Japan International Cooperation Agency

Ministry of Lands and Agriculture Republic of Zimbabwe

THE FEASIBILITY STUDY ON THE LOWER MUNYATI RIVER BASIN AGRICULTURAL DEVELOPMENT PROJECT IN THE REPUBLIC OF ZIMBABWE

Volume - II

APPENDIXES (1/2)

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November 2000

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Japan International Cooperation Agency (JICA)

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Volume – II - APPENDIXES (1/2) -

NOVEMBER 2000

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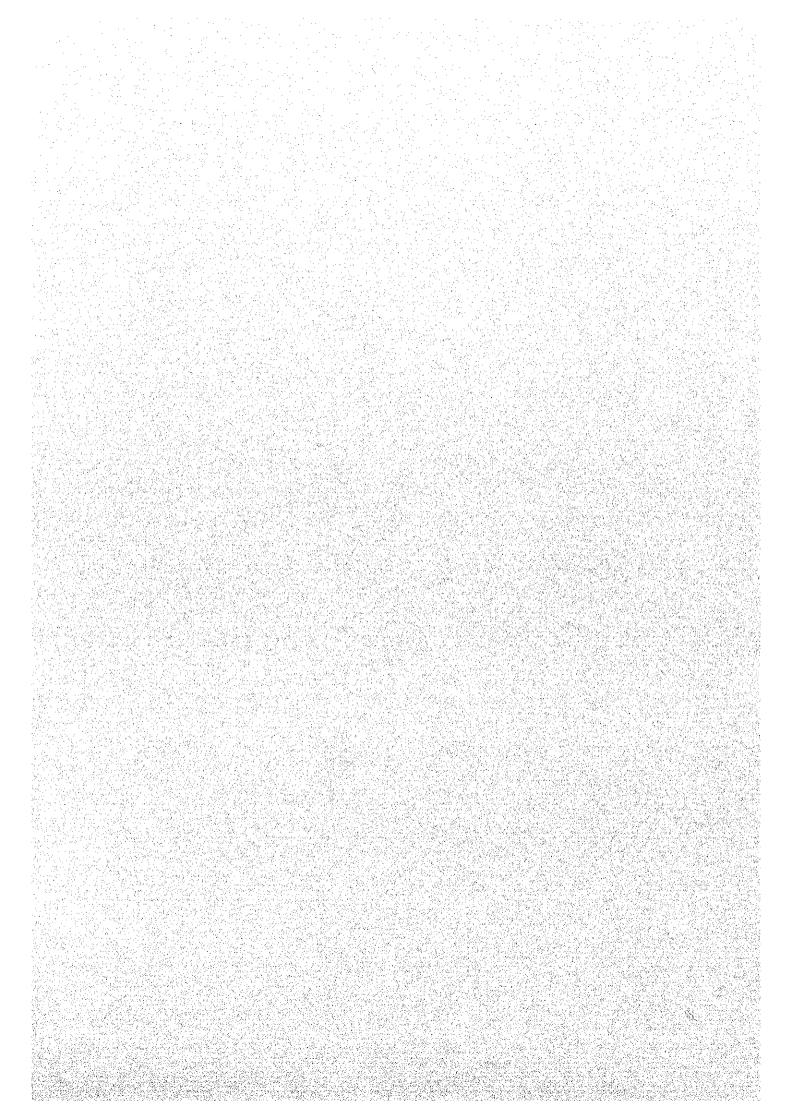
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METEO - HYDROLOGY

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1. Data Collection

Fig.1 shows the location of meteorological and hydrological stations in and around the study area.

1.1 Meteorological Data

Meteorological data were collected from the Meteorological Office in Harare as available for the Meteorological Stations of Kadoma and Gokwe, for the following years:

Meteorological Data

Meteorologic		
Data	Period for Kadoma	Period for Gokwe
1. Daily rainfall	1952 - 97	1964 - 97
2. Monthly and annual maximum temperatures	1951 - 98	1963 - 98
3. Monthly and annual minimum temperatures	1951 - 98	1963 - 98
4. Monthly and annual wind speed	1959 - 98	1963 - 98
5. Monthly and annual cloud amount	1959 - 98	1963 - 98
6. Monthly and annual sunshine hours	1951 - 9 8	1966 - 98
7. Monthly and annual pan evaporation	1962 - 98	1963 - 98
8. Monthly and annual relative humidity	Not available	1983 - 98

1.2 River Runoff Data

There are eleven river runoff gauging stations in and around Munyati river basin, and the daily runoff data of these stations were collected from the data processing section of Department of Water Development (DWD) in Harare. The station number and data available period of respective stations are shown below.

River Runoff Data

Station No.	River	Data Ava	ilab	le Period
C8	Munyati	49/50	-	96/97
С9	KweKwe	68/69	-	93/94
C18	Munyati	62/63	-	96/97
C20	Ngesi	70/71	-	96/97
C30	Munyati	77/78	-	96/97
C36	Sebakwe	55/56	-	96/97
C48	Umsweswe	57/58	-	96/97
C59	Sanyati	61/62	-	96/97
C84	Mupfure	90/91		95/96
C87	Umswewe	76/77	-	96/97
C88	Munyati	76/77	-	94/95

1.3 Water Rights Data

Munyati river basin is divided by seven sub-hydrological zones, and the lists of water rights in sub-hydrological zones are prepared by the Water Right Section of DWD in Harare. The water rights list of Munyati river sub-hydrological zones, namely CUN1 to CUN6 and CUS were collected from DWD.

2. Climate and Rainfall

The mean monthly climate and rainfall records at Kadoma and Gokwe Stations are shown in Table 1 and summarized below.

	Climate	e and Rainfall
Max. Temperature	Kadoma	24.0 °C in July - 32.0 °C in October
	Gokwe	22.6 °C in July – 30.2 °C in October
Min. Temperature	Kadoma	8.5 °C in July - 17.8 °C in December
•	Gokwe	8.9 °C in July – 18.0 °C in November
Relative Humidity	Kadoma	(not available)
•	Gokwe	37.0 % in September - 74.0 % in January
Pan Evaporation	Kadoma	4.5 mm/day in June - 9.0 mm/day in October
•	Gokwe	4.6 mm/day in June - 10.4 mm/day in September
Wind Speed	Kadoma	162.4 km/hr in February - 276.2 km/hr in October
•	Gokwe	158.5 km/hr in January - 229.9 km/hr in October
Sunshine Hour	Kadoma	6.6 hours in December - 10.0 hours in August
	Gokwe	6.8 hours in December - 10.2 hours in August
Rainfall	Kadoma	0.3 mm in July – 184.7 mm in January
	Gokwe	0.2 mm in July – 182.1 mm in January

The mean annual rainfalls are recorded at 735.4 mm at Kadoma Station and 734.9 mm at Gokwe Station. The annual rainfall distribution is uneven showing that about 95% of annual rainfall is concentrated in the summer season from October to March and there is almost no rain in the winter season.

3. River Runoff

Among eleven hydrological gauging stations in and around the Munyati river basin, data of Station C8 at Munyati river, C9 at Kwekwe river, C36 at Sebakwe river and C48 at Umsweswe river are used for water resources development study with the Kudu Dam. Figs.2 to 5 show the availability of river runoff data at these four stations. As shown these figures, some data are intermittent and supplemented by using specific river runoff of the highest correlative station. The mean monthly discharges for the last 30 years are shown in Tables 2 to 5, and summarized below.

Mean Monthly Discharges

				(Unit: m³/sec)
Month	Station C8	Station C9	Station C36	Station C48
	(C.A=5,890km ²)	(C.A=1,250km ²)	$(C.A=4,170km^2)$	(C.A=2,480km ²)
January	31.033	5.630	21.832	11.556
February	47.985	8.606	23.015	17.721
March	25.169	4.010	20.162	7.465
April	6.095	1.055	5.389	1.682
May	0.913	0.123	1.086	0.247
June	0.404	0.167	0.592	0.160
July	0.228	0.087	0.549	0.152
August	0.105	0.026	0.472	0.126
September	0.047	0.043	0.509	0.085
October	0.178	0.047	0.519	0.051
November	2.115	0.152	1.415	0.863
December	21.649	3.181	11.385	6.078
Annual	11.327	1.927	7.244	3.849

Fig.6 shows 10-days average river runoff, and Fig.7 presents the fluctuation of annual river runoff for the last 30 years. The annual river runoff shows wide fluctuation with the inclination to decrease in recent years.

4. Water Rights

There are many water rights in the Munyati river sub-hydrological zones. However, water rights at the upstream of the river runoff gauging stations are already abstracted in the measured river runoffs, and therefore only water rights of the downstream of gauging stations are considered for the water balance study. The annual total amounts of water rights in the downstream of river runoff gauging stations are shown in Tables 6 to 12, and summarized below.

Water Rights

Section	Ref No. in Inflow Model	No. of Water Rights	Annual Total Amount (1,000m³)
Gauging Sta. C9 to KweKwe-Sebakwe CP	Q3	15	1,258.50
Gauging Sta. C36 to KweKwe-Sebakwe CP	Q 7	9	5,901.00
KweKwe-Sebakwe CP to Sebakwe-Munyati CP	Q11	6	3,468.70
Gauging Sta. C8 to Munyati-Sebakwe CP	Q15	15	3,280.05
Munyati-Sebakwe CP to Munyati-Umsweswe CP	Q19	3	34.60
Gauging Sta. C48 to Unsweswe-Munyati CP	Q23	10	2,596.09
Kudu Dam Downstream to Munyati-Mupfure CP	Q26	12	20,858.42

Note: CP - Confluence Point

5. Water Quality

The water quality survey was carried out so as to verify if the available water is suitable for the irrigation and domestic water use during the First Field Work. The following locations were selected and water was sampled at each site

(1) River water sampling locations

- Site 1: Mazoe tributary, near Mari Mari Ranch
- Site 2: Umsweswe river, 1-2 km downstream of Vic
- Site 3: Upper Munyati river, 1 km upstream of Lucky Beanie
- Site 4: Sebakwe river, 5-6 km upstream of confluence with Kwekwe river
- Site 5: Kwekwe river, 1-2 km upstream of confluence with Sebakwe river
- Site 6: Munyati river, causeway/bridge on the Empress Mine road
- Site 7: Ngondoma tributary, 1-2 km downstream of Kudu damsite
- Site 8: Munyati river, just downstream of confluence with the Mtanke river
- Site 9: Munyati river, Renje bridge near Renji Camp
- Site 10: Munyati river, downstream of Copper Queen (Cattle Fence)

- (2) Well water sampling locations
 - Site 1: Kadoma district, Sanyati-K21, BH village 24
 - Site 2: Kadoma district, Sanyati-K22, BH village 9
 - Site 3: Kadoma district, Sanyati-K23, BH village 25
 - Site 4: Kadoma district, Sanyati-K24, BH village 32
 - Site 5: Kadoma district, Muzvezve I-K17, BH village 2
 - Site 6: Gokwe South district, Chisina I-GS 23 Vidco Batanai, BH Marundu
 - Site 7: Gokwe South district, Chisina I-GS 24 Vidco Murumemkuru, BH Nyamatshemi
 - Site 8: Gokwe South district, Chisina II-GS24 Vidco Mhungu, BH St. Cuthberts School
 - Site 9: Gokwe North district, Makore I-GN 11 Vidco Kushinga, BH Makore School
 - Site10: Gokwe North district, Ungwe State Land, Copper Queen Small Scale Commercial Farming Area, BH Ungwe School

20 samples (10 sites x 2 samples/site – December 1998 and February 1999) were collected from the river water sampling sites and 10 samples (10 sites x 1 sample/site) were taken from the existing wells. Water quality analysis was carried out on the following items for these 30 samples by the Government Analyst Laboratory on subcontract basis.

- (a) Physical property Color, Turbidity, Water Temperature, Total Dissolved Solid (TDS), Suspended Solid (SS)
- (b) Chemical property Concentration (pH), Electric Conductivity (EC),
 Dissolved Oxygen (DO), Sodium (Na), Fluorine (F),
 Nitrogen (N), Phosphoric Acid (P), Magnesium (Mg),
 Calcium (Ca), Potassium (K), Mercury (Hg), Lead
 (Pb), Chromium (Cr), Cadmium (Cd), Copper (Cu)
- (c) Microorganism Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), COLIFORM (Plate count)

Laboratory analysis was completed and submitted to the JICA Study Team at the beginning of April 1999. The result of analysis is presented in Table 13 and it showed that Mercury, Lead and Coliforms concentrations were very high for both samples of rivers and the existing wells. The existing wells is being used for drinking by people in the area, and people's health is supposed to be severely affected if water has high concentrations of Mercury and Lead as shown in the result of analysis.

In order to confirm the reliability of the above result, additional analysis on Mercury and Lead was conducted during this Phase II Third Field Work. 10 samples from rivers and 10 samples from the existing wells were taken in January and February 2000 by JICA Study Team, and these samples were sent to Japan for analysis. The result of analysis in Japan showed low concentration of Mercury and Lead as presented in Table 14. All samples are under WHO standard, except for 2 samples from wells which show a little bit higher value of Lead. From this result, it can be said that water of rivers and wells in the area have no problem for domestic water use.

TABLES

Table 1 Mean Monthly Climatological Data

Name of Station: Kadoma

Description	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Average Rainll (mm)	184.7	128.0	86.7	27.7	6.8	1.5	0.3	1.2	8.3	35.0	90.8	164.4	735.4
Air Temperature													
- Max. (°C)	28.6	28.4	28.9	28.1	26.4	24.1	24.0	26.7	30.4	32.0	30.7	29.0	28.1
- Min. (°C)	17.7	17.3	16.3	14.5	11.4	8.8	8.5	10.3	13.8	16.8	17.6	17.8	14.2
Relative Humidity (%)	-	-	_	-	-	-			-	-			-
Pan Evaporation (mm)	5.5	5.2	5.5	5.3	4.9	4.5	4.8	6.3	8.4	9.0	7.6	5.8	6.1
Wind Speed (km/hr)	176.6	162.4	172.0	193.5	194.2	212.5	226.9	246.2	264.9	276.2	244.2	204.0	214.5
Sunshine Hour (hrs)	7.2	7.3	8.3	8.9	9.2	9.2	9.4	10.0	9.9	9.1	7.5	6.6	8.6

Note: Data for relative humidity are not available.

Name of Station: Gokwe

Description	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Average Rainll (mm)	182.1	158.7	76.3	34.4	5.9	1.1	0.2	0.7	3.5	26.3	85.2	160.4	734.8
Air Temperature									ļ				
- Max. (°C)	27.3	27.1	27.6	26.8	25.0	22.8	22.6	25.3	29.0	30.2	29.4	27.6	26.7
- Min. (°C)	17.7	17.4	17.0	15.1	12.0	9.3	8.9	11.4	15.2	17.6	18.0	17.6	14.8
Relative Humidity (%)	74.0	72.1	67.3	59.3	53.4	50.5	48.5	41.4	37.0	41.6	51.7	68.5	55.4
Pan Evaporation (mm)	5.5	5.5	5.8	5.6	5.1	4.6	4.9	6.3	10.4	8.9	7.5	5.7	6.3
Wind Speed (km/hr)	158.5	160.6	171.7	182.5	173.3	177.7	190.6	200.4	223.4	229.9	205.2	173.5	187.3
Sunshine Hour (hrs)	7.1	7.4	8.0	8.9	9.3	9.4	9.6	10.2	10.0	9.4	8.0	6.8	8.7

Table 2 Discharges at C8 Station (Catchment Area = 5,890 km²)

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Table 3 Discharges at C9 Station (Catchment Area = 1,250 km²)

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Table 4 Discharges at C36 Station (Catchment Area = 4,170 km²)

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Table 5 Discharges at C48 Station (Catchment Area = 2,480 km²)

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Table 6 Summary of Water Right (Kwekwe River) <River runoff gauging station C9 to Kwekwe-Sebakwe confluence point>

River Status TOTALIS From To Days (1000m³) (1000m³) (1000m³) Kwekwe FG 45/5/3 0.00284 4/1 9/30 183 30.84 Kwekwe FG 37/11/22 0.00142 10/1 9/30 183 30.84 Kwekwe FG 49/1/10 0.00284 4/1 9/30 183 30.84 Kwekwe FG 49/1/10 0.00284 4/1 9/30 183 10.00 Kwekwe FG 45/5/3 0.0100 4/1 9/30 183 45.46 Kwekwe FG 64/9/21 0.00057 10/1 9/30 365 27.28 8.00 Kwekwe FG 64/9/21 0.00057 10/1 9/30 365 50.01 56.00 Kwekwe FG 64/3/11 0.02841 12/15 3/31 106 50.01 Kwekwe FG 64/3/11 0.02000 12/15 3/31 106
CX/MA/D (m ³ /s) From To Days (1000m ³) (10
FG '45/5/3 0.00284 4/1 9/30 183 FG '37/11/22 0.00142 10/1 9/30 365 FG '40/1/10 0.00284 4/1 9/30 183 PR '43/10/27 0.01000 4/1 9/30 183 FG '45/5/3 81.83 365 81.83 FG '66/1/9 9/30 365 81.83 FG '64/9/21 0.00057 10/1 9/30 365 27.28 FG '64/9/21 0.00057 12/15 3/31 106 50.01 FG '64/9/21 0.00057 12/15 3/31 106 50.01 FG '65/4/20 64/3/11 0.02841 12/15 3/31 106 50.01 FG '65/4/20 0.01400 12/15 3/31 106 70.01 FG '66/1/20 0.01400 12/15 3/31 106 70.01 FG '70/11/18 <td< td=""></td<>
FG 37/11/22 0.00142 10/1 9/30 365 FG 40/1/10 0.00284 4/1 9/30 183 PR 43/10/27 0.01000 4/1 9/30 183 FG 45/5/3 81.83 45.46 FG '66/1/9 365 81.83 FG '64/9/21 0.00057 10/1 9/30 365 81.83 FG '64/9/21 0.00057 12/15 3/31 106 . FG '64/3/11 0.02841 12/15 3/31 106 . FG '64/3/11 0.02000 12/15 3/31
FG 40/1/10 0.00284 4/1 9/30 183 PR 43/10/27 0.01000 4/1 9/30 183 45.46 FG 45/5/3 80/1/9 365 45.46 45.46 FG 66/1/9 365 81.83 81.83 FG 56/8/27 365 27.28 FG 64/9/21 0.00057 10/1 9/30 365 27.28 FG 64/9/21 0.00057 12/15 3/31 106 50.01 FG 65/4/15 0.01400 12/15 3/31 106 50.01 FG 64/3/11 0.02841 12/15 3/31 106 50.01 FG 64/3/11 0.02000 12/15 3/31 106 760.01 FG 70/11/18 0.02000 12/15 3/31 106 760.00
PR 43/10/27 0.01000 4/1 9/30 183 45.46 FG 46/5/3 365 81.83 45.46 FG '66/1/9 365 81.83 27.28 FG '64/9/21 0.00057 10/1 9/30 365 27.28 FG '64/9/21 0.00057 12/15 3/31 106 . FG '65/4/15 3/31 106 . 50.01 FG '65/4/20 12/15 3/31 106 . FG '64/3/11 0.02841 12/15 3/31 106 . FG '64/3/11 0.02000 12/15 3/31 106 . FG '64/3/11 0.02000 12/15 3/31 106 . FG '70/11/18 0.02000 12/15 3/31 106 .
FG '45/5/3 365 45.46 FG '60/1/9 365 81.83 FG '64/9/21 0.00057 10/1 9/30 365 27.28 FG '64/9/21 0.00057 12/15 3/31 106 50.01 FG '65/4/15 365 50.01 50.01 50.01 FG '65/4/20 12/15 3/31 106 50.01 FG '64/3/11 0.02841 12/15 3/31 106 50.01 FG '64/3/11 0.02000 12/15 3/31 106 160.00 FG '64/3/11 0.02000 12/15 3/31 106 160.00
FG '60/1/9 365 81.83 FG '56/8/27 365 27.28 FG '64/9/21 0.00057 10/1 9/30 365 27.28 FG '64/9/21 0.00057 12/15 3/31 106 . FG '65/4/15 365 50.01 . FG '65/4/20 365 50.01 FG '64/3/11 0.02841 12/15 3/31 106 FG '64/3/12 0.01400 12/15 3/31 106 FG '68/7/26 0.01400 12/15 3/31 106 FG '70/11/18 0.02000 12/15 3/31 106
FG '56/8/27 9/30 365 27.28 FG '64/9/21 0.00057 10/1 9/30 365 27.28 FG '64/9/21 0.00057 12/15 3/31 106 50.01 FG '65/4/15 365 50.01 50.01 50.01 50.01 FG '65/4/20 12/15 3/31 106 50.01 10.02 FG '64/3/11 0.02000 12/15 3/31 106 160.00 FG '70/11/18 0.02000 12/15 3/31 106 160.00
FG '64/9/21 0.00057 10/1 9/30 365 FG '64/9/21 0.00057 12/15 3/31 106 50.01 FG '65/4/15 365 50.01 50.01 FG '65/4/31 0.02841 12/15 3/31 106 FG '64/3/11 0.02841 12/15 3/31 106 FG '68/7/26 0.01400 12/15 3/31 106 FG '70/11/18 0.02000 12/15 3/31 106
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Table 7 Summary of Water Right (Sebakwe River) <River runoff gauging station C36 to Kwekwe-Sebakwe confluence point>

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		River	Status	Priority	Abstract	Ē.	Period (M/D))	Store	Abstract Total	Average
Application No.	Property Name	- Tarki		(X/M/D) (m ³ /s)	(m ³ /s)	From	To	Days	(1000m³)	$(1000m^{3})$	(1000m³/day)
		Sebalove Lower	FG	65/1/12	0.02200	4/1	9/30	183		93.00	0.00588
6653	6653 LOI 4A SFIERWOOD	Scholeme I ower	υ <u>υ</u>	51/1/59	0.02131	12/15	3/31	106		92.51	0.01010
6653A	6653A LOT 1 OF LOT4 SHERWOOD BLUCK	Separate Tower	2 5	2/0/22				365	264.00		0.00837
7629	7629 LOT 4 A SHERWOOD BLOCK	Sebakwe Lower	ב	C/6/00				200	10000		0.00431
7700	COSTA CONTROLLO DE OUR	Sebakwe Lower	FG	71/3/15	•			365	130.00		75-00-0
PJ CK	LOI / OF SHEAWOOD DESCRIP	Sehabura Louzer	<u>5</u> 4	76/4/20	0.04000	12/15	3/31	106		180.00	0.01965
11123	1123 LOT 4A SHERWOOD BLOCK	SCOON TOWN	2	0 27 27 0 17	000200	10/15	2/21	106		261.00	0.02850
11451	1451 TOT 1 OF LOT 4 SHERWOOD BLOCK	Sebakwe Lower	PR	7/1/18	0.03800	CT/71	3/31	201		20:102	00000
CCTT	A OF CIPDWOOD BLOCK	Sehakwe Lower	FG	181/4/22	0.07000	12/15	3/31	106		840.00	0.091/2
12153	12133 LUK 4A UF SHERWOOD BLOCK	Coholome I ower	ad	06/9/08				365	4000.00	17.27	0.12739
14450	14450 DELVILLE WOOD ESTATES	SCUARWC LOWCI	17.7	210100	22000	1	080	3,45		17.77	0.00055
M1129	M1129 SEBAKWE MINE DUMPS	Sebakwe Lower	PR	0/8/90	0.00055	10/1	2/50	505		10015	TAY 7000
	TOTA				0.2119				4400.00	1501.05	0.2904/
	IOIAL										

Table 8 Summary of Water Right (Sebakwe River) < Kwekwe-Sebakwe confluence point to Sebakwe-Munyati confluence point>

					-					Abstract	Average
		River	Status	Priority	Abstract	ď.	Period (M/D)	(Store	Total	Demand
Application No.	riopeny ivanie			(Y/M/D)	(m ³ /s)	From	To	Days	(1000m³)	(1000m³) (1000m³/day)
0000	ACCOUNTY AND COLUMNALE	Sebaltwe Lower	FG	48/1/10	0.00139	4/1	06/6	183		25.00	0.00158
8707		Sebalawa I ower	ΕĞ	161/1/30				365	120.00		0.00381
5835	5835 BROWNLANDS OF LINDALE	SCUANNE LUNG	?	20/2/20	097300	12/15	2/21	106		246.70	0.02694
		Cohokura I outer	Ä	CT /7/60.	0.0000	CT /77	10/0	2 6			000000
8636	8636 LINDALE & DELVILLE WOOD	SCORPWC TOWAR)	71/3/29	0.25490	12/15	3/31	106		70.0277	0.272
110	AND A STATE OF THE	Schologo I ower	FG	9/01/69	0.00500	10/1	9/30	365		49.00	0.00155
8781	8781 IMPAKA KANCH	Scholmer Lower	200	717714				365	68.00		0.00216
9440	9440 DEVILLE WOOD & REM LINDALE	Separate Lower	2 5	11,11	0.13000	31/11	2/21	10. AO.		740.00	0.08080
9441	9441 BONSTED	Sebakwe Lower	Ď.	6///1/	0.17000	Ct/71	1.C/C	001	30,7	00000	000000
	TVTAI				0.48789				188.00	3280.70	0.33823
	TUTOT										

Table 9 Summary of Water Right (Munyati River)

										A 1. 24.2.24	Arionomo
		Dinor	Status	Priority	Abstract	ρĹ	Period (M/D)		Store	Aostract Total	Average Demand
Application No.	Property Name	NACI	and a	(X/W/D)	(m ³ /s)	From	To	Days	(1000m³)	(1000m³)	(1000m³/day)
	4 % T. A.	Munvati	FG	142/6/16	0.01152	4/1	6/30	183	572.80	363.68	0.05923
1101	1101 SELIMA	Munyati	F. F.	148/10/22	1	10/1	9/30	365		30.84	0.00098
1919	1919 LURKAINE	Municati	F.F.	149/1/20	1	10/1	9/30	365	159.11	123.35	0.00896
2187A	2187A REM GLOVERS	Manyan	2 2 2 2	158/10/28		10/1	9/30	365		46.26	0.00147
5193	5193 RUNNIMEDE	Muniyati	2 2	160/5/14		10/1	9/30	365		30.84	0.00098
2608	5608 RICHMOND FARM	Munyan		161/10/9				365	95.47		0.00303
5949	5949 KOPPIES	Munyau	2 2	7/07/10				365	454.60		0.01442
7521	7521 UMNIATI RANCH	Munyatı	ř	01/6/00				375	00 000		0.02882
		.,	ָרָ ב	69/1/13				COC	202.00		
2098	8607 REM GLOVERS	Munyati	Ď	71/1/26	0.07100	12/15	3/31	106		308.00	0.03363
	1,5,4 (1,1) of 1,0 (1,1)	Munwati	F	164/9/29	0.00126	10/1	9/30	365		39.80	0.00126
M1080	M1080JANEI MINE	Muniyan	200	01/89	0.00016	10/1	9/30	365		5.00	0.00016
M1166	M1166 RUNNIMEDE	Munyau	2 2	2/7/00	20000	10/1	02/0	398		1.82	900000
M1176	M1176 GLOVERS FOR OLYMPUS CONS	ı	2	00/4/0	20000	10/1	02/0	376		1 82	0.00006
M1177	M1177 GLOVERS FOR OLYMPUS CONSO	Munyati	FG	68/4/8	cooon	10/1	2/20			7	70000
111000	THE WILL OVEDS HABY FOR MID KENT	Munyati	FĞ	70/9/14	0.00006	10/1	9/30	365		1.30	0.0000+
1777WI	OLO VENS FAMILIA CIN MILE	Mumieti	E E	20/4/12	0.00316	10/1	9/30	365		68.19	0.00216
R6	R63 SELIMA	Minister		1000	215000	10,1	07/0	365		68.19	0.00216
R9,	R97 SELIMA	Munyati	ŗ	50/5/5	0.0000	1/01	22/2		2100 07	٦	0.15741
	TOTAL				0.11169				4120.21	1	21/27/

Table 10 Summary of water Right (Munyati River) <a href="Munyati-Sebak

										Abstract	Average
N. C. S.	Proceed Name	River	Status	Priority	Abstract	<u>a.</u>	eriod (M/D))	Store	Total	Demand
Application 180.				(CV/W//D)	(m ³ /s)	From	To	Days	(1000m³)	(1000m³)	(1000m ³ /day)
T TO TO	no an prepare	Munuati	FG	75777	0.00002	4/1	9/30	183		09.0	0.00004
CK217	KUAU KESER VE	574 W.1 y W.1					0000	,,,		49.00	0.00054
71217	ACCOUNT TOD MINE	Munvati	P 8	80/6/20	0.00079	10/1	9/30	300		17.00	+00000
M1347	DULLER WINE		1	1	OF COO	,,,,,	000	376		17.00	0.00054
111252	MARCHE BANDH FOR LINDA	Munyati	7	80///14	0.00079	10/1	00/6	300		7.7.00	
INT TOTAL					0.000				000	27.60	0.00112
	TOTAL				0.00139				3	١	

Table 11 Summary of Water Right (Umsweswe River) -River runoff gauging station C48 to Umsweswe-Munyati confluence point>

				-		۶				Abstract	Average
- N		River	Status	Priority	Abstract	.	reriou (M/D)		Store	Total	Demand
Application No.	Alleberty Manual			(Y/M/D)	(m ³ /s)	From	To	Days	(1000m ³)	(1000m³)	(1000m ³ /day)
				157/6/17		4/1	9/30	183	76.50		0.00484
0,00	ACCOUNTY OF OF VANVEMBA ESTATE DE IImsweswe	Imsweswe	PF	69/11/8			-	365	38.50		0.00122
4839	KEM BENILEI OF NAM JEMBA ESIGIETI	2100	:	90/10/15			- w	365	94.50		0.00300
				158/2/27				365	76.50		0.00243
5021	5021 REM KANYEMBA ESTATE	Umsweswe	Ŧ.	70/3/11			·	365	38.50		0.00122
0027	VO PINOG DO MOR 0022	Ilmsweswe	FG	165/5/11	0.05683	10/1	3/31	182		370.04	0.02353
01/00	SEM OF BENTALLI	1 Imeniocura	TIC.	5411172	0.05683	10/1	3/31	182		370.04	0.02353
6863	0803 KEM OF KAN TEMBA ESTATE	2 Long House	2	71/5/10	0.00425	12/15	3/31	106		18.50	0.00202
9367	9367 LOT 1 BENTLEY KENYEMBA ESTATE	Umsweswe	Ð.	71/5/12	0.00000	4/1	12/14	258	•	2.00	60000.0
	TEATER DEVICES VENTOR DE LE CONTRACTOR	Timeweeve	БG	72/9/6	0.00400	12/15	3/31	106		16.00	0.00175
788	988/ LOI 6 BENIELEI, NENIEMBA ESIAIE	Timomiconio	S	73/7/17	0.1000	12/15	5/31	167		500.00	0.03465
10241	10241 PAMENE & KEM KAILWAI FAKM 6	CHISWESWE		12/1/2/	10000	10/15	5/21	167		550 00	0.03812
10242	10242 LIDFORD AND CORYTON	Omsweswe	בר	11/1/6/	1	14/17	100			103 00	90000
		Y T	Ü	74/11/15	0.04 /00	CT/71	16/6	201		134.00	20000
10796	10796 PTN A&B&REM S/D A KANYEMBA EST	Omsweswe	2	75/9/30				365	23.00		0.00073
3007	PENINTAL BA GETATE	Imeweswe	PR	88/2/29				365	230.00		0.00729
1403	14033 NEW LEWING ESTATE				000250				577 50	2018 50	0.16538
	TOTAL				0.30690				2000	10.0100	2201.2

Table 12 Summary of Water Right (Munyati River) < Kudu Dam to Munyati-Mupfure confluence point>

				<u> </u>					Abstract	Average
	D.i.o.	Cratus	Priority	Abstract	<u>A</u>	Period (M/D))	Store	Total	Demand
Property Name	JAN C	Crata	(X/M/D)	(m ₃ /s)	From	To	Days	$(1000m^3)$	$(1000m^3)$	(1000m³/day)
	New york	בטב	60/1/09	0.00568	10/1	9/30	365		61.67	0.00196
6011 SANYATI RANCH NO 3	Munyan		154/0/16	0.00500	12/15	3/31	106		28.00	0.00306
6554 KUDU RIVER RANCH	Munyati	27	16410177	222	/==		365	455.00		0.01443
	Manager	£	73/9/26				365	445.00		0.01411
	Ivanishan	}	73/9/26		12/15	3/31	106		440.00	0.04804
	Manageri	U	1650.03	0.00300	10/1	9/30	365		50.00	0.00159
6695 KUDU RIVER RANCH	Manage	2 2	1,65/8/2	0.04700	10/1	9/30	365		567.00	0.01798
6894 SANYATI RANCH NO 3	IMINITARI		9/6/59,	0.02200	11/15	3/31	137		130.00	0.01098
6963 REM RHINO RANCH	Munyati	P.	9/6/59,	0,00500	4/1	11/14	228		55.00	0.00279
			45/11/5	0.01500	4/1	12/14	258		442.00	0.01983
	Managati	ב	165/11/5	0.01500	12/15	3/31	106		45.00	0.00491
7125 REM LODES LAK KANCH	marin mari		74/12/23	0.01000	12/15	3/31	106		30.00	0.00328
	Minyati	FG	'67/4/14	0.05660	10/1	06/6	365		616.74	0.01956
	Muning	FG	168/10/16	0.00200	10/1	06/6	365		31.00	0.00098
	Muliyan		80/3/8/2	0.78000	10/1	9/30	365	5270.00	00.0869	0.38844
10578 GOKWE & SANYATI CL	Munyan	21 5	30,6,57	2002			365	5200.00		0.16489
11299 CIRCLE K RANCH & GOKWE CL	Munyati	ָבָּר בַּי	L4/C///	0.00100	10/1	0,40	365		12.00	0.00038
	Munyati	בַּר	+7/ \ /CQ	0.00	T/\\T	22/2		11370 00	9	0.71721
			_					2000		

Result of Water Analysis Undertaken during the Phase I First Fueld Work (1/3) Table 13

					Commales	Somular toltan from Diviers on December 1998	ere on Dece	nher 1998			
Analysis					Samples ta	Con mon Miv	77 10 615	27.72		0 710	C 242 10
Items	Standard	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8		Site 10
STEAT	(1993)	(Mazoe R.)	8	(Upper M.R.)	(Sebakwe R.)	(Kwekwe R.)	(Munyati R.)	(Munyati R.) (Ngondoma R)	(Munyati R.)	(Munyati R.)	(Lower M.R.)
(1 m) (1)	15.0	20.0	15.0	15.0	10.0	7.5	10.0	20.0	15.0	20.0	100.0
Color (100)	0.01	162.2	92.1	148.0	57.7	6.1	90.3	275.0	185.0	202.0	1,605.0
Turbidity (NIU)	0.0	25.1	28.0	25.5	24.5	26.2	27.6	31.7	27.2	26.6	27.6
The (mall)	1 000 0	43.3	57.3	43.3	86.7	290.7	77.2	86.0	55.0	58.5	52.7
SS (mg/l)	2:20047	0.04	0.03	0.06	0.006	0.003	0.03	0.04	0.03	0.04	1.46
Hu Hu	6.5 - 9.5	6.7	7.1	6.9	7.1	7.8	7.7	7.7	7.4	7.4	7.1
DC (mSm·l)	ı	7.4	9.8	7.4	14.3	49.7	13.2	14.7	9.4	10.0	0.6
DO (month)		19.1	11.2	9.0	11.7	12.4	6.7	9.3	9.6	9.4	7.3
No (mg/)	200.0	4.0	10.0	6.0	11.0	35.0	9.0	8.0	6.0	0.9	5.0
F (mg/l)	1.50	0.05	0.06	0.05	0.07	0.18	90'0	0.12	0.05	0.05	0.03
r (mg/l)	50.0	not detected	not detected	not detected	not detected	2.1	not detected	not detected	not detected	not detected	not detected
D (mg/l)		not detected	not detected	not detected	0.1	not detected	not detected	not detected	not detected	not detected	not detected
Mar (mar)		4.5	5.5	6.5	9.0	29.0	8.5	8.5	6.5	7.0	9.0
Co (mall)		0.6	12.3	7.4	17.2	45.0	15.6	22.9	8.6	12.3	15.6
V (max/l)		5.8	6.1	5.5	8.8	7.8	6.5	8.8	6.4	7.0	17.0
In (mg/l)	0.001	0.02	0.09	0.00	0.08	80.0	0.11	0.11	0.10	0.00	0.20
Trg (mg/l)	0.01	0.20	0.25	0.35	0.25	0.12	0.29	0.08	0.33	0.27	0.24
Cr (mg/l)	0.05	not detected	not detected	not detected	not detected	not detected	not detected	0.04	0.04	not detected	0.12
Cd (mg/l)	0.003	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected
Cu (mg/l)	1.00	not detected	90.0	0.04	0.08	0.08	0.16	0.21	0.20	0.22	0.23
BOD (mg/l)	5.0	3.4	2.8	2.9	2.5	2.4	2.6	1.5	2.7	2.5	2.8
COD (mg/l)	30.0	not detected	not detected	not detected	23.7	15.8	19.8	19.8	23.7	ļ	
COLTEODIA (MBN/100ml)	10	920	920	350	140	180	1,600	> 1,800	> 1,800	^	^
COLIFORM (MINISTER)	3	1×10^3	₩.	2 x 10 ³	2×10^2	2 x 10 ¹	2×10^{5}	2 x 104	1×10^2	2×10^2	1×10^4
(VI O) mil											

(Nore) TDS: Total Dissolved Solid, SS: Suspended Solid, EC: Electric Conductivity, DO: Dissolved Oxygen, Na: Sodium, F: Fluorine, N: Nitrogen, P: Phosphoric Acid, Mg: Magnesium, Ca: Calcium, K: Potassium, Hg: Mercury, Pb: Lead, Cr: Chromium, Cd: Cadmium, Cu: Copper, BOD: Biological Oxygen Demand, COD: Chemical Oxygen Demand

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Result of Water Analysis Undertaken during the Phase I First Fueld Work (2/3) Table 13

	CAMER				Samples ta	ken from Riv	Samples taken from Rivers on February 1999	1999 Jary 1999			
Analysis	OHW (7	0.000	Cito 3	Site	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10
Items	Standard	Site 1	2316	Calle	1 210	Company)	No construction of National Poly	Nacadoma P	3	~	(Lower M.R.)
	(1993)	(Mazoe R.)	(Umsweswe R)	(Upper M.K.)	(Sepakwe R.)	(Awekwe A.)	January and January	The Control of the	(2)	_	3.6
Color (TCI)	15.0	2.5	5.0	5.0	2.5	7.5	0.01	22	0.0	0.0	
Turbidity (NTI)	5.0	41.2	75.1	37.7	51.0	68.1	83.4	117.0	58.8	78.7	83.7
Woter Temperarine (%)		25.8	24.9	24.6	23.9	23.2	23.9	26.2	24.3	24.9	24.8
The (mall)	1 000.0	63.8	44.5	53.8	48.6	0.69	46.8	97.1	51.5	42.1	45.0
SS (ma/l)	200047	0.001	0.001	0.001	900.0	0.003	0.00	0.004	0.003	0.002	0.005
nu (1/2m)	65-95	7.5	7.5	7.7	7.5	7.5	7.6	7.9	7.7	7.7	7.4
EC (mSm·l)	2	10.9	7.6	9.2	8.3	11.8	8.0	16.6	8.8	7.2	7.7
DO (ma/l)		17.7	17.4	20.2	18.3	18.9	20.9	20.6	19.5	21.1	20.3
Na (mg/l)	200.0	8.0	7.0	5.0	7.0	11.0	0.9	15.0	7.0	0.9	0.9
F (mg/l)	1.50	0.05	0.02	0.02	not detected	not detected	not detected	0.01	not detected	0.01	not detected
N (mg/l)	50.0	2.5	not detected	4.6	2.4	5.8	0.7	3.4	3.2	not detected	not detected
D (mg/l)		0.01	0.01	0.03	0.10	0.13	0.30	0.40	0.20	1.00	1.20
May (may))		4.5	3.5	7.0	6.0	4.0	4.0	4.5	4.0	3.5	3.5
(1/8/11/8/11)		13.1	8.2	7.4	6.5	13.1	7.4	21.3	0.6	7.4	9.8
Ca (mg/l)		3.9	5.3	4.1	5.0	5.0	4.6	7.3	4.8	5.1	6.5
N (IIIg/1)	0.001	0.12	0.0	0.11	0.10	0.11	0.12	0.07	0.11	0.14	0.07
ng (iiig/1)	0.01	not detected	not detected	0.01	not detected	0.01	0.02	0.03	0.04	0.08	0.04
Cr (mo/l)	0.05	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected
Cd (mg/l)	0.003	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected
Cu (mg/l)	1.00	not detected	not detected	not detected	90.0	0.03	0.03	0.04	0.01	90.0	0.01
ROD (mg/l)	5.0	3.6	2.0	2.6	2.9	3.8	2.8	1.8	2.7	3.0	2.7
COD (mg/l)	30.0	15.8	7.9	11.9	11.9	35.6	35.6	27.7	27.7	11.9	27.7
COLIEOPM (MPN/100ml)	10	> 1,800	920	> 1,800	> 1,800	920	1,600	1,600			
CELL CHANGE CONTRACTOR		3×10^{2}	6			7×10^{3}	2×10^{2}	1×10^{2}	7×10^{2}	2×10^3	1 x 104
,											

(Nore) TDS: Total Dissolved Solid, SS: Suspended Solid, EC: Electric Conductivity, DO: Dissolved Oxygen, Na: Sodium, F: Fluorine, N: Nitrogen, ·P: Phosphoric Acid, Mg: Magnesium, Ca: Calcium, K: Potassium, Hg: Mercury, Pb: Lead, Cr: Chromium, Cd: Cadmium, Cu: Copper, BOD: Biological Oxygen Demand, COD: Chemical Oxygen Demand

AI-16

Table 13 Result of Water Analysis Undertaken during the Phase I First Fueld Work (3/3)

	OTUM				Samples to	Samples taken from Wells on January 1999	ells on Janu	ary 1999			
Anaiysis	OUM	,		0 -4:5	1 0 0 11 13	Cito C	Site A	Site 7	Site 8	Site 9	Site 10
Items	Standard	Site 1	Site 2	Site 3	Sile 4	Siles	o arre	, 247	20.00	Control of the second	Tra School
	(1993)	(Village 24)	(Village 9)	(Village 25)	(Village 32)	(Village 2)	(Marundu)		(St.C.School) (Mak. School) (Ong. School	Mak. School	Ong. School
Color (TCII)	15.0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	0.0	0.0	10.01
Turbidity (NTI)	5.0	5.4	36.4	20.5	55.5	2.2	16.5	0.9	4.7	1.9	570.0
Woter Temperature (%)		28.6	27.4	27.8	27.7	25.1	28.5	26.2	27.5	27.7	26.2
TDC (mall)	1 000 0	501.3		294.3	80.7	445.8	233.4	685.0	869.3	413.6	459.2
SS (ma/l)	200	not detected	0.001	0.001	0.002	0.001	0.002	not detected	not detected	not detected	0.06
Transconding to	65-95	7.2	6.5	7.2	6.3	7.1	7.5	7.6	7.3	7.3	7.0
EC (mSm ⁻¹)		85.7	18.5	50.3	13.8	76.2	39.9	117.1	143.6	7.0.7	78.5
DO (mg/l)		3.0	7.1	3.2	3.9	2.8	2.6	4.1	4.6	5.3	1.3
No (mg/l)	200.0	11.0	8.0	49.0	12.0	52.0	245.0	175.0	62.0	21.0	17.0
174 (111g/1) E (ma/l)	1.50	0.20	0.17	0.71	0.25	0.26	0.28	0.94	0.36	0.22	0.55
N (mg/l)	50.0	7.2	8.2	0.2	9.0	8.7	9.0	1.3	14.5	1.2	0.5
D (mg/l)		not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected
May (mg/l)		74.5	2.5	27.5	5.5	40.5	22.5	21.0	78.0	36.0	40.5
(1/Zini) Am		97.4	29.5	50.7	17.2	100.7	80.2	67.1	125.2	103.9	101.5
Cd (mg/l)		not detected	15.4	0.0	0.6	not detected	2.3	not detected	0.03	11.8	30.5
In (mg/l)	0.001	0.10	0.08	0.10	0.00	0.00	0.10	0.11	0.11	0.11	not detected
Th (mo/l)	0.01	0.5	0.5	9.0	0.4	0.5	0.6	0.5	0.7	0.5	0.5
Cr (mg/l)	0.05	2.9	3.2	3.2	3.5	3.0	2.9	2.4	2.4	2.8	2.1
Cd (mg/l)	0.003	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected
Cu (mg/l)	1.00	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected	not detected
BOD (mo/l)	5.0	1.6	0.04	0.08	not detected	not detected	not detected	0.92	1.8	not detected	0.08
COD (ma/l)	30.0	not detected	7.9	15.8	7.9	4.0	7.9	7.9	15.8	11.9	4.0
COLIEDEM (MEN/100ml)		> 1.800	920	> 1,800	> 1,800	076	1,600	1,600	^		1,600
(CELI/ml)		3 x 10 ²	6			7×10^{3}	2×10^{2}	1×10^2	7×10^2	2×10^3	$1 \times 10^{\circ}$
, , , , , , , , , , , , , , , , , , ,											

(Nore) TDS: Total Dissolved Solid, SS: Suspended Solid, EC: Electric Conductivity, DO: Dissolved Oxygen, Na: Sodium, F: Fluorine, N: Nitrogen, P: Phosphoric Acid, Mg: Magnesium, Ca: Calcium, K: Potassium, Hg: Mercury, Pb: Lead, Cr: Chromium, Cd: Cadmium, Cu: Copper, BOD: Biological Oxygen Demand, COD: Chemical Oxygen Demand

Result of Water Quality Analysis of Mercury and Lead Undertaken during the Phase II Third Field Work Table 14

(Unit: mg/l)

	Anal	Analysis in Zimbabwe(GAL)	babwe(G/	<u> </u>	Analysis in Japan	1 Japan
	Dec. 1998	866	Jan./Feb. 1999	, 1999	Feb. 2000	000
Sampling Locations	Hg	Pb	Hg	Pb	Hg	Pb
(River)	0.05	0.20	0.12	not detected	0.00005	0.0017
Site 1. Mazoe tributary, near Mari Mari Ranch	0.00	0.25	0.00	not detected		0.0026
Site 2. Umsweswe river, 1-2 km downstream of 1 neky Reanie	0.00	0.35	0.11	0.01	0.00004	0.0025
Site 3. Upper Munyatt 11vet, 1 Ann upper confinence with Kwekwe river	0.08	0.25	0.10	not detected	20 00003	0.0035
Sile 4. Sebakwe fiver, 3-9 km upstream of confluence with Sebakwe fiver	0.08	0.12	0.11	0.01	200000	
Site 5. Kwekwe fiver, 1-2 kill upstream of commerce with road	0.11	0.29	0.12	0.02	0.00008	0.0048
Site 6. Munyati river, causeway/oringe on Empires Armedia	0.11	0.08	0.07	0.03	0.00007	0.0082
Site /. Ngondoma tributary, 1-2 and downstream of south-same with Manke river	0.10	0.33	0.11	0.04	0.00003	0.0045
\$	0.00	0.27	0.14	0.08	<0.00003	0.0017
Site 9. Munyati river, Kenji bridge near Kenji Camp	0.20	0.24	0.07	0.04	- under anaysis -	naysis -
Site 10. Munyati river, downstream of Copper Queen					- under anaysis -	naysis -
Site 11. Nyarupakwe Dam Site						
(Well)		1	0.10	0.50	<0.00003	0.0040
Site 1. Sanyati-K21, BH village 24		j	0.08	0.50	<0.00003	0.0072
Site 2. Sanyati-K22, BH village 9			0.10	0.60	<0.00003	0.0116
Site 3. Sanyati-K23, BH village 23	1	1	0.00	0.40		0.0057
Site 4. Sanyall-K.4, BH Villiage 32			0.00	0.50	<0.00003	0.0044
Site 5. Muzvezve I-K.I /, Bri vinage 2			0.10	09.0		0.0021
Site 6. Chisina I-GS 23 VICCO Datallal, Dil Istaliano B. Nyamatshemi			0.11	0.50	<0.00003	0.0014
Site /. Chisima I-GS 24 Video Multulifolitatin, Dirity minerals	1	1	0.11	0.70		0.0029
Site 8. Chisma II-Go 24 Video Milliaga, Dil Oc. Campora School			0.11	0.50	<0.00003	0.0019
Site 9. Makore 1-Civ 11 Video Rushinga, Di Makore Canal Stre 10. Copper Oueen Small Scale Commercial Farming Area, BH Ungwe School			not detected	0.50	<0.00003	0.0496
Office and the Manager Dr. 1 and						

Pb = 0.01 mg/lNote: (1) Hg - Mercury, Pb - Lead
(2) WHO Standard (1993): Hg = 0.001 mg/l, Pb = 0.0
(3) Bold figuers show higher values than WHO Standard.

FIGURES



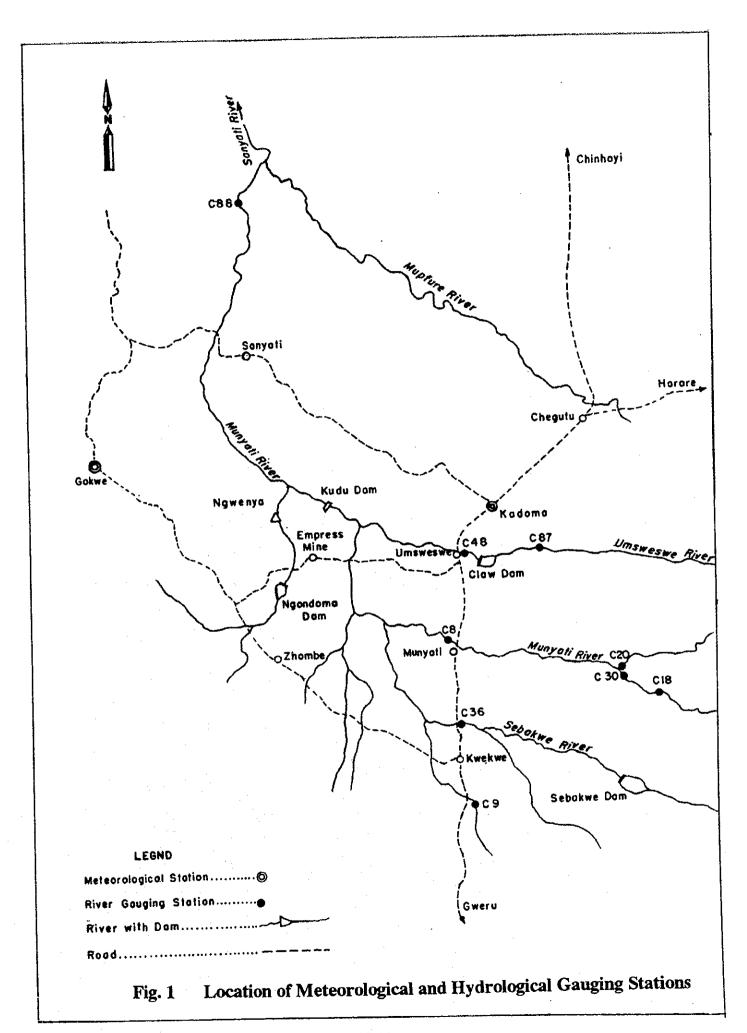


Fig. 2 Availability of River Runoff Data (Gauging Station C8)

C8	Oct	Nov	Dec 1 2 3	Jan 1 2 3	Feb 1 2 3	Mar 1 2 3	Apr	May 1 2 3	Jun 1 2 3	Jul 1 2 3	Aug 1 2 3	Sep 1 2 3
1966 to 1967	1 2 3	123 WWW	1 2 3 WWW	1 2 3 XXXXX	01686	01010	016818		38/88/8			33(3)(6)
1967 to 1968	17.10.4	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1
1968 to 1969	191919	10 3 .683.63	1918189	(S)(S)(S)	(0)(0)(0)	Ø1010	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1
1969 to 1970	91919		391315	33/33/8	88888	6 3 646	68686	<i>33333</i>	3888A	6	<i>8</i> 88888	38888
1970 to 1971	<i>3</i> 3333	<i>9</i>	<i>9</i>	Ø13333	Ø X	9888	Ø\$Ø\$\$	98989	98888	<i>3</i> 888	3833	3330
1971 to 1972	<i>3</i> 4046	3 \$\$\$\$\$	<i>3</i> 8389	<i>999</i>		98989	88880 8	33333	\$\$\$\$\$\$	98888	Ø888	<i>9</i>
1972 to 1973	<i>3</i>	<i>6</i> 8888	9999	98989	<i>99999</i>	(9)(9)(9)	Ø\$Ø\$\$	<i>\$</i> \$\$\$\$\$\$	<i>3</i> 8888	<i>\$</i> \$\$\$\$\$	8 9 888	<i>#</i>
1973 to 1974	111	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1
1974 to 1975	33,331,33	<i>9</i> 3889	91919	<i>\$</i>	Ø1010	934933	(S)(S)(S)	(SKOLO	91919	9¥9¥9	SX 9330	89 X9 X9
1975 to 1976	31918	91919	31010	<u> </u>	XXXX	53X 94 92	2010010	13X9X9	<i>\$</i> \$\$\$\$\$\$	ØX9X9	91919	3913838
1976 to 1977	778777	121010	91999	999999	98989	91919	98989	K9X9X9	398 9832	(393293)	<i>*************************************</i>	2989892
1977 to 1978		1 1 1	1 1 1		1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1
1978 to 1979		1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1111		1 1 1 1 180078
1979 to 1980		193834892 18383888		0232452 083687	XXXXXXX XXXXXX	VEXESTO	15100122 1510016	YNNNY YNNXA	15115155 15115155	73.87.822 7.687.687.68	XXXXXX XXXXXX	2424 1888
1980 to 1981 1981 to 1982	778747	19109 <u>09</u> 130800	151851X51 15886X6	2182182 2587586	XXXXXX XXXXXXX	1288282 1688688	098982 168687	XXXXXXX XXXXXXXX	(22)22422 (8)(3)(3)	18X8X6	18818X	18848XX
1981 to 1982		VAXAYA	VAXXXX VAXXXX	VIXXXX	VSVVXX	171.5322 1614816	101110	424212 468/888	(3/6)3	(20.72.7 (0)(0)(8	122722 13310335	138616
1982 to 1984	777777	1245115 1616116			estata	151616	1212A2	101010	101010	(8)(8)(8)	1881818	(0)(0)(0)
1984 to 1985	22027	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1
1985 to 1986			1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1
1986 to 1987		1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1
1987 to 1988	3 2 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1111	1 1 1	1 1 1	111	1 1 1
1988 to 1989		1000	Ø1886	Ø1616	11	38	1888	19191				8898
1989 to 1990	K-7-4-7-1			88888	1888				988	(0X8XI)	198989	191919
1990 to 1991		1010 10	19888	MAN		101010	\$910X	\$ 9¥ 9¥ 9	<i>\$</i>			\$\$\$\$\$\$\$
1991 to 1992			1889		XXXX				1888	10000	19388	10000
1992 to 1993		KOKKK	KOKOK	FOLON	KOLOK	19198	19190	X 91 913	181818	XXXXX	XXXXX	188989
1993 to 1994	7.12.22	ROYOU	18181		481818	KOKOK	HORAL	1100000	121818	101000	¥9¥9¥9	1919 <u>19</u>
1994 to 1995		HONO I	191919	THE STATE OF	NO TO THE	40100	Kakak	XXXXX	#8#8#8	KOKOKS	XXXXX	15989899 Tarranz
1995 to 1996		NOTES P	XXXXX	HANAN	1191913 1	10888	1988			1 2012313	XXXX	393939
1996 to 1997		Wininal Vicininal	NONESK	KOKOK	3494333		<u> </u>	1] 1] 1] ne of Da	1 1 1 1	<u>[[1]1[]</u>		11118

Original Data (C8)

Some of Data are Estimated from 2nd Priority Station (C30)

Some of Data are Estimated from 1st Priority Station (C18)

Fig. 3 Availability of River Runoff Data (Gauging Station C9)

C9	Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Scp
	1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3
1966 to 1967	
1967 to 1968	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
1968 to 1969	THE STATE OF THE S
1969 to 1970	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1970 to 1971	MONORAN CHARLES AND
1971 to 1972	
1972 to 1973	
1973 to 1974	MOTO MOTO MATERIAL STATE OF THE
1974 to 1975	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1975 to 1976	$5 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ $
1976 to 1977	7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1977 to 1978	3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
1978 to 1979	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
1979 to 1980	
1980 to 1981	
1981 to 1982	
1982 to 1983	3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1983 to 1984	4 949 949 949 949 949 949 949 949 949 9
1984 to 1985	5 0000000000000000000000000000000000000
1985 to 1986	6 34 34 34 34 34 34 34 34 34 34 34 34 34
1986 to 1987	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
1987 to 198	8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1988 to 1989	9 19 19 19 19 19 19 19 19 19 19 19 19 19
1989 to 199	
1990 to 199	
1991 to 199	
1992 to 199	
1993 to 199	
1994 to 199	
1995 to 199	06 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1996 to 199	
	Original Data (C9) Some of Data are Estimated from 2nd

Original Data (C9)

Some of Data are Estimated from 2nd Priority Station (C18)

Some of Data are Estimated from 1st Priority Station (C8)

Fig. 4 Availability of River Runoff Data (Gauging Station C36)

C36	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
C30	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3		123	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
1966 to 1967		<i>19</i>	<i>9</i>		<i>9</i>		93 <u>4</u> 9388	988989	<i>538333</i> 5	98989	<i>\$\$</i> \$\$\$\$\$	33139132
1967 to 1968	<i>3</i> 4944	3 1918	<i>888</i> 888		888	<i>9</i>	<i>3</i> 3333	<i>33.99.99</i>	13XXX	9 8889	93939	20102003
1968 to 1969	199999	(9)(8)(9)	<i>\$</i> \$\$\$\$\$\$	Ø888	<i>\$</i> \$\$\$\$\$	9888	33333	98989	38383	38	<i>9</i> 8999	
1969 to 1970	MAN	68686	<i>*************************************</i>	88888	3833	3888	99399	<i>888</i>	33333 3	<i>3</i> 3333	9853	
1970 to 1971	W 33	686	(0)(0)(0)	8888	Ø10100		<i>688888</i>	98982	<i>8</i> 88888	8888	888	
1971 to 1972	31313	888	68686	8868		(3)(3)(3)	333333	<i>8888</i>	88889	0000	<i>8</i> 888	
1972 to 1973	131313	0000	00000	(8) (8) (8) (8) (8) (8) (8) (8) (8) (8)	3	(9)(9)(9)	3800	3333	<i>(3)</i>	3830	<i>888</i>	
1973 to 1974	3836	33(3)(3)	(S)(S)(S)	W 510	3500	<i>33</i> (3)(0)	33.9 19	1988	100000	00000	(2) 89 (S)	101010
1974 to 1975	10160169	(0)(0)(0)	(0)(0)(0)	0000	(S) (S) (S)	98939	W 1000	\$\$ \$\$ \$\$	9898	9899	8888	
1975 to 1976	31310	(9)(9)(9)	W ST	3555	888	333	33399	8888	8888 9	9889	Ø888	
1976 to 1977	101616	(0)(0)(0)	101033	(SEE)	Ø1959	191919	191919	(3)(3)(2)	68K8K	8888	3808	
1977 to 1978	SHOW	101010	191919	01010	8888	101001 00	888	<i>\$66.60</i>	1333	100000	Ø888	
1978 to 1979	100000	101010	101010	WW.	91010	101101	388				<i>8888</i>	
1979 to 1980	38		KW 91	1888			3333	<i>*************************************</i>	XXX	988	(8)(S)(100000
1980 to 1981	888	101016	KAKAKA A	1000	100000	1 1000	33		KAKAKA KA	XXXXX		
1981 to 1982	2 3 3 3 3		1886			1888	1999	<i>100000</i>		9888	(0)(0)(0)	
1982 to 1983	3 100000		10000	0000	9888		300			39898	89899	191919
1983 to 1984	1 39 30 3	XXXXI	ASSESSED A	XXXXX		19191	<i>8888</i>	100000	1989	1000	101031	101010
1984 to 1985	5 2000	100000					1919	1919	NAME OF	88888 8		
1985 to 198	6 3 9 9	38836	1888	33330	****	100000				10000		
1986 to 198	7 19 19 19		10101	10000	300000	10100	33888			38888		36366
1987 to 198	8 3 6 6	NO STATE	XXX	3888	******	3888				30000		
1988 to 198	9	40000		3000		3000	3838		3			
1989 to 199			NO STATE	3338Y	3888	3888	989899			9 25 350		9191919
1990 to 199	1	919191	999	1 1 1	1 10 139			30000	88 88 E			9
1991 to 199						00000	3 55 55			91999		9493939
1992 to 199	3		900	999	1 11 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1 1
1993 to 199	4 33 3	000	989	988		6 8 8 8 P	0 8888			9 9 9 9	giggigi	1 1 1 1
1994 to 199	5 15 15 1	9 9 9	999	999	1 1198	999	Ø 111	1 1 1	1 1 1	1 1 1	1 1 1	<i>9</i> 8889
1995 to 199	6 9 9	61 SK 61	000	6 33 33		6888			9688	3	94949	99.933
1996 to 199	7	919191	999	MANA	oloros	888	1 1 2		888			588
	<i>P27</i> 1	Origina	l Data (C36)		1	So	me of D	ata are	Estimat	ed from	2nd

Original Data (C36)

Some of Data are Estimated from 2nd Priority Station (C18)

Some of Data are Estimated from 1st Priority Station (C8)

Fig. 5 Availability of River Runoff Data (Gauging Station C48)

C48	Oct	Nov	Dec	Jan	Feb	Mar	Apr 1 2 3	May 1 2 3	Jun 123	Jul 1 2 3	Aug	Sep 1 2 3
1966 to 1967	T		1 2 3 20100133	1 2 3	<u> </u>		 Ø1Ø1Ø	 Ø\$Ø\$Ø	98989 98	9 1 919		8888
1967 to 1968		31315	61/01/8	59 5 9159	8¥9¥9	(N) (N) (N)	88/88/9	355350	133 33	01000	Ø1993	
1968 to 1969		(0)(0)(3)	01010	(0)(0)(6)	\$\$\$\$\$\$	(\$\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	68 69 69	(3)(8)(8)	3888	300		
1969 to 1970	01010	(\$16)(5)	(3)(3)(8)	(M) (M) (M)	88 SS 88	8 3 888	8	<i>\$</i> \$\$\$\$\$	331313	(S)(S)(S)	<i>(</i>	
1970 to 1971	63 (8)(9)	(8) (8) (9)	9X8X9	0100	Ø 89 89		999	98989	38080	3 4346	<i>3</i> 3333	
1971 to 1972	SKOKO	84949	64646	333 3	8989	33535	8888 B		188889	Ø18169	<i>8</i> 8888	
1972 to 1973	1988	8888	98889	Ø1016	ØØ8	98989	<i>6</i> 1000	98 (S) (S)	81010	98989	3868	
1973 to 1974	2 2 2	222	2 2 2	2 2 2	222	2 2 2	222	2 2 2	2 2 2	2 2 2	2 2 2	222
1974 to 1975	2 2 2	222	2 2 2	222	222	2 2 2	222	2 2 2	2 2 2	2 2 2	2/2/2	2 2 2
1975 to 1976	3100	888	88989	886	8X8X8	<i>33</i> 380	6868	<i>9</i> 8889	<i>(9)</i>	9999	91919	
1976 to 1977	98	1989	Ø8889	0000	<i>\$</i> \$\$\$\$\$	<i>(</i> 94949)	3100	<i>(9)(9)(9)</i>	98989	999	8888	181616
1977 to 1978	35000	3830	8888	8888	8888	(M)	9889	<i>\$3</i> \$\$\$		(9) (9) (9)	100000	1010100
1978 to 1979	1989	00000	(0)(0)(s)	00000	<i>100</i>	91010	98089	91999	1 1	1 1 1	1 1 1	1 1 1
1979 to 1980	3333	39	9898	88910	88989		9889	1 1 1	1 1	10000	(0)(0)(0)	191919
1980 to 1981	2000	988	198889	(M)(M)	<i>(</i>		33,000	1	1 1 1	1 1 1	XXXXX	101010
1981 to 1982	39		SK9	3333			<i>888</i>		VOXXX	98889	(0)(0)()	101010
1982 to 1983	35	(9)(9)(9)	1988		<i>5</i> 33333		191919	191010	XXXXX	191910	XXXX	XXXXX
1983 to 1984	222	2888			<i>8</i> 8888	XXXX	10000		101010	100000	12188	121212
1984 to 1985	5 1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1
1985 to 1986						TO SE		121,910	101013	XXXXXX	¥9¥9¥	NOVYXX
1986 to 1987	7 19899		K 00000	9000		HOLOK	X9X9X	SOLON	ASKON	90000	100000	X9X9X92
1987 to 1988	8		ASKON	XXXXX	100000	XXXXX	XXXXX	10101	11212	3434348	XXXXX	g 1 19989
1988 to 1989	9 33 33 9	WAXW.	NOXXX	X 92 85 85	KOLOK	galak	raiois	<i>\$9</i> 8988	31,931,931,3	31,931,933 22,232		XXXXXXX
1989 to 199			48890	33353	XXXXX		33333	10101			XXXXX	35355555 35355555
1990 to 199	1 20000					491.013	*****	3535515	35959X3	28898		XXXXXX
1991 to 199	2 989	3333	35 35 S	35353	HOROR	40808	200000	10101		4XXXXXX		34922XX
1992 to 199	3	XXXX	¥9855	3436838	XXXXX	S SHEET	3434544	XXXX	3131311 3131311	2434933		2008/98/92 2008/98/92
1993 to 199	4 3330		33131	XXX	ANN A	XXXXXX	200000	42181	3222		XXXXX	24.2000.00 FAX.2002.00
1994 to 199		949898	340100	9/9/9/	KAKAK	ANNER	343434	NOVOX	219999	9189898 2012 - 1212 - 1212 - 1212 - 1212 - 1212 - 1212 - 1212 - 1212 - 1212 - 1212 - 1212 - 1212 - 1212 - 1212 - 1212	77775X	2000 200 200 2
1995 to 199	7		XXXX	288891	akakaki	#2X2X	3438888	343438 343439	21201231	489888	######	\$\$\$\$\$\$\$\$ #********
1996 to 199			okokok	9494949	3 1 1 1	389838	366 Sor	<u> </u>	212352	Estimate	<u> </u>	<u> </u>

Original Data (C48)

Some of Data are Estimated from 2nd Priority Station (C18)

Some of Data are Estimated from 1st Priority Station (C87)

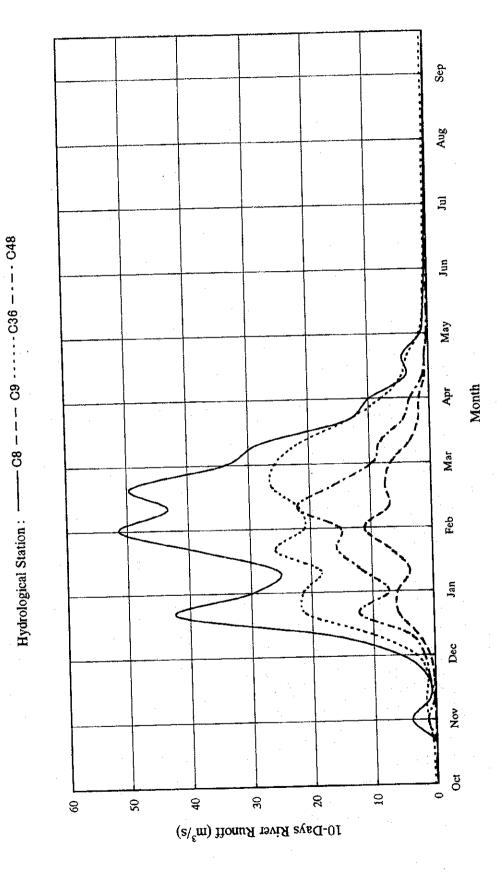


Fig. 6 10-Days Average River Runoff

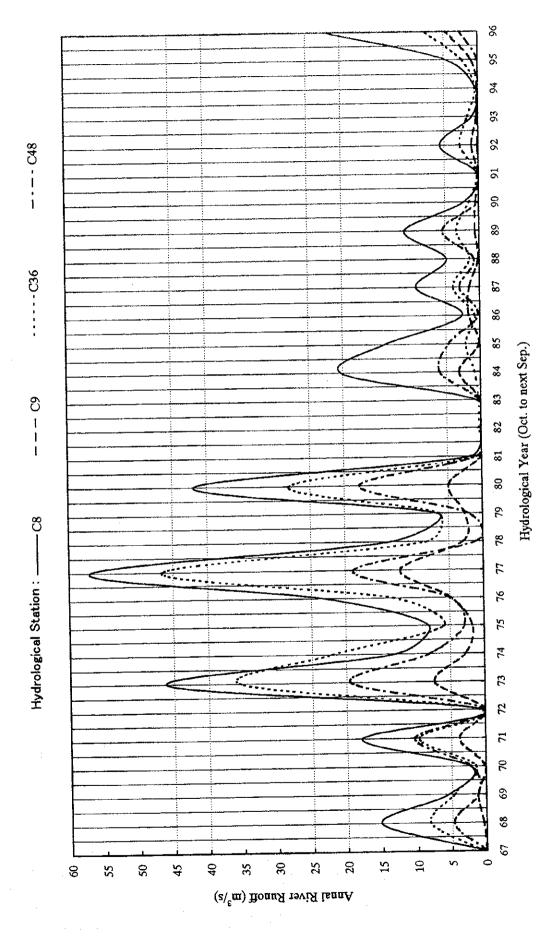


Fig. 7 Fluctuation of Annual River Runoff (Last 30 Years)