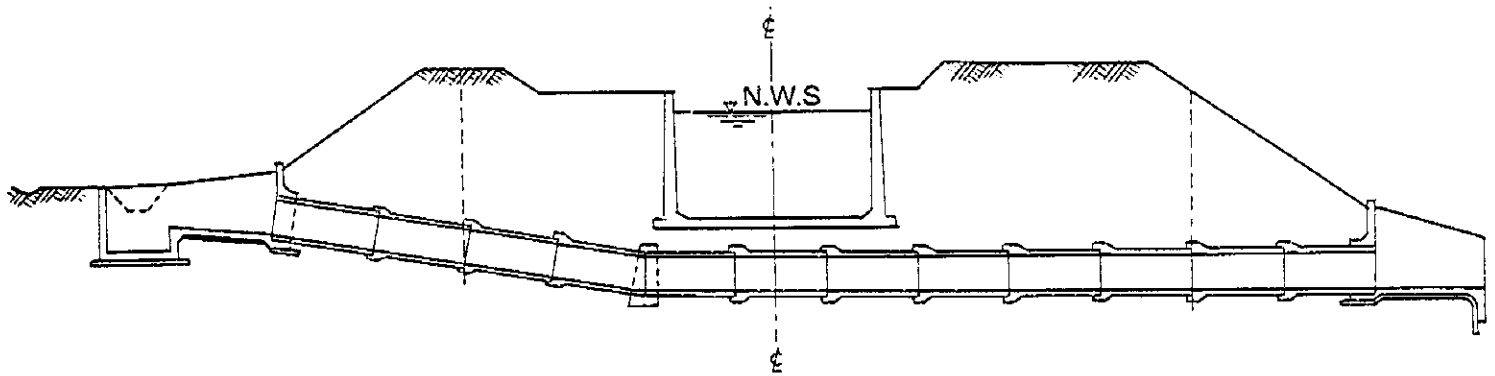


Figure G-2 INVERTED SIPHON

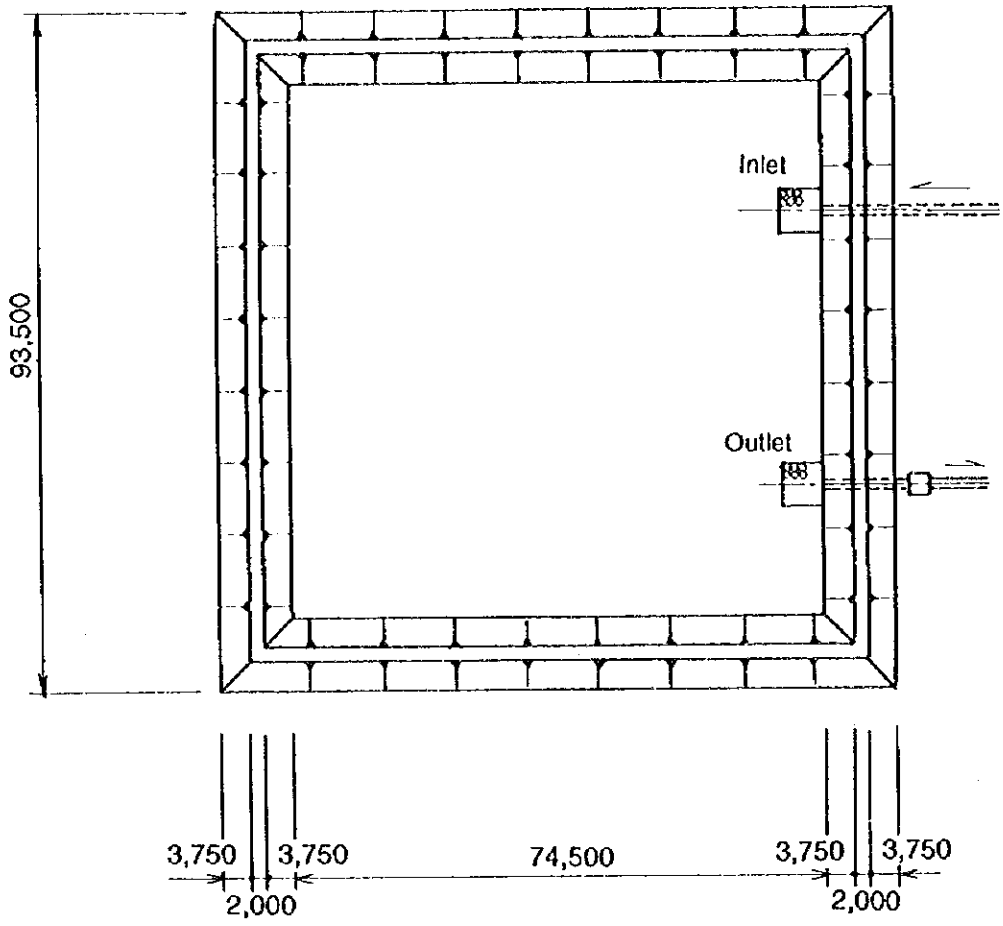


PLAN OF PIPE CULVERT

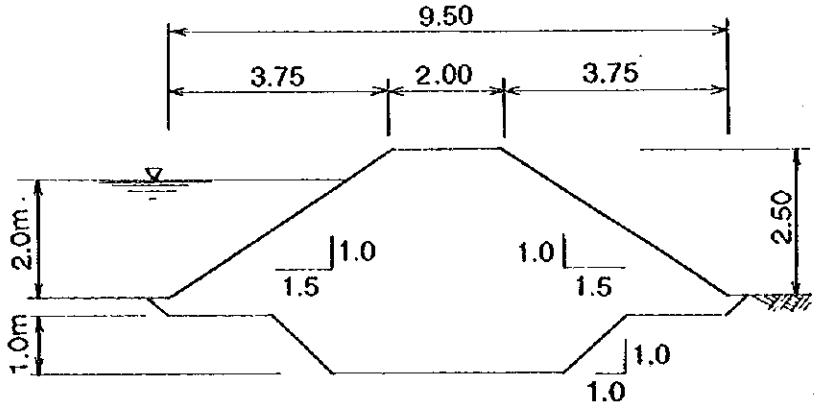


TYPICAL SECTION A-A

Figure G-3 PIPE CULVERT



PLAN OF NIGHT STORAGE RESERVOIR



TYPICAL SECTION OF DIKE EMBANKMENT

Figure G-4 NIGHT STORAGE RESERVOIR

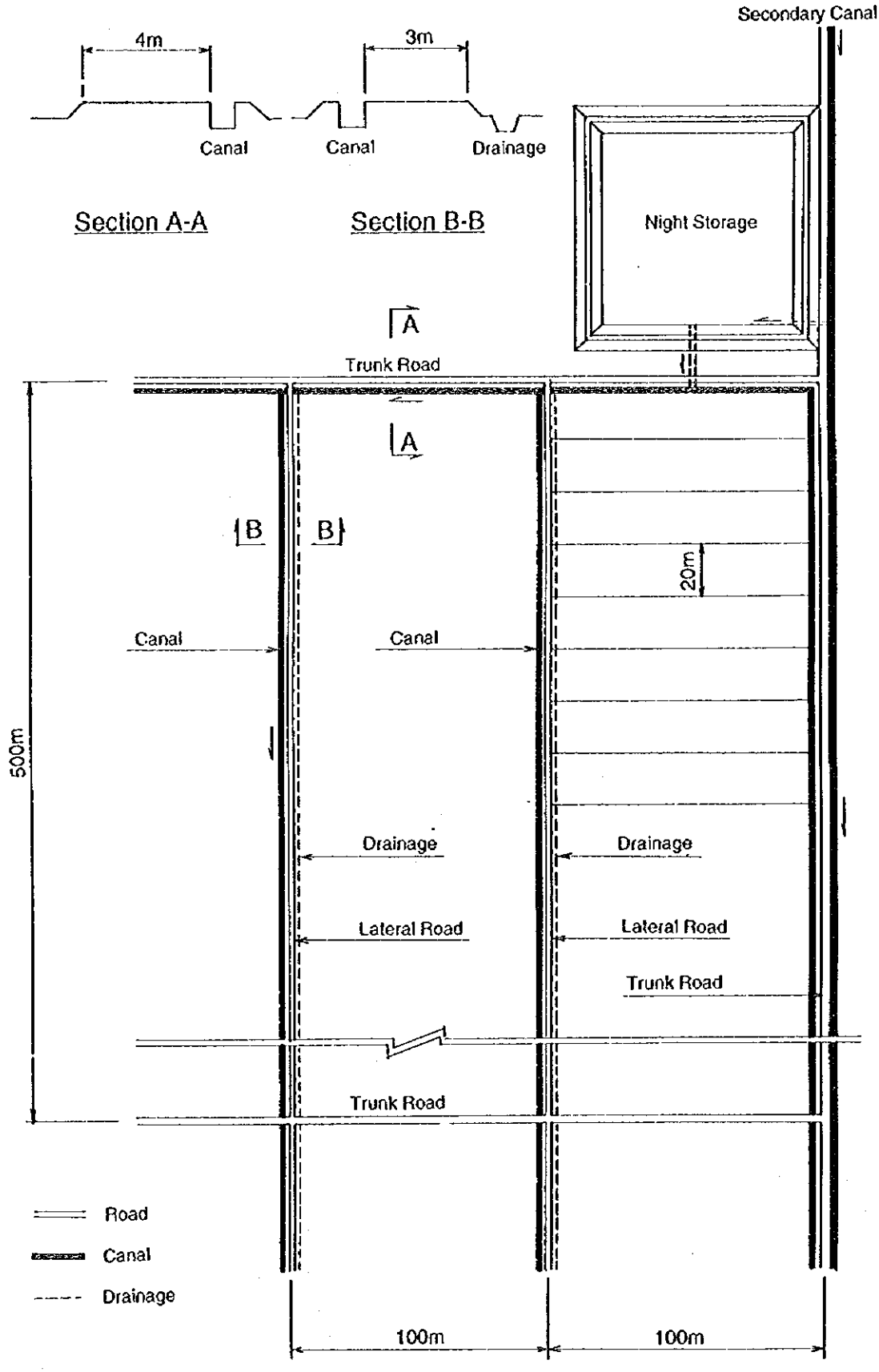


Figure G-5 FARMLAND BLOCK PLAN

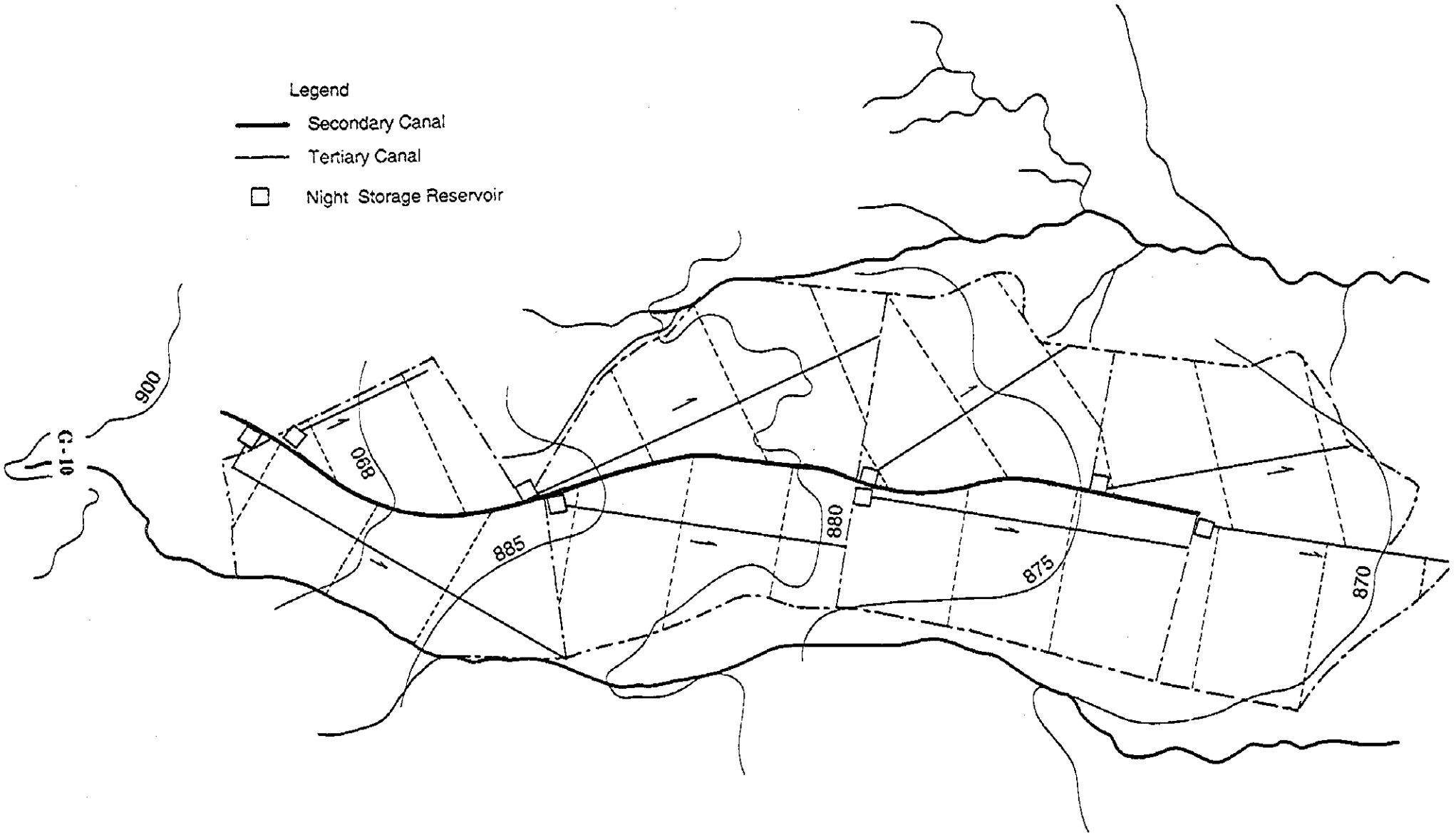
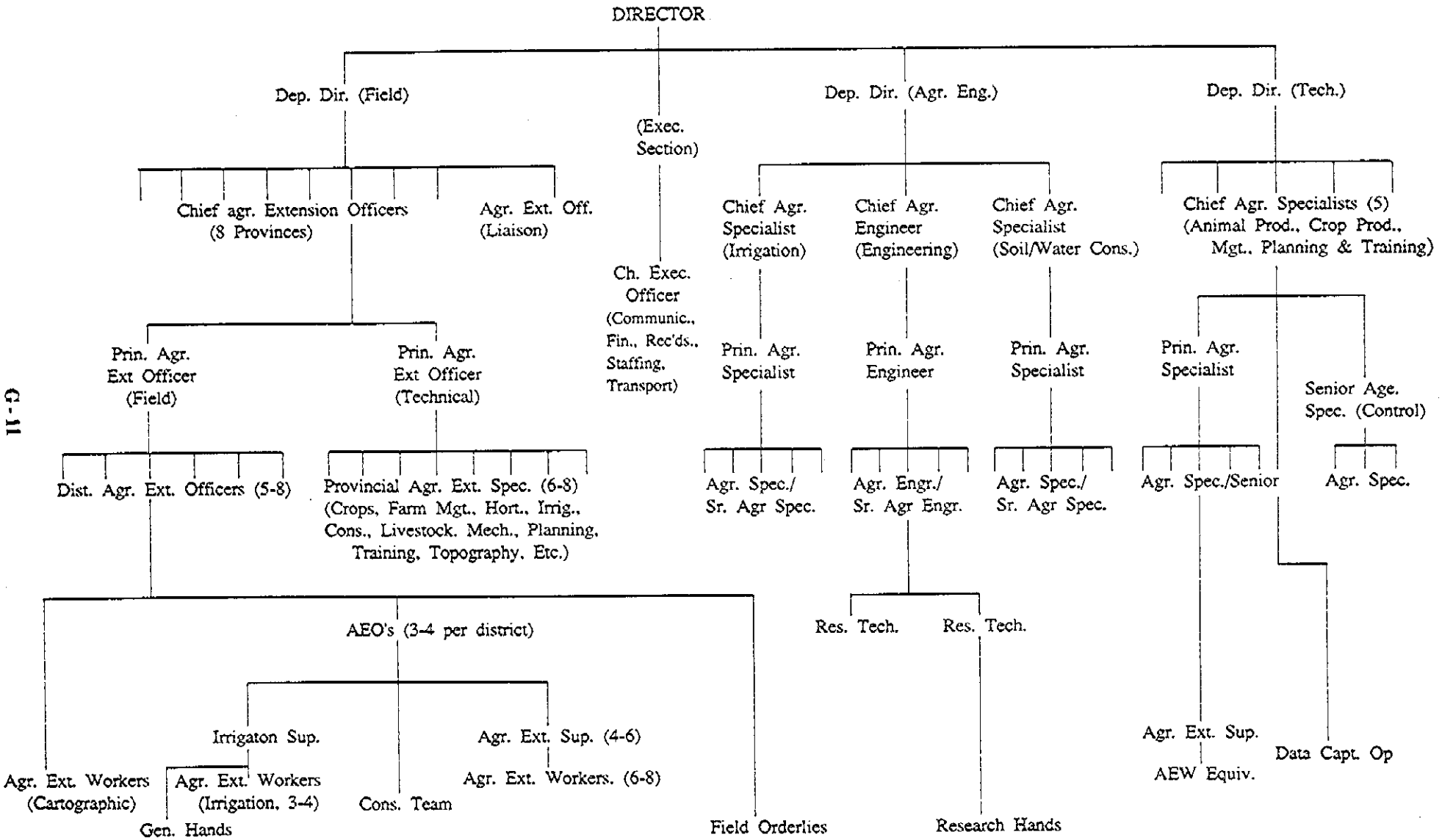


Figure G-6 GENERAL LAYOUT OF IRRIGATION SCHEME



[AGRITEX Training Branch, January, 94]

Figure G-7 ORGANIZATIONAL CHART OF MLAWD

DEPARTMENT OF WATER DEVELOPMENT
ORGANISATIONAL STRUCTURE AS AT 19.11.92

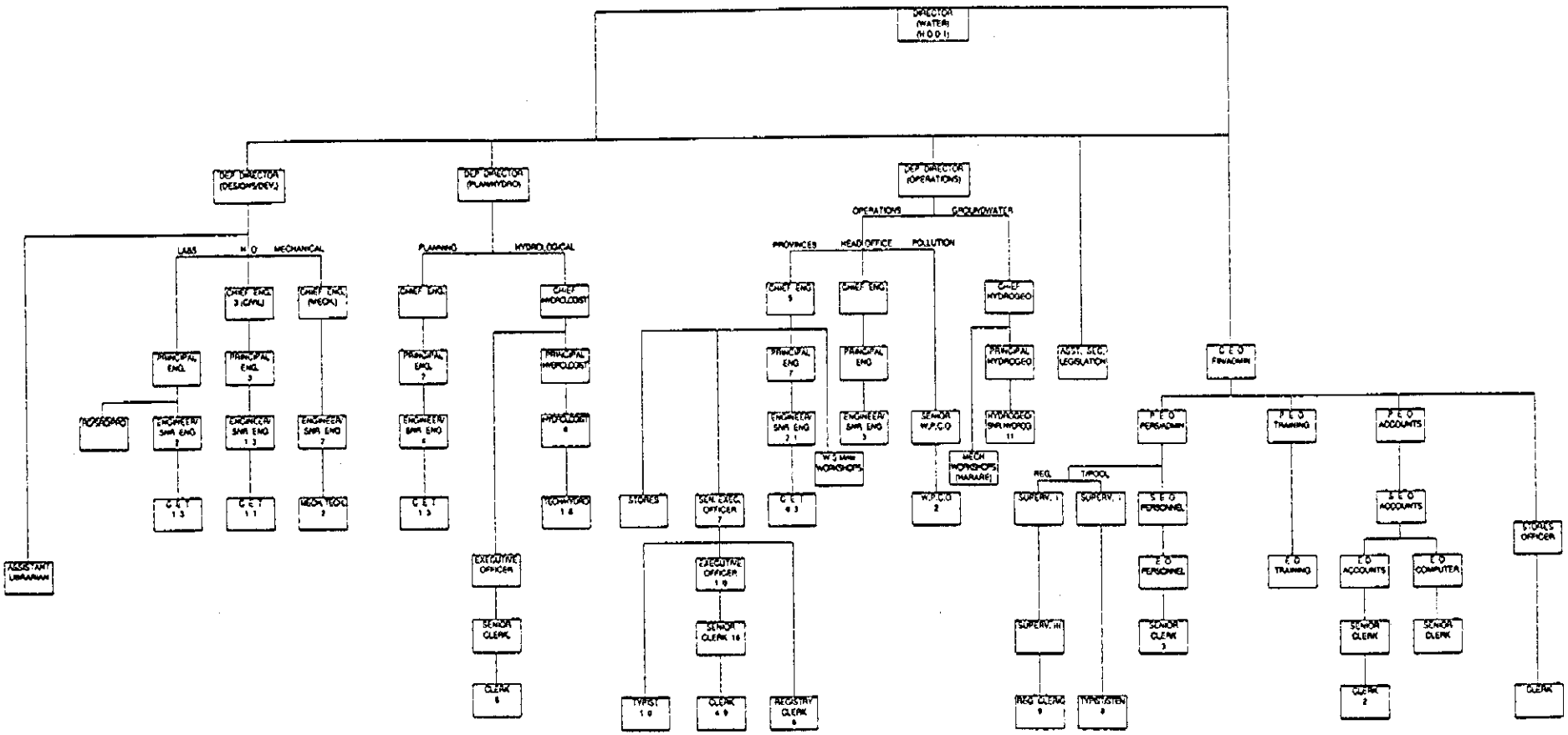
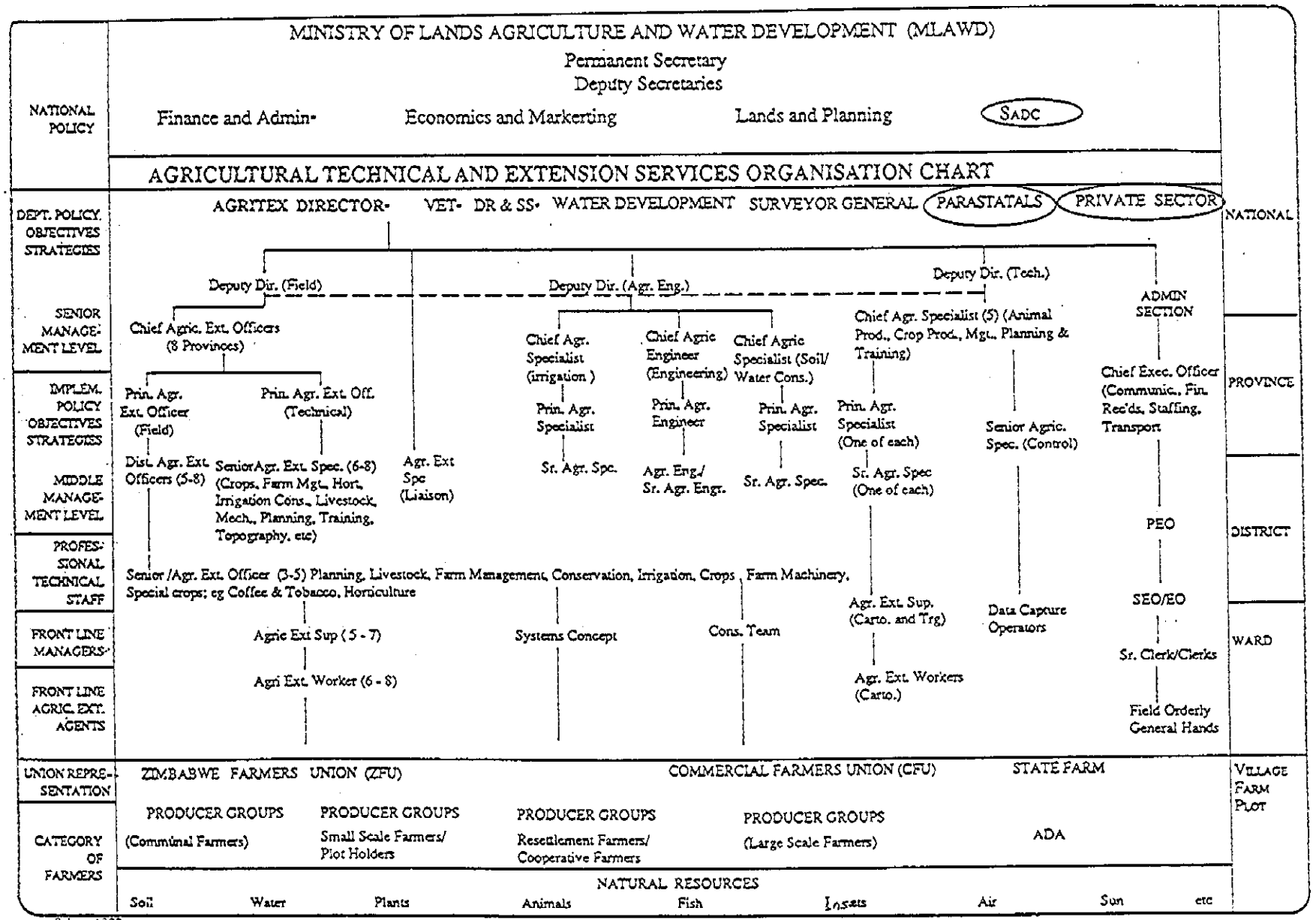


Figure G-8 ORGANIZATION CHART OF DWD

Figure G-9 ORGANIZATION CHART OF AGRITEX



3 June 1993

APPENDIX H SOCIO ECONOMIC CONDITION

APPENDIX II. SOCIO-ECONOMIC CONDITION

Table H-1(1) SOCIO ECONOMIC CONDITION(1)

Communal Code	Land Tenure Type	Name of District	Name of Ward	Name of Commune	Year of Settlement	Preoccupated Commune	Reason of Removal	Major Tribe	Minor Tribe	House -hold
1	Communal	Kadoma	No. 20	Tafura	1974	Munyati		Shona	Ndebele	79
2	Communal	Kadoma	No. 21	Tazvinzwa	1952	Rhodes Dale	government order	Karanga	Ndebele	44
3	Communal	Kadoma	No. 22	Neuso	in 19 A.D.	Buhera		Zebune	Ndebele/Karanga	120
4	Communal	Kadoma	Sanyati 23	Sakungwe	1951	Rhodes Dale		Karanga/Zezuru		230
5	Communal	Kadoma	Sanyati 24	Kusi	1948	Chenawgwa/Hondoro		Zezuru		92
6	Communal	Gokwe North	Makore I	Dakwende	1961/67	Nyaurungwe/Gutu	better farming opportunity	Karanga/Korekore	Nyanja(ex-Malawi)	196
7	Communal	Gokwe North	Makore II	Muzira	1965	Gutu/Chilimanzi/etc	-ditto-	Karanga	Zezuru	52
9	Communal	Gokwe South	Chisina II	Moses	1956	Zombe	displacement	Shona	Ndebele	
10	Communal	Kwekwe	Sidakeni	Shidakeni-1	1942	different places	for grazing cattle	Mixed		200
11	Communal	Kwekwe	Mabura	VIDCO-5	1964	Chiundura/Mukolo	better farming opportunity	Karanga/Ndebele	Nyanja	75
12	Resettlement	Kadoma	Muzwezwe I	village 31	1984	different places	in search of land	Shona	Ndebele	19
13	Resettlement	Kadoma	Sachuru	village 22	1989	Chinhoyi/others	attracted by better soil	Zezuru	Korekore	42
14	Resettlement	Gokwe North	Nyaurungwe	village 148	1979	Masvingo	better farming opportunity	Karanga	Zezuru	32
15	Small scale	Kadoma	Chenjiri West		1961	different places	better farming opportunity	Karanga	Ndebele	67
16	Small scale	Kadoma	Chenjiri Central		1959/62	Gutu/Shurungwe		Karanga		78
17	Small scale	Gokwe North	Copper Queen North		1963	Gutu/Chibi	attracted by better soil	Karanga	Zezuru	173
18	Small scale	Gokwe North	Copper Queen Central		1963	Gutu/Mondoro/Shurugwe		Karanga	Zezuru	77
19	Small scale	Gokwe North	Copper Queen South		1963	Gutu/Mondoro/Chibi		Karanga	different	96

Table H-1(2) SOCIO ECONOMIC CONDITION(2)

Communal Code	Population	Religion	Major Industry	Current Status of Employment-act of Village				Imformation on Water Source			
				member of employment	employer	vocation	reason of being employed	water source	developper	year of construction	degree of sufficiency
1	529	Christian	Farming	10+-	Sanyati	ginning	to make extra income	borehole	dist. council	1974	sufficient
2	400	-ditto-	-ditto-	3	Sanyati	ginning	-ditto-	borehole	government	1981	dry in Sep/Oct
3	750	-ditto-	-ditto-	few		teacher/etc.		bh./well	government	15 yrs	short in season
4	1,200	-ditto-	-ditto-					borehole	government	1951	dry in July/Nov
5	600	-ditto-	-ditto-	few	Sanyati	ADA farm		bh./river	government	1951/52	sufficient
6	1,176	mainly csn	-ditto-	17	different	teacher/etc.		bh./well	government	1959	dry in season
7	312	Christian	-ditto-	few				bh./well	government	1964	dry in season
9	*	mainly csn	-ditto-	many	different	different	to have better job	rv./well	inhabitant	-	dry in Mar/April
10	1,600	Christian	Fm./Mine	few	different	different	to supplement income	bh./well	NGO/inhabitant	digging	short in season
11	750	-ditto-	Farming	13	different	teacher/etc.	to have better income	borehole	government/NGO	1965/1989	short for animal
12	247	-ditto-	-ditto-	none	-	-		borehole	government	1984	sufficient
13	300	-ditto-	-ditto-	none	-	-		borehole	government	1989	short in capacity
14	258	-ditto-	-ditto-	none	-	-		borehole	government	1994	short for animal
15	670	-ditto-	-ditto-					borehole	farm owner	since 1970	sufficient
16	780	-ditto-	-ditto-					borehole	govern./farm own.	since 1959	sufficient
17	1,730	mainly csn	-ditto-	4	different	teacher	to have extra income	borehole	govern./farm own.	since 1963	not sufficient
18	780	Christian	-ditto-	2	-	teacher	to have extra income	borehole	govern./farm own.	since 1952	not sufficient
19	1,500	-ditto-	-ditto-	some	-	-		borehole	govern./farm own.	since 1963	not sufficient

Table H-1(3) SOCIO ECONOMIC CONDITION(3)

Communal Code	Location of Medical Facility	Number of patients	Major Disease	Educational Facility	Number of Pupils	Traffic Media	Holding per H.H. (arc.)	Area under Forest (ha)	Major Crop	Acreage bty Crop/H.H.			
										Cotton	Maize	Sun-flower	Ground -nut
1	within Ward	7,000	malaria/dysentery	primary/secondary	-	2 buses	8	50	cotton/maize	5	3		
2	Chirikiti		malaria/diarrhoea	primary	100	2 buses	7	not enough	cn/mz/sf/gn	4	2	0.5	0.5
3	Chirikiti/Sanyati		malaria/diarrhoea	primary/secondary	350	buses	4	120	cn/mz/gn/mt/sm	2	1	-	*
4	within Ward/Sanyt.	few	malaria/diarrhoea	-ditto-	-	buses	10	limitted	cn/mz/gn/mt/sf	6	3	*	*
5	2 in Sanyati	few	malaria/dysentery	not available nearby		difficult	10	limitted	cn/mz/gn	5	2.5		0.5
6	Copper Queen		malaria	primary	all aged pop.	buses	10	250	mz/cn/sf/gn	4	2.5	1.5	0.25
7	15km far		malaria/dysentery	primary/secondary	-ditto-	buses	10	150	mz/cn/sf/gn/mt	4	2.5	1.25	1.25
9	within Ward	many	malaria/bilharzia	-ditto-		shortage	10		cn/mz/sf/gn	5	1	1	
10	within Ward	many	malaria	-ditto-		buses	5	limitted	cn/mz/sf/gn	2	3		
11	Sidakeni	many	malaria/T.B.	-ditto-		difficult	5	limitted	cn/mz/gn/sf/sm	2.5	1	0.5	0.5
12	15km far		malaria	prim. in 12km far		buses	12.5	3 paddocks	cn/mz	7.5	5		
13	Sanyati/Chinjiri	few	malaria	primary		1 bus	6.25		cn/mz	4	2.25		
14	within Ward		malaria	primary		buses	7	75	cn/mz/sorgham	3	3		
15	Chenji Central	many	mlr/bilharzia/drh	primary		buses	300	150 in farm	cn/mz/gn/sf/sm	80	40	5	5
16	within Ward	many	malaria	primary/secondary		shortage	300	200 in farm	cn/mz/gn/sf/sm	60	30		
17	2 clinic in Ward	few	malaria/diarrhoea	primary		buses	625	in farm	cn/mz/sf/gn/sm	15	10	4	4
18	within Ward	many	malaria/diarrhoea	primary/secondary		buses	500	in farm	cn/mz/sf/gn/sm	30	10	5	7
19	Sanyati/C.Q.C	few	malaria	primary		buses	500	450 in farm	cn/mz/gn/sm/sf	30	12	2	2

NOTE) cn : cotton mz : maize sf : sunflower gn : groundnut mt : millet sm : sorghum

Table H-1(4) SOCIO ECONOMIC CONDITION(4)

Communal Code	Availability of Irrigable Land	Water Source Thereof		Orchard and Perennial Crops *	Tillage		Days for Major Practices						Average Yield(kg/ha)				Limiting Factors on Agriculture **	Solution Therefor
							Welding		Pest Control		Harvest							
		Water Source	Water Source Thereof		Means	Days Required	cn.	mz.	cn.	mz.	cn.	mz.	cotton	maize	sun-flower	groud-nut		
1	none				oxen	16 days	18	10	16	-	14	4	800	2000			fnc/lbr/wt/tp	solve drought prob.
2	vegetable	dam	enough	none	oxen/DDF	14 days	7	5	2	-	21	3	860	1125			wt/tp/da/fnc	dam/group works
3	vegetable	dam	rain season only	og/av/mg/lm	oxen/DDF	2-3 weeks	5		1		14	2	800	1800			da/wt/fnc	CSC financing
4	vegetable	b.hole	rain season only	none	oxen/DDF								1000	2250			wt/fnc/da/tp	financing/dam
5	vegetable	b.hole	enough	mg/og from 1994	oxen/trac.								1200	2250		640	wt/fnc/da	dam/financing system
6	vegetable	wells	rain season only	mg	oxen								1200	2250	320	400	da/wt/tp/fnc	dam/road/financing
7	0.8ha vg.	wells	rain season only	og/bn	oxen								1000	1620	320	600	da/wt/fnc/tp	dam/financing system
9	none			none	oxen	4-5 days							1400	1000		1000	da/wt/tp/ic	financing/damm
10	garden	well	not enough	none	oxen/trac.								600	1000			wt/da/tp/fnc/ip	dam
11	none				oxen/donky	3-4 days							600	1170	250	200	ft/da/in/mk/tp	dam/road/financing
12	none			none	oxen	2 days							1000	1800			wt/st/fnc/da	move-out
13	none			none	oxen								1400	1800			da/ft/wt/tp/fnc	group works/dam/fnc
14	vegetable	b.hole	enough		oxen/trac.								1400	2250			wt/ip/fnc/tp	sml.dam/group lending
15	none				trac./oxen								1400	2250	600	1320	da/fnc/tp	bridge
16	none			few	oxen/trac.								1200	2250	600	800	da/tp/fnc/ip	sub-depots/bridge
17	vegetable	b.hole	enough	few	oxen/trac.								1200	2250	825	400	wt/da/ft/fnc/tp	irrigation/fnc/group w.
18	vegetable	dam	not enough	mg-home consumt	oxen/trac.								1200	2700	850	500	wt/da/ft	dam/financing/group w.
19	vegetable	b.h./rv	enough	few	oxen/trac.								1500	2250	280	1000	fnc/da/wt	dam/fnc/CSC cattle

NOTE) * og:orange av:avocado mg:mango lm:lemon bn:banana

** fnc:finance kbr:labourer wt:water tp:transport da:draft animal ic:insecticide ip:input price ft:farm tool in:insect mk:monkey st:soil texture

Table H-1(5) SOCIO ECONOMIC CONDITION(5)

Communal Code	Livestock Holding/H.H.				Objecture of Keeping *	Constrains on Live-stock **	Traditional Tribal Organization	Regular Festival	Custom of Inheritance	Matrimonial Custom	Farmer's Groups ****					ZFU	
	Cattle	Sheep	Goat	Chicken							Name ***	Year of Es-tablishment	Membership	Principal Activity	Annual Fee($)	ZFU Membership	Principal Activity
1	7	-	6	4	da/mk/fs	fw/pest	NHIMBE	occasionally	eldest son	self select						all farmer	tax exempt.
2	3	-	*	*	da/mk/mn	sg/pest	Nakamera gp.	none	wife	-ditto-	Nakamera	1994	28	fnc	50		
3	4	*	10	10	da/mk/ch	sg/pest		none	eldest son	-ditto-	fg/vp	1980	52	fnc/vp	5/10	all farmer	tax exempt.
4	10		15	25	da/mk/ch	sg/sw/pest	NHIMBE	harvest fest.	eldest son		fg/vp	1992/82	15/60	vp/fnc	20/vp	not all	very few
5	5		6	5		sg/pest/vs			eldest son		vp/cg	1992	33/36	vp	60	most farmer	lobby act.
6	3	*	10	10	da/mk/ch	sg/sw/pest		harvest fest.	eldest son	self select	Kuyedza	1968	208	fnc/cv	30	all farmer	lobby act.
7	4	2	12	20		sg/sw/pest		harvest fest.	eldest son	self select	Nyatu Co.	1972	72	fpm/hk	varied	all farmer	orgn.coop.
9	*		*	*	da/ch/mk	sw/sg/pst/price	NHIMBE	harvest fest.	eldest son	self select	farm coop	1976	500	fpm	15	all farmer	lobby act.
10	5	*	10	15	da/mk	sg/sw/vs/tf		occasionally	family mt.	self select	Artx grp.	1982	mostly	fpm	5	most farmer	lobby act.
11	5		5	4		sg/sw		harvest fest.	eldest child	self select	Bee Mine	1989	31	jf	5	all farmer	tax exempt.
12	6		6	8	da/mk/ch	sw		occasionally	wife	self select	Shan grp.	1987	19	fpm	2.5	all farmer	lobby act.
13	2	1	5	10	da/mk/ch	fw/vs/pest			1st wife	courtship	fg/cg	1991	20	fnc	5	all farmer	tax exempt.
14	8	1	3	12	da/mk	pest/sw	NHIMBE	none			Hamamaoko	1992	28	vp	50	20/32	tax exempt.
15	25	3	10	10	da/mk/lb/ch	fw/pest		none	family mt.	courtship	many	1992	not all	fnc/mg	nil	all farmer	lobby act.
16	20	5	15	30	da/mk/ch	fw/vs/price		none	one of sons	courtship	ICA/cg	1992	30-50	fnc	nil	all farmer	tax exempt.
17	10	*	3	30	da/mk/mt/ch	fw/vs/pest		field day	eldest son	self select	ICA/CMB	1992/CMB	mostly	fpm		all farmer	tax exempt.
18	30	10	10	50	da/mt/mk/ch	fw/vs/pest	NHIMBE	field day	eldest son	self select	ICA/CMB	1964/1994	mostly	fpm		all farmer	tax exempt.
19	15	5	8	60	da/mt/ch	sw/tf/fs	NHIMBE	field day	eldest son	self select	ICA/vp	1964/1992	mostly	fpm	20/vp	all farmer	tax exempt.

NOTE) * da:draft power mk:milk fs:financial security mn:manure ch:cash income lb:lobola mt:meat

** fw:food/water sg:shortage of grazing sw:shortage of water vs:veternary service insufficient tf:thief fs:forage shortage

*** fg:financing group vp:vegetable production cg:cotton production group

**** fnc:financing vp:vegetable production cv:crop improvement fpm:farming,procurement of inputs & marketing hk:house keeping jf:joint farming mg:marketing group

harvest festival include farming competition day, field day, etc.

APPENDIX I RURAL SOCIOLOGY AND INSTITUTION

APPENDIX I. RURAL SOCIOLOGY AND INSTITUTION

Table I-1(1) ROAD REHABILITATION PLAN IN SCENARIO B-2

District	Type of Road	Road Length to be improved	Road Length to be constructed	No. of Household to be benifited	No. of Population to be benifited	Design Speed
		km	km			km/hr
Kadoma	①Wide Tarred					100
	②Narrow Tarred	②⇒①				80
	③Gravel or Earth	③⇒②	35	985	5758	50
	④Track	97 ④⇒③		7305	44969	30
Gokwe North	①Wide Tarred					
	②Narrow Tarred	②⇒①				100
	③Gravel or Earth	③⇒②				80
	④Track	54 ④⇒③		3288	20435	50
						30
Gokwe South	①Wide Tarred					
	②Narrow Tarred	②⇒①				100
	③Gravel or Earth	③⇒②				80
	④Track	98 ④⇒③		5179	31922	50
						30
Kwekwe	①Wide Tarred					
	②Narrow Tarred	②⇒①				100
	③Gravel or Earth	③⇒②				80
	④Track	30 ④⇒③		2502	13510	50
						30
Kadoma to						
Gokwe North	③Gravel or Earth	70 ③⇒②				80
		349	35	19259	116594	

Table I-1 (2) ROAD REHABILITATION PLAN IN SCENARIO B-1

District	Type of Road	Road Length to be improved	Road Length to be constructed	No. of Household to be benifited	No. of Population to be benifited	Design Speed
		km	km			km/hr
Kadoma	①Wide Tarred					100
	②Narrow Tarred	②⇒①				80
	③Gravel or Earth	③⇒②	35	1108	6483	50
	④Track	97 ④⇒③		8224	50630	30
Gokwe North	①Wide Tarred					
	②Narrow Tarred	②⇒①				100
	③Gravel or Earth	③⇒②				80
	④Track	54 ④⇒③		3780	23494	50
						30
Gokwe South	①Wide Tarred					
	②Narrow Tarred	②⇒①				100
	③Gravel or Earth	③⇒②				80
	④Track	98 ④⇒③		5955	36702	50
						30
Kwekwe	①Wide Tarred					
	②Narrow Tarred	②⇒①				100
	③Gravel or Earth	③⇒②				80
	④Track	30 ④⇒③		2834	15300	50
						30
Kadoma to						
Gokwe North	③Gravel or Earth	70 ③⇒②		12004	74124	80
		349	35	33905	206733	

Table I-1(3) ROAD REHABILITATION PLAN IN SCENARIO A

District	Type of Road	Road Length to be improved	Road Length to be constructed	No. of Household to be benifited	No. of Population to be benifited	Design Speed
		km	km			km/hr
Kadoma	①Wide Tarred					100
	②Narrow Tarred	②⇒①				80
	③Gravel or Earth	③⇒②	156(35)	9260	57003	50
	④Track	97 ④⇒③		9260	57003	30
Gokwe North	①Wide Tarred					
	②Narrow Tarred	②⇒①				100
	③Gravel or Earth	③⇒②	71	4062	25296	80
	④Track	54 ④⇒③		4346	27013	50
						30
Gokwe South	①Wide Tarred					
	②Narrow Tarred	②⇒①				100
	③Gravel or Earth	③⇒②	69	6846	42198	80
	④Track	98 ④⇒③		6846	42198	50
						30
Kwekwe	①Wide Tarred					
	②Narrow Tarred	②⇒①				100
	③Gravel or Earth	③⇒②				80
	④Track	30 ④⇒③		3208	17328	50
						30
Kadoma to						
Gokwe North	③Gravel or Earth	70 ③⇒②		13606	84016	80
Total		349	**296(35)	57434	352055	
	Narrow Tarred		70			
	Gravel	279	35			

** : 296 km shows the length of O & M of Kudu Irrigation Canal

Table I-2 EXISTING AND PROPOSED COLLECTION POINT & DEPOSIT POINT AND COMMUNITY CENTER

Location	Ward Name	Deposit point		Collection Point		Community Center	Remarks
		COTTCO	GMB	COTTCO	GMB		
Kadoma		■	●				
Gokwe		□	●				
Sanyati		■	●				
Nembudziya		■	●				
Empress Mine	Sidakeni			▽	▲	○	
Everglades	Muzvezve			▽	△	○	
Mtanke	Chisina I			▽	△	○	
Marungu BC	Chisina II			▽	△	○	
Chenjiri Camp	Chnjiri S.S.F.			▽	△	○	
Nyimo BC	Sanyati Communal			▽	△	○	
	Total (Proposed)	1		6	5	6	

■、●、▲: Existing

□、▽、△: Proposed

COTTCO : Cotton Company of Zimbabwe

GMB : Grain Marketing Board

APPENDIX J ENVIRONMENTAL CONDITION AND MANAGEMENT

ZIMBABWE

ENVIRONMENTAL IMPACT ASSESSMENT POLICY

JULY 1994

Ministry of Environment and Tourism
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Zimbabwe
Environmental Impact Assessment Policy

1. Introduction

A variety of environmental issues affect both rural and urban life in Zimbabwe -- deforestation, soil erosion, loss of biodiversity, and air and water pollution to name a few. Government is responding to these priority problems through a number of statutory instruments, policies, programmes and projects. Many of these initiatives address long-recognised conservation and natural resource management needs. Others derive from:

- the adoption of a National Conservation Strategy in 1987;
- being party to international conventions dealing with, for example, desertification and the depletion of atmospheric ozone; and
- participation in the 1992 United Nations Conference on Environment and Development, and commitment to the resultant Agenda 21 programme for sustainable development.

To achieve the goal of sustainable development, Government recognises that new initiatives are required to complement existing efforts and provide additional means for obtaining sound environmental management. Consequently, an *Environmental Impact Assessment Policy* ("EIA Policy") for Zimbabwe has been developed and is being implemented by the Ministry of Environment and Tourism for application to development projects likely to have significant environmental consequences.

EIA is both a process and tool for project planning and decision-making. Its purpose is to ensure that the environmental and socio-economic costs and benefits of economic development projects are properly accounted for, that unwarranted negative impacts are avoided or mitigated, and that potential benefits are realised. EIA involves carrying out environmental and socio-economic studies of projects in parallel with analyses of engineering and economic feasibility. At key decision points in the development of a project, EIA ensures that decision-makers are provided with information on its environmental costs and benefits to complement information on its technical and economic feasibility.

Many EIA studies have been carried out in Zimbabwe, some as early as the mid-1970s but most since the mid-1980s. Their number is increasing rapidly. Though the Second Five Year Development Plan (1991-1995) specifies that EIA be undertaken before major development projects are implemented, no formal Government procedure for requiring, reviewing and commenting on EIA studies of individual projects has yet been established. As a consequence, opportunities to benefit from EIA studies and improve environmental management are being missed, a situation which the EIA Policy is intended to rectify.

Although an EIA programme is best implemented under statutory authority, the development of new environmental management legislation for Zimbabwe will take time. In the meantime, the EIA Policy will minimise confusion and uncertainty for both project developers and Government regarding ongoing EIA activities, and contribute to realising the benefits to environmental management which can flow from these activities.

Over the past two years, the Ministry of Environment and Tourism has consulted extensively with other government agencies and the public on responding to the imperatives of sustainable development embodied in Agenda 21. The EIA Policy is one product of this consultation process. These consultations resulted in a strong endorsement of the need for Government to implement an EIA programme, and in the delineation of broad goals and principles for environmental impact assessment in Zimbabwe. These goals and principles are given in Tables 1 and 2.

Table 1:
Goals for Environmental Impact Assessment

- Environmentally-responsible investment and development in Zimbabwe must be encouraged through transparent, predictable, equitable and effectively administered environmental assessment policy.
- The long-term ability of natural resources to support human, plant and animal life must be maintained.
- A broad diversity of plants, animals and ecosystems must be conserved.
- Natural processes such as the recycling of air, water and soil nutrients must be preserved.
- Irreversible environmental damage must be avoided and any environmental damage must be minimised.
- The basic needs of the people affected or likely to be affected by a development proposal for food, water, shelter, health and sanitation must be met.
- Social, historical and cultural values of people and their communities must be conserved.

Table 2:
Principles for Environmental Impact Assessment

- Both public- and private-sector development projects must be subject to EIA.
- Proponents must fund EIA studies and Government must fund EIA reviews.
- Application of a prescribed activities list and screening guidelines will be needed for an effective and manageable EIA policy. Basic criteria for establishing prescribed activities and screening guidelines are:
    - The development needs and experience of Zimbabwe should be reflected.
    - The terms and requirements of international conventions and protocols to which Zimbabwe is a signatory should be met.
- A project should be subject to some level of EIA if it is likely to cause significant impacts to the biophysical, socio-economic, historical or cultural environments.
- EIA should begin as early as possible in the project cycle.
- People potentially affected by a development project should be consulted during the planning process and participate in reviewing the proposal.
- Information about a development project should be readily available to all public and private stakeholders.
- Formal review and approval of an EIA report should be conducted by a qualified, impartial body independent of the proponent, the preparers of the report, and the project permitting or approval authorities.
- EIA should provide for specifically-identified mitigation measures, management planning for impacts during project construction and operation, and impact monitoring and management from construction through to decommissioning.
- People and communities that suffer a loss from a development project should be fairly compensated.

The EIA Policy is being established on a trial basis. Its design and further application will be reviewed annually until it is superseded by formal legislation requiring EIA. The lessons learned from implementing the Policy will provide valuable input to the overall development of an environmental assessment programme for Zimbabwe, including institutional and legislative needs.

2. Definitions

"DEIA" refers to a detailed environmental impact assessment study. The product of the study is an "DEIA report."

"Environment" refers to the air, land, water, plants, animals, humans and their historical and cultural characteristics as expressed physically, socially and economically.

"Environmental impacts" refer to the effects an activity has on the environment. These effects may be positive or negative, or produce costs or benefits.

"Environmental impact assessment" or "EIA" refers to the assessment of a development project in terms of its impact on the environment. The product of the study is an "EIA report."

"Ministry" refers to the Ministry of Environment and Tourism.

"Minister" refers to the Minister of Environment and Tourism.

"NEPC" refers to the National Economic Planning Commission of Zimbabwe.

"PEIA" refers to a preliminary environmental impact assessment study. The product of the study is a "PEIA report."

"Permanent Secretary" refers to the Permanent Secretary of Environment and Tourism.

"Permitting authority" refers to an agency of government responsible for regulating specific kinds or aspects of development activities.

"Prescribed activity" refers to a project subject to the EIA Policy.

"Proponent" refers to any public- or private-sector agent, body or individual proposing to carry out a prescribed activity.

"Prospectus" is the initial information document on which a determination of the need for an EIA study is made.

"Residual impacts" refer to those negative environmental impacts which could not be eliminated during project design.

"Scoping" refers to the process of defining the terms-of-reference for the conduct of an environmental impact assessment and establishing the salient issues to be addressed, the study methods and data requirements.

"Screening" refers to the process of determining what projects should be subject to EIA requirements, the main considerations being project type, size and the environmental sensitivity of project location.

"Stakeholders" are individuals, communities, government agencies, private organisations, non-governmental organisations or others having an interest or "stake" in both the EIA Policy and the outcomes of projects.

"ZIC" refers to the Zimbabwe Investment Centre.

3. Principles of the Environmental Impact Assessment Policy

The EIA Policy embodies a number of principles as outlined below. They are based on the outcomes of Ministry consultations as described in the Introduction to this policy and from international experience with EIA. Basing an EIA programme on a clear set of principles has been found to be essential to its effective implementation.

3.1 EIA must enhance development, by contributing to its environmental sustainability, not inhibit it

The EIA Policy is intended to support environmentally-sustainable development, not inhibit economic investment in the country. The Ministry will work closely with established project development and approval authorities, especially the NEPC and ZIC, to ensure that EIA requirements do not unnecessarily inhibit needed economic development of Zimbabwe.

3.2 EIA is a means for project planning, not just evaluation

Zimbabwe's EIA Policy integrates environmental assessment into every phase of the project cycle, beginning in its earliest stages. The Policy is intended to encourage the consideration of environmental impacts (costs and benefits) during all stages of project planning. Thus, in essence, EIA reports are progress reports on the formulation of a project, from an environmental point of view, as it moves through the project cycle. The reports must describe the process and results of

environmental planning that have gone into a project as well as both the anticipated environmental costs and benefits residual to the planning effort and the proposed means for managing them.

3.3 Identifying means for managing project impacts is an essential component of the EIA Policy

Zimbabwe's EIA Policy requires proponents to include in their EIA reports specific plans for monitoring and managing environmental impacts. The plans must provide for regular reporting and evaluation of progress with their implementation. A clear proponent commitment to implementing such plans is an essential element of acceptable EIA reports.

3.4 The EIA Policy depends on the normal regulatory functions of permitting authorities to implement EIA results

The EIA Policy provides only for formal acceptance of an EIA report by the Minister. It is the responsibility of permitting authorities to implement environmental terms and conditions specified by the Minister when accepting an EIA report.

3.5 The EIA Policy involves the participation of all government agencies with a mandated interest in the benefits and costs of a project

In Zimbabwe, government agencies having an interest in a project are involved in the review and approval of EIA documents. Their participation facilitates reaching consensus on the significance of likely environmental costs and benefits and developing commitment to measures for managing them.

3.6 The EIA Policy pays particular attention to the distribution of project costs and benefits

Zimbabwe's EIA Policy pays particular attention to the distribution of project costs and benefits. One of its principal mandates is to ensure that, to the extent practicable, development projects are agents of local as well as national development. A minimum standard is that local people be no worse off than they were before a project is implemented.

3.7 Public consultation is an essential part of the EIA Policy

Zimbabwe's EIA Policy provides genuine opportunities for individuals, communities, private organisations and public interest groups to provide input to

the process of specifying, reviewing and accepting EIA reports. To facilitate effective public consultation in Zimbabwe, individuals and groups with a legitimate interest in projects have unrestricted access to all formal EIA documents.

4. Administration of the EIA Policy

The EIA Policy is administered by the Ministry of Environment and Tourism.

The Policy applies to both public- and private-sector development activities. Activities subject to the EIA Policy ("prescribed activities") are specified in Section 6.2 below. In addition to the activities prescribed in this Policy, the Minister is empowered to prescribe any activity which, in his or her view, may cause significant environmental impacts or community disruption.

A prescribed activity shall not receive the required authorisations to proceed from the relevant permitting authorities unless and until the Minister has exempted the activity from the requirements of the EIA Policy or has granted "EIA Acceptance."

"EIA Acceptance" is granted when the Minister determines that the environmental planning and assessment of an activity has been sufficiently thorough to adequately identify the impacts which it is likely to cause as well as measures for managing them. "EIA Acceptance" does <u>not</u> imply that the environmental impacts of an activity are acceptable to the Minister.

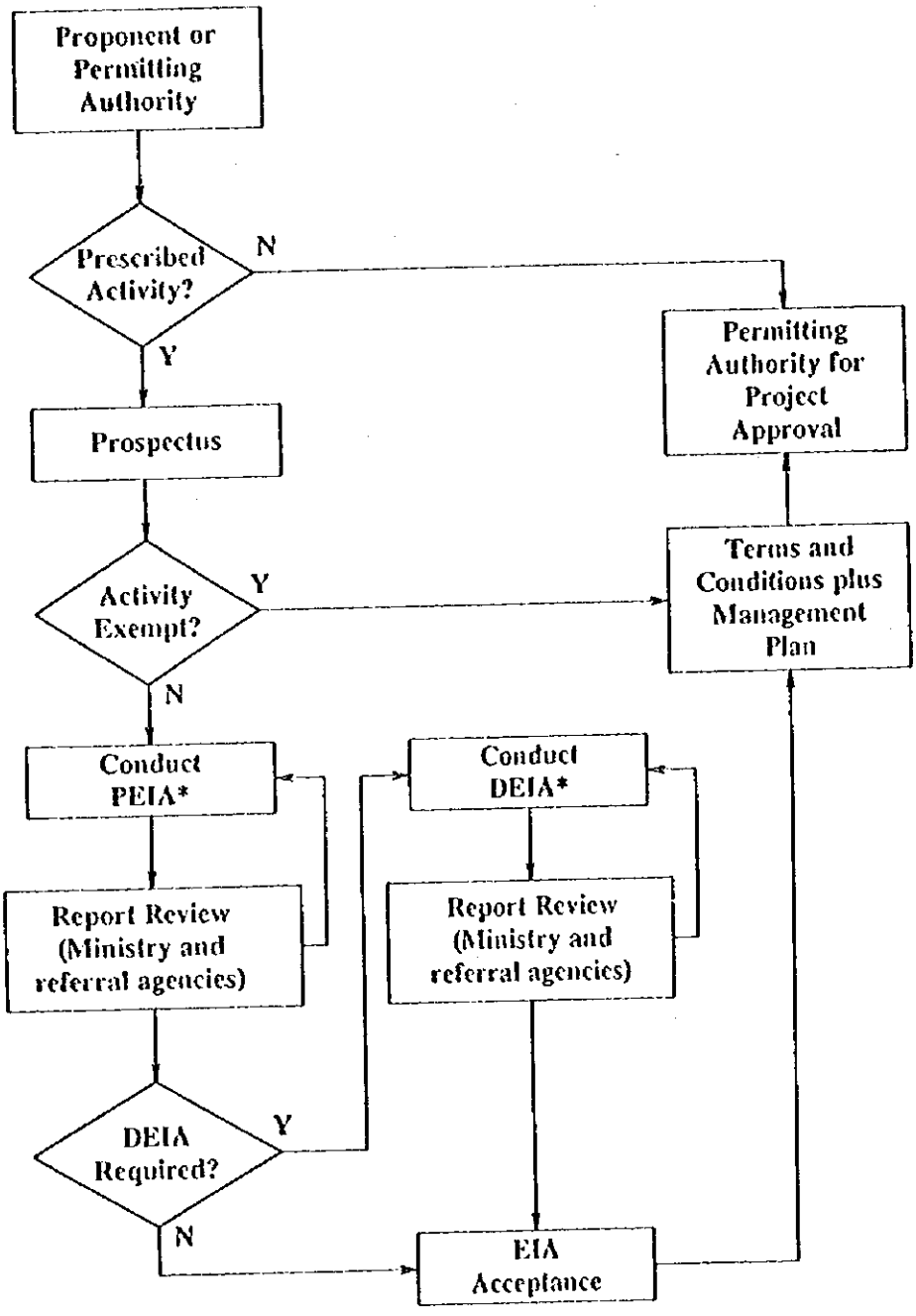
All formal submissions under the EIA Policy are made to the Minister. The Ministry will maintain a register of all activities currently being appraised under the Policy.

The preparation of EIA reports is the responsibility of proponents. The Ministry provides procedural and technical advice to proponents, as required, on how best to comply with the EIA Policy.

The EIA Policy incorporates a referral process whereby other government ministries and departments are informed about activities being appraised under the Policy and are given the opportunity to review and comment upon EIA reports. The Ministry will establish a "core referral group" which will be consulted on every activity being appraised. This group will be augmented as required for specific proposals to ensure that all activities receive the attention of the appropriate government agencies.

There are three types of EIA reports which represent sequential stages in the project cycle and EIA review process (Figure 1). They are a Prospectus, a Preliminary EIA Report, and a Detailed EIA Report.

Figure 1:
Administrative Flow Chart of the EIA Policy



* Based on terms-of-reference approved by Ministry

4.1 Prospectus

A Prospectus is a short document informing the Minister that a prescribed activity is being considered. Proponents should be able to prepare a Prospectus with little or no assistance from environmental specialists. The Prospectus provides a basic description of the activity, including proposed environmental management measures, and indicates the status of the feasibility studies. It should be prepared and submitted during the pre-feasibility studies and provide sufficient information to allow the Ministry to determine the need for an EIA study based on established screening guidelines (Section 6.3).

A Prospectus must be submitted for all prescribed activities.

Guidance on preparing a Prospectus is provided by the Ministry.

The National Economic Planning Commission, the Zimbabwe Investment Centre and the Department of Physical Planning are required to refer a Prospectus on all prescribed activities to the Minister for assessment under the EIA Policy. Municipalities must submit a Prospectus on all prescribed activities directly to the Minister.

Based on the Prospectus, the Ministry assesses whether or not an EIA report is required. This assessment is based on screening guidelines specified in Section 6.3 below. The Ministry has 21 days to assess whether or not an EIA report is required. If this deadline is not met, exemption from further compliance with the EIA Policy is assumed to have been granted.

If an EIA report is not required, the activity is exempt from further compliance with the EIA Policy. In such instances, the Minister advises the appropriate permitting authority of the exemption with recommendations for environmental management of the activity.

4.2 Preliminary EIA Report

If an EIA report is required, a preliminary EIA (PEIA) report is prepared, in draft, by the proponent based on terms-of-reference approved by the Ministry. The Minister may require that a scoping exercise be undertaken by the Ministry and proponent before terms-of-reference are prepared to ensure that all potentially significant impacts are included in the PEIA and that evidently insignificant concerns are excluded. The scoping exercise may involve public consultation.

A PEIA is a comprehensive initial assessment of the environmental impacts of an activity, based largely on existing information and some field reconnaissance. It should be undertaken during the early feasibility studies. Its main purpose is to identify likely impacts, to estimate their severity, to indicate which impacts are liable to be significant, and to indicate what opportunities are available to avoid or

minimise negative impacts and enhance potential benefits. A PEIA report includes proposals for monitoring and managing the anticipated impacts, especially those which accrue to local people.

Guidance on preparing PEIA reports is provided by the Ministry.

Public consultation is mandatory when undertaking a PEIA. At minimum, the proponent must meet with the principal stakeholders to inform them about the proposed activity and to solicit their views about it. More problematic activities should involve more extensive consultations. The methods and results of these consultations must be documented in the PEIA report.

When a draft PEIA report is received by the Minister, the Ministry initiates a review. The report is referred to the Natural Resources Board for its comments and recommendations. Depending on the complexity and scope of the activity, individual outside experts or an independent review panel may be retained to advise the Ministry. Ministry staff may also meet with non-government stakeholders to verify or extend the proponent's public consultations.

The Ministry also refers the report to other government agencies having a mandated interest in the potential costs and benefits of the activity for their comments and recommendations.

When the reviews are completed and consolidated, the Ministry meets with the proponent to discuss the draft PEIA report and, if necessary, require that corrections and/or additions be made before it is finalised.

The Ministry has 60 days in which to complete the review of the first draft of a PEIA report, and 30 days for the review of subsequent drafts. If any of these deadlines are not met, "EIA Acceptance" is assumed to have been granted.

When the Ministry's review is complete, the Permanent Secretary recommends to the Minister that:

a) EIA Acceptance should be granted since the PEIA is sufficient analysis. Government should approve the activity with, if necessary, environmental terms and conditions;

or b) EIA Acceptance should not be granted since the PEIA indicates significant impacts with the activity as proposed and more detailed study is required. The Minister should require that a detailed EIA be undertaken before EIA Acceptance is considered further.

The Minister determines what course to follow and advises the proponent accordingly.

In case a), the Permanent Secretary's report to the Minister includes (1) an account of what environmental terms and conditions should apply to the activity as well as (2) a draft government management plan outlining the actions required of various agencies to ensure good environmental performance of the activity.

4.3 Detailed EIA Report

A detailed EIA (DEIA) is a detailed analysis of significant environmental impacts indicated by a PEIA. It is not comprehensive but focuses on those issues of primary concern. A DEIA involves sufficient project-specific field work to adequately study and analyse the issues to be addressed. It should be undertaken during detailed feasibility studies and in close liaison with engineering, financial and other project planners.

A DEIA report describes the environmental planning that went into an activity and what features are incorporated to avoid or minimise negative impacts and capture benefits. It presents an analysis of the severity and significance of residual impacts and of benefits, especially for individuals and communities directly affected by the activity. It also provides an impact monitoring and management plan.

Guidance on preparing DEIA reports is provided by the Ministry.

Public consultation is mandatory while undertaking a DEIA. At minimum, the proponent must meet with the principal stakeholders to inform them about the issues being addressed in the DEIA and to solicit their views about them. More problematic activities should involve more extensive consultations. The methods and results of the consultations must be documented in the DEIA report.

When a draft DEIA report is received by the Minister, the Ministry initiates a review. The report is referred to the Natural Resources Board for its comments and recommendations. If individual outside experts or an independent review panel were retained to advise on the PEIA report, their advice will be sought on the DEIA report. Ministry staff may also meet with non-government stakeholders to verify or extend the proponent's public consultations.

The Ministry also refers the draft DEIA report to other government agencies having a mandated interest in the potential costs and benefits of the activity for their comments and recommendations.

When the reviews are completed and consolidated, the Ministry meets with the proponent to discuss the draft DEIA report and, if necessary, require that corrections and/or additions be made before it is finalised. The Minister may, if it is considered warranted, request the Natural Resources Board to hold public meetings on an activity to solicit further public comment on it and on the draft DEIA report.

The Ministry has 60 days in which to complete the review of the first draft of a DEIA report, and 30 days for the review of subsequent drafts. In the event of public meetings on an activity by the Natural Resources Board, the Minister may extend the review period upon giving notice to the affected parties. If any of these deadlines are not met, "EIA Acceptance" is assumed to have been granted.

When the Ministry's review is complete, the Permanent Secretary recommends to the Minister that:

a) EIA Acceptance should be granted since the DEIA is sufficient analysis. Government should approve the activity with, if necessary, environmental terms and conditions;

or b) EIA Acceptance should be granted since the DEIA is sufficient analysis. However, government should not approve the activity since, as proposed, it would have unacceptable impacts.

The Minister determines what course to follow and advises the proponent accordingly.

In case a) above, the Permanent Secretary's report to the Minister includes (1) an account of what environmental terms and conditions should apply to the activity as well as (2) a draft government management plan outlining the actions required of various agencies to ensure good environmental performance of the activity.

5. Public Consultation and Access to Information

Public consultation is an integral component of the EIA Policy as indicated in several places above. The principal elements are:

1) Proponents are required to conduct public consultation during the preparation of both PEIA and DEIA reports.

2) The Minister is empowered to conduct his or her own public consultation to verify or extend the work of a proponent.

3) During review of draft DEIA reports, the Natural Resources Board can conduct public meetings on an activity if the Minister determines that they are warranted under the circumstances.

4) For all prescribed activities, formal EIA documents are made available for public review and comment on demand.

Guidance on public consultation is provided by the Ministry.

EIA documents to which the public has unrestricted access include all Prospectus, terms-of-reference, draft and final PEIA and DEIA reports, and decisions of the Minister regarding EIA Acceptance. Procedures for making these documents available to the public will be determined by the Ministry for approval by the Minister.

It is very unusual that EIA reports need contain market-sensitive information (eg. technological, financial) which a proponent would prefer remain confidential. Unless public knowledge of such information if crucial to project review, the Ministry will comply with requests that such information not appear in EIA documents.

6. Prescribed Activities and Screening Guidelines

6.1 Introduction

The EIA Policy establishes a project review process which, in its initial stage, "screens" projects for assessment. The screening process has two elements:

1) A schedule of activities subject to the Policy ("prescribed activities"). For these activities, a short Prospectus must submitted to the Minister for a determination of the need for an EIA report. Activities which are not prescribed are not subject to the Policy.

2) A review of the Prospectus by the Ministry and a decision as to the need for an EIA report for the proposed activity. This review is based on screening guidelines which take into account the type, size and location of the proposed activity as well as the likelihood of significant environmental impacts.

6.2 Prescribed Activities

New activities, and substantial additions or expansions to existing activities, listed in Table 3 are prescribed under the EIA Policy. Activities are prescribed in terms of type, not size. The need for establishing size thresholds for prescribed activities (eg. reservoirs greater than a certain area or volume, mines exceeding a certain lease area) will be critically reviewed as the EIA Policy is implemented.

In addition, any activities in or likely to affect the following environmentally-sensitive areas are prescribed under the Policy:

- the National Parks Estate
- wetlands, dambos and vleis
- productive agricultural land
- national monuments and important archaeological and cultural sites

Table 3:
Prescribed Activities

Agriculture
- new land development for agricultural production
- subdivision of land
- feedlots

Dams and man-made lakes

Drainage and irrigation
- drainage of wetland or wildlife habitat
- irrigation schemes

Forestry
- conversion of forest land to other use
- conversion of natural woodland to other use within the catchment area of reservoirs used for water supply, irrigation or hydropower generation, or in areas adjacent to national parks

Housing developments

Industry
- chemical plants
- petrochemical plants
- iron and steel smelters and plants
- smelters other than iron and steel
- cement plants
- lime plants
- pulp and paper mills
- agro-industries
- tanneries
- breweries
- industries involving the use, manufacture, handling, storage, transport or disposal of hazardous or toxic materials

Infrastructure
- highways
- new towns or townships
- airports and airport facilities
- industrial sites for medium and heavy industries
- new railway routes and branch lines

Table 3 (Continued):
Prescribed Activities

Mining and Quarrying
- mineral prospecting
- mineral mining
- ore processing and concentrating
- quarrying

Petroleum
- oil and gas exploration and development
- pipelines
- oil and gas separation, processing, handling and storage facilities
- oil refineries

Power generation and transmission
- thermal power stations
- hydropower schemes
- high voltage transmission lines

Tourist, resort and recreational development
- resort facilities and hotels
- marinas
- safari operations

Waste treatment and disposal
- toxic and hazardous waste: incineration plants, recovery plants (off-site), wastewater treatment plants (off-site), landfill facilities, storage facilities (off-site)
- municipal solid waste: incineration, composting and recovery/recycling plants, landfill facilities
- municipal sewage: waste treatment plants, outfalls into aquatic systems, effluent water irrigation schemes

Water supply
- groundwater development for industrial, agricultural or urban water supply
- water withdrawals from rivers or reservoirs
- major pipelines
- major canals
- cross-drainage water transfers

- areas protected under legislation, eg. the Natural Resources Act, the National Monuments Act
- areas containing rare or endangered flora or fauna
- areas containing unique or outstanding scenery

6.3 Screening Guidelines

Once a Prospectus has been received and reviewed by the Ministry, a prescribed activity is exempted from further compliance with the EIA Policy if all of the following conditions are satisfied:

1) The activity will not substantially utilise a natural resource in a way that pre-empts the use, or potential use, of that resource for any other purpose.

2) Potential residual impacts on the environment are likely to be minor, of little significance and easily mitigated.

3) The type of activity, it's environmental impacts and measures for managing them are well-understood in Zimbabwe.

4) Reliable means exist for ensuring that impact management measures can and will be adequately planned and implemented.

5) The activity will not displace significant numbers of people, families or communities.

6) The activity is not located in, and will not affect, any environmentally-sensitive areas such as:
   - the National Parks Estate
   - wetlands, dambos and vleis
   - productive agricultural land
   - national monuments and important archaeological and cultural sites
   - areas protected under legislation, eg. the Natural Resources Act, the National Monuments Act
   - areas containing rare or endangered flora or fauna
   - areas containing unique or outstanding scenery

7) The activity will not cause the emission of any pollutants or create by-products, residual or waste materials which require handling and disposal in a manner that is not regulated by existing authorities.

8) The activity will not cause significant public concern because of potential environmental changes.

9) The activity will not necessitate further development activity which is likely to have a significant impact on the environment.

APPENDIX K INTERVIEW SURVEY

APPENDIX K. INTERVIEW SURVEY

K 1. SAMPLE BETWEEN QUESTIONNAIRE CODE AND ANSWER CODE

The Average Value of Numerical Code

Questionnaire Code

Table K-1 Results of Farm Household Survey (1)

	2101a	2101b	2101c	2101d	2101e	2101f	2102a	2102b	2102c	2102d	2102e	2102f
Average	9.2						8.9					

	2101a	2101b	2101c	2101d	2101e	2101f	2102a	2102b	2102c	2102d	2102e	2102f
Count / 0		0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%
1		9.6%	57.3%	35.0%	29.1%	58.7%		11.0%	79.5%	51.4%	48.6%	63.0%
2		13.5%	11.7%	59.2%	65.0%	14.4%		16.4%	4.1%	44.4%	45.8%	16.4%
3		74.0%	31.1%	1.0%	5.8%	5.8%		69.9%	16.4%	0.0%	5.6%	8.2%
4		1.0%	0.0%	4.9%	0.0%	6.7%		1.4%	0.0%	4.2%	0.0%	8.2%
5		1.0%	0.0%	0.0%	0.0%	8.7%		1.4%	0.0%	0.0%	0.0%	2.7%
6		1.0%	0.0%	0.0%	0.0%	1.9%		0.0%	0.0%	0.0%	0.0%	1.4%
7		0.0%	0.0%	0.0%	0.0%	2.9%		0.0%	0.0%	0.0%	0.0%	0.0%
8		0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%
9		0.0%	0.0%	0.0%	0.0%	1.0%		0.0%	0.0%	0.0%	0.0%	0.0%
Total(0-9)		100.0%	100.0%	100.0%	100.0%	100.0%		100.0%	100.0%	100.0%	100.0%	100.0%

Percentage of Each Answer Code

Table K-1 Results of Farm Household Survey (1)

	2101a	2101b	2101c	2101d	2101e	2101f	2102a	2102b	2102c	2102d	2102e	2102f
Average	9.2						8.9					

	2101a	2101b	2101c	2101d	2101e	2101f	2102a	2102b	2102c	2102d	2102e	2102f
Count / 0		0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%
1		9.6%	57.3%	35.0%	29.1%	58.7%		11.0%	79.5%	51.4%	48.6%	63.0%
2		13.5%	11.7%	59.2%	65.0%	14.4%		16.4%	4.1%	44.4%	45.8%	16.4%
3		74.0%	31.1%	1.0%	5.8%	5.8%		69.9%	16.4%	0.0%	5.6%	8.2%
4		1.0%	0.0%	4.9%	0.0%	6.7%		1.4%	0.0%	4.2%	0.0%	8.2%
5		1.0%	0.0%	0.0%	0.0%	8.7%		1.4%	0.0%	0.0%	0.0%	2.7%
6		1.0%	0.0%	0.0%	0.0%	1.9%		0.0%	0.0%	0.0%	0.0%	1.4%
7		0.0%	0.0%	0.0%	0.0%	2.9%		0.0%	0.0%	0.0%	0.0%	0.0%
8		0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%
9		0.0%	0.0%	0.0%	0.0%	1.0%		0.0%	0.0%	0.0%	0.0%	0.0%
Total(0-9)		100.0%	100.0%	100.0%	100.0%	100.0%		100.0%	100.0%	100.0%	100.0%	100.0%

Table K-2 Results of Farm Household Survey (2)

	2103a	2103b	2103c	2103d	2103e	2103f	2104a	2104b	2104c	2104d	2104e	2104f
Average	8.3						8.8					

	2103a	2103b	2103c	2103d	2103e	2103f	2104a	2104b	2104c	2104d	2104e	2104f
Count / 0		0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%
1		9.2%	91.7%	47.2%	90.7%	96.3%		17.7%	82.3%	80.0%	18.3%	72.6%
2		16.5%	4.6%	47.2%	8.3%	3.7%		35.5%	4.8%	13.3%	46.7%	9.7%
3		71.6%	3.7%	0.9%	0.9%	0.0%		46.8%	12.9%	1.7%	35.0%	12.9%
4		0.9%	0.0%	4.6%	0.0%	0.0%		0.0%	0.0%	3.3%	0.0%	4.8%
5		1.8%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%	1.7%	0.0%	0.0%
6		0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%
7		0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%
8		0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%
9		0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%
Total(0-9)		100.0%	100.0%	100.0%	100.0%	100.0%		100.0%	100.0%	100.0%	100.0%	100.0%

Table K-3 Results of Farm Household Survey (3)

	2105a	2105b	2105c	2105d	2105e	2105f	2106a	2106b	2106c	2106d	2106e	2106f
Average	5.6						11.7					

	2105a	2105b	2105c	2105d	2105e	2105f	2106a	2106b	2106c	2106d	2106e	2106f
Count / 0		0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%
1		0.0%	18.4%	3.4%	23.7%	79.3%		69.2%	60.0%	75.0%	7.7%	92.3%
2		1.7%	12.2%	87.9%	55.9%	15.5%		15.4%	0.0%	12.5%	61.5%	7.7%
3		95.0%	32.7%	1.7%	20.3%	3.4%		15.4%	40.0%	12.5%	30.8%	0.0%
4		3.3%	34.7%	6.9%	0.0%	1.7%		0.0%	0.0%	0.0%	0.0%	0.0%
5		0.0%	2.0%	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%
6		0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%
7		0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%
8		0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%
9		0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%
Total (0-9)		100.0%	100.0%	100.0%	100.0%	100.0%		100.0%	100.0%	100.0%	100.0%	100.0%

Table K-4 Results of Farm Household Survey (4)

	2201	2202	2203	2204a	2204b	2205	2206	2207	2208	2209	2210	2211
Average							14.5	63.4	577.8		104.1	

	2201	2202	2203	2204a	2204b	2205	2206	2207	2208	2209	2210	2211
Count / 0	0.0%	0.0%	17.2%	13.0%	25.0%	0.0%				0.0%		0.0%
1	81.6%	16.7%	81.0%	87.0%	75.0%	8.8%				12.7%		45.5%
2	8.8%	0.0%	1.7%	0.0%	0.0%	54.0%				53.7%		39.9%
3	0.7%	61.1%	0.0%	0.0%	0.0%	37.2%				5.2%		4.9%
4	8.8%	22.2%	0.0%	0.0%	0.0%	0.0%				13.4%		9.8%
5	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%				2.2%		0.0%
6	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%				0.7%		0.0%
7	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%				2.2%		0.0%
8	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%				9.0%		0.0%
9	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%				0.7%		0.0%
Total (0-9)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%				100.0%		100.0%

Table K-5 Results of Farm Household Survey (5)

	2301	2302	2303	2304	2305	2306	2307	2308
Average				15.6				4.8

	2301	2302	2303	2304	2305	2306	2307	2308
Count / 0	0.0%	0.0%	0.0%		21.8%	0.0%	5.2%	
1	99.3%	52.3%	21.8%		78.2%	81.6%	94.8%	
2	0.7%	11.4%	48.9%		0.0%	14.7%	0.0%	
3	0.0%	36.4%	4.5%		0.0%	3.7%	0.0%	
4	0.0%	0.0%	12.8%		0.0%	0.0%	0.0%	
5	0.0%	0.0%	2.3%		0.0%	0.0%	0.0%	
6	0.0%	0.0%	0.8%		0.0%	0.0%	0.0%	
7	0.0%	0.0%	1.5%		0.0%	0.0%	0.0%	
8	0.0%	0.0%	6.8%		0.0%	0.0%	0.0%	
9	0.0%	0.0%	0.8%		0.0%	0.0%	0.0%	
Total (0-9)	100.0%	100.0%	100.0%		100.0%	100.0%	100.0%	

Table K-6 Results of Farm Household Survey (6)

	3101a	3101b	3101c	3101d	3101e	3101f	3102a	3102b	3102c	3102d	3102e	3102f
Average	1444.4	4457.1	0.0	0.0	4457.1		1097.2	935.2	911.0	788.0	1723.2	

	3101a	3101b	3101c	3101d	3101e	3101f	3102a	3102b	3102c	3102d	3102e	3102f
Count / 0						0.0%						0.0%
1						26.9%						0.0%
2						0.0%						0.0%
3						0.0%						0.0%
4						0.0%						0.0%
5						0.0%						0.0%
6						0.0%						0.0%
7						0.0%						0.0%
8						0.0%						0.0%
9						73.1%						100.0%
Total (0-9)						26.9%						0.0%

Table K-7 Results of Farm Household Survey (7)

	3201	3202	3203	3204
Average	178.7			116.9

	3201	3202	3203	3204
Count / 0		60.6%	6.8%	
1		39.4%	86.4%	
2		0.0%	2.3%	
3		0.0%	4.5%	
4		0.0%	0.0%	
5		0.0%	0.0%	
6		0.0%	0.0%	
7		0.0%	0.0%	
8		0.0%	0.0%	
9		0.0%	0.0%	
Total (0-9)		100.0%	100.0%	

Table K-8 Results of Farm Household Survey (8)

	3301	3302	3303	3304	3305	3306	3307	3308	3309	3310	3311	3312
Average	211.6	7.4	14.4	17.3	56.8	15.2	36.5	13.4	30.0	4.5	35.9	19.2

	3301	3302	3303	3304	3305	3306	3307	3308	3309	3310	3311	3312
Count / 0												
1												
2												
3												
4												
5												
6												
7												
8												
9												
Total (0-9)												

Table K-9 Results of Farm Household Survey (9)

	3401a	3401b	3401c	3401d	3402a	3402b	3402c	3402d	3403a	3403b	3403c	3403d
Average												

	3401a	3401b	3401c	3401d	3402a	3402b	3402c	3402d	3403a	3403b	3403c	3403d
Count / 0	0.0%	0.0%	0.0%	0.0%	5.0%	0.0%	0.0%	0.0%	0.0%	2.0%	0.0%	0.0%
1	72.4%	12.9%	5.4%	63.2%	57.5%	8.6%	2.8%	56.3%	43.9%	5.9%	3.6%	52.0%
2	25.0%	18.6%	44.6%	25.0%	32.5%	28.6%	16.7%	25.0%	22.8%	9.8%	5.5%	40.0%
3	1.3%	24.3%	10.8%	11.8%	2.5%	8.6%	16.7%	15.6%	33.3%	19.6%	16.4%	8.0%
4	0.0%	2.9%	39.2%	0.0%	0.0%	0.0%	63.9%	0.0%	0.0%	3.9%	74.5%	0.0%
5	0.0%	1.4%	0.0%	0.0%	0.0%	5.7%	0.0%	0.0%	0.0%	3.9%	0.0%	0.0%
6	0.0%	5.7%	0.0%	0.0%	0.0%	5.7%	0.0%	0.0%	0.0%	3.9%	0.0%	0.0%
7	1.3%	7.1%	0.0%	0.0%	0.0%	20.0%	0.0%	0.0%	0.0%	21.6%	0.0%	0.0%
8	0.0%	25.7%	0.0%	0.0%	0.0%	22.9%	0.0%	0.0%	0.0%	29.4%	0.0%	0.0%
9	0.0%	1.4%	0.0%	0.0%	2.5%	0.0%	0.0%	3.1%	0.0%	0.0%	0.0%	0.0%
Total (0-9)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table K-10 Results of Farm Household Survey (10)

	4101a	4101b	4102a	4102b	4103a	4103b	4104a	4104b	4105a	4105b	4106a	4106b
Average		16.7		18.0		9.8		14.7		10.9		16.5

	4101a	4101b	4102a	4102b	4103a	4103b	4104a	4104b	4105a	4105b	4106a	4106b
Count / 0	44.8%		77.1%		94.3%		65.7%		63.8%		92.4%	
1	41.0%		21.0%		5.7%		31.4%		35.2%		7.6%	
2	12.4%		1.9%		0.0%		2.9%		1.0%		0.0%	
3	1.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
4	1.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
5	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
6	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
7	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
8	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
9	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
Total (0-9)	100.0%		100.0%		100.0%		100.0%		100.0%		100.0%	

Table K-11 Results of Farm Household Survey (11)

	4107a	4107b	4108a	4108b	4109a	4109b	4110a	4110b	4111a	4111b	4112a	4112b
Average		13.0		8.1		12.0		6.5		9.0		0.0

	4107a	4107b	4108a	4108b	4109a	4109b	4110a	4110b	4111a	4111b	4112a	4112b
Count / 0	72.4%		81.0%		98.1%		98.1%		100.0%		100.0%	
1	23.8%		15.2%		1.0%		1.9%		0.0%		0.0%	
2	3.8%		2.9%		1.0%		0.0%		0.0%		0.0%	
3	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
4	0.0%		1.0%		0.0%		0.0%		0.0%		0.0%	
5	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
6	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
7	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
8	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
9	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
Total (0-9)	100.0%		100.0%		100.0%		100.0%		100.0%		100.0%	

Table K-12 Results of Farm Household Survey (12)

	4113a	4113b	4114a	4114b	4115a	4115b	4116a	4116b	4117a	4117b	4118a	4118b
Average		11.0		9.7		9.0		9.0		12.6		0.0

	4113a	4113b	4114a	4114b	4115a	4115b	4116a	4116b	4117a	4117b	4118a	4118b
Count / 0	97.1%		72.4%		100.0%		100.0%		74.3%		100.0%	
1	2.9%		25.7%		0.0%		0.0%		22.9%		0.0%	
2	0.0%		1.9%		0.0%		0.0%		1.9%		0.0%	
3	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
4	0.0%		0.0%		0.0%		0.0%		1.0%		0.0%	
5	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
6	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
7	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
8	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
9	0.0%		0.0%		0.0%		0.0%		0.0%		0.0%	
Total (0-9)	100.0%		100.0%		100.0%		100.0%		100.0%		100.0%	

Table K-13 Results of Farm Household Survey (13)

	4119a	4119b	4120a	4120b	4121a	4121b
Average		8.0		9.4		2.6

	4119a	4119b	4120a	4120b	4121a	4121b
Count / 0	91.3%		37.0%		84.8%	
1	4.3%		58.7%		15.2%	
2	0.0%		0.0%		0.0%	
3	4.3%		0.0%		0.0%	
4	0.0%		4.3%		0.0%	
5	0.0%		0.0%		0.0%	
6	0.0%		0.0%		0.0%	
7	0.0%		0.0%		0.0%	
8	0.0%		0.0%		0.0%	
9	0.0%		0.0%		0.0%	
Total (0-9)	100.0%		100.0%		100.0%	

Table K-14 Results of Farm Household Survey (14)

	4201	4202	4203	4204	4205
Average					

	4201	4202	4203	4204	4205
Count / 0	0.0%	0.0%	0.0%	0.0%	0.0%
1	15.4%	9.4%	0.0%	0.0%	14.3%
2	15.4%	18.9%	27.6%	7.7%	0.0%
3	15.4%	15.1%	20.7%	7.7%	14.3%
4	1.5%	5.7%	6.9%	7.7%	0.0%
5	7.7%	11.3%	17.2%	23.1%	28.6%
6	7.7%	3.8%	3.4%	7.7%	14.3%
7	20.0%	22.6%	13.8%	15.4%	0.0%
8	4.6%	3.8%	6.9%	15.4%	0.0%
9	12.3%	9.4%	3.4%	15.4%	28.6%
Total (0-9)	100.0%	100.0%	100.0%	100.0%	100.0%

Table K-15 Results of Farm Household Survey (15)

	5101a	5101b	5101c	5101d	5101e	5101f	5102a	5102b	5102c	5102d	5102e	5102f
Average	0.1	0.0	1.4	0.0	1.4	0.0	0.5	0.0	8.3	0.0	8.9	0.1

	5101a	5101b	5101c	5101d	5101e	5101f	5102a	5102b	5102c	5102d	5102e	5102f
Count / 0												
1												
2												
3												
4												
5												
6												
7												
8												
9												
Total (0-9)												

Table K-16 Results of Farm Household Survey (16)

	5103a	5103b	5103c	5103d	5103e	5103f	5104a	5104b	5104c	5104d	5104e	5104f
Average	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	5103a	5103b	5103c	5103d	5103e	5103f	5104a	5104b	5104c	5104d	5104e	5104f
Count / 0												
1												
2												
3												
4												
5												
6												
7												
8												
9												
Total (0-9)												