APP. III-3
RECORD OF WATER LEVEL IN DRILLHOSES

FORMAT-1: RECORD OF WATER LEVEL IN DRILLHOLE DURING DRILLING
(DATA SHEET)

KIKULETWA DAM PROJECT HOLE No. K-1 (SHEET OF)

LOCATION No.1 POWER STATION
ELEAVTION 828,724 m
COORDINATE
ANGLE FROM HORIZONTAL -90°
BEARING OF ANGLE HOLE
EQUIPMENT FOR WATER LEVEL MEASUREMENT DIPMETER(ELECTRICAL)

DEPTH OF HOLE 25.00 m
DIAMETER OF HOLE 101/86 mm

COMMENCED 1-3-1988
COMPLETED 7-3-1988

MEASURED BY J. DIMBU

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASURMENT	DEPTH OF WATER LEVEL (*-1)	ELAPSED TIME (*-2)	CEMENTING CASING	REMARKS
2-3	14:00	-5.30	-2.40		-0.60	BEFORE WATER TEST
,,	18:00	-5.30	-2.10		-0.60	AFTER WORK
3-3	8:00	-5.30	-2.40		-0.60	BEFORE DRILLING
,,	13:00	-6.80	-3.00		-3.20	BREAK
,,	18:00	-8.20	-6.00		-7.30	AFTER DRILLING
4-3	7:00	-8.20	-6.75		-7.30	BEFORE DRILLING
,,	9:30	-10.00	-9.60		-7.30	BEFORE TEST WATER LOSS AT9.80
,,	12:35	-10.00	-9.60		-7.30	AFTER WATER TEST
,,	13:00	-11.10	-10.00		-7.30	BREAK
,,	18:00	-15.00	-10.00		-7.30	AFTER DRILLING
5-3	7:45	-15.00	-10.15		-7.30	BEFORE DRILLING
,,	12:00	-15.00	-9.65		-	AFTER CASHING REMOVED
,,	18:25	-18.00	-9.18		-9.45	AFTER DRILLING
6-3	8:00	-18.00	-9.70		-9.45	BEFORE DRILLING
,,	13:40	-20.20	-11.20		-17.50	BREAK
,,	19:25	-25.32	-8.30		-17.50	AFTER DRILLING
7-3	9:45	-25.32	-10.80		-17.50	BEFORE WATER TEST
,,	18:30	-25.32	-10.70		-17.50	AFTER TEST
8-3	7:45	-25.32	-10.75		-17.50	

(*-1) Mark "None" when water level exists under the bottom of hole.
(*-2) Elapsed time from shutting off of drilling water

FORMAT-1: RECORD OF WATER LEVEL IN DRILLHOLE DURING DRILLING
(DATA SHEET)

KIKULETWA DAM PROJECT HOLE No. KD-1 SHEET OF 1

LOCATION RIGHT BANK
ELEAVTION 822,386 m
COORDINATE
ANGLE FROM HORIZONTAL -90°
BEARING OF ANGLE HOLE
EQUIPMENT FOR WATER LEVEL MEASUREMENT DIPMETER(ELECTRICAL)

DEPTH OF HOLE 20.00 m
DIAMETER OF HOLE 101/86/76 mm

COMMENCED 9-3-1988
COMPLETED 13-3-1988

MEASURED BY J.DIMBU

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASURMENT	DEPTH OF WATER LEVEL (*-1)	ELAPSED TIME (*-2)	CEMENTING CASING	REMARKS
9-3	18:00	-5.00	-4.00	4hr	-1.50	AFTER DRILLING
10-3	7:45	-5.00	-4.00		-1.50	BEFORE WORK
,,	12:00	-5.00	-4.00		-1.50	AFTER WATER TEST
,,	19:30	-10.00	-5.20	15min	-5.20	AFTER DRILLING
11-3	7:45	-10.00	NONE	12hr15min	-5.20	BEFORE DRILLING
,,	13:00	-12.25	-9.00	30min	-5.20	BREAK
,,	14:00	12.25	-9.20	1hr30min	-5.20	AFTER BREAK
,,	17:45	-14.00	-7.60	30min	-5.20	AFTER DRILLING
12-3	7:45	-14.00	-9.20	14hr30min	-5.20	BEFORE DRILLING
,,	12:00	-15.00	-8.85		-5.20	BEFORE TEST
,,	13:00	-15.00	-8.80		-5.20	AFTER TEST
,,	18:00	-20.00	-8.80		-5.20	AFTER DRILLING
13-3	7:45	-20.00	-9.60		-5.20	BEFORE WORK
,,	10:30	-20.00	-9.60		-5.20	AFTER TEST

(*-1) Mark "None" when water level exists under the bottom of hole
(*-2) Elapsed time from shutting off of drilling water

(DATA SHEET)

PROJECT KIKULETWA TA'HOLE No KD-2 SHEET OF

LOCATION LEFT BANK
ELEAVTION 812.406m
COORDINATE
ANGLE FROM HORIZONTAL -90°
BEARING OF ANGLE HOLE
EQUIPMENT FOR WATER LEVEL MEASUREMENT DIPMETER (ELECTRICAL)

DEPTH OF HOLE 15.00 m
DIAMETER OF HOLE 101/86 mm

COMMENCED 16-2-1988
COMPLETED 21/2/1988

MEASURED BY H. WAMEYO

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASURMENT	DEPTH OF WATER LEVEL (*-1)	ELAPSED TIME (*-2)	CEMENTING CASING	REMARKS
16-2	13:00	G.L. m	G.L. m	-	NIL m	
"	18:00	-1.75	G.L.	15min	NIL	AFTER WORK
17-2	7:30	-1.75	G.L	13 hr 45min	NIL	BEFORE STARTING
"	12:15	-5.00	G.L	15min	NIL	BEFORE WATER TEST
"	12:45	-5.00	G.L		NIL	AFTER WATER TEST
"	18.00	-5.00	G.L		NIL	AFTER WORK
18-2	7:30	-5.00	G.L		NIL	BEFORE STARTING
"	10.40	-5.00	G.L		NIL	
"	16:45	-5.00	G.L		NIL	
"	18:30	-8.00	G.L		NIL	AFTER WORK
19-2	7:00	-8.00	G.L		NIL	BEFORE STARTING
"	18:00	-12.50	G.L.	6hr 00 min	-7.00	AFTER WORK
20-2	7:00	-12:50	G.L	19hr 00 min	- 7:00	BEFORE STARTING
"	9:00	-12.50	G.L		- 7:00	AFTER WATER TEST
"	11:00	-12.50	G.L		-10:00	AFTER WATER TEST
"	13.30	-15:00	G.L	30 min	-12.50	BEFORE WATER TEST
"	16:30	-15:00	G.L		- 12.50	AFTER WATER TEST
21-2	8:00	-15 :00	G.L		-0.50	

(*-1) Mark "None" when water level exists under the bottom of hole
(*-2) Elapsed time from shutting off of drilling water

(DATA SHEET)

PROJECT KIKULETWA DAM HOLE No KD-3 SHEET OF

LOCATION LEFT BANK DEPTH OF HOLE 20.00 m COMMENCED 21-2-1988

ELEAVTION 817.454 M DIAMETER OF HOLE 101/86 mm COMPLETED 25-2-1988

COORDINATE

ANGLE FROM HORIZONTAL -90°

BEARING OF ANGLE HOLE —

MEASURED BY H. WAHEYO

EQUIPMENT FOR WATER LEVEL MEASUREMENT DIPMETER (ELECTRICAL)

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASURMENT	DEPTH OF WATER LEVEL (*-1)	ELAPSED TIME (*-2)	CEMENTING CASING	REMARKS
		M			M	
21-2	7:00	G.L	NIL	-	NIL	START OF BORING
"	15:00	-5.00	8-3.40	15Min.	NIL	BEFORE WATER TEST
"	16:15	-5.00	-3.00		NIL	AFTER WATER TEST
"	18:00	-8.00	-2.15	15 Min.	NIL	EVENING AT CLOSING
22-2	7:00	-8.00	-4.30	13hr 15Min	NIL	MORNING BEFOR STARTING
"	9:45	-10.00	-2.90	15 Min.	NIL	BEFORE WATER TEST
"	11:15	-10.00	-3.70		NIL	AFTER WATER TEST
"	18:00	-15.00	-4.30	2 hr00Min	-14.00	EVENING AT CLOSING
23-2	7:00	-15.00	-5.00	15 hr00Min	-14.00	MORNING BEFORE STARTIN
"	15:00	-20.00	-4.20	15 Min.	-17.60	BEFORE WATER TEST
"	18:00	-20.00	-4.30		-17.60	ATER WATER TEST
25-2.	7:30	-20.00	-4.45		-0.20	

(*-1) Mark "None" when water level exists under the bottom of hole

(*-2) Elapsed time from shutting off of drilling water

FORMAT-1: RECORD OF WATER LEVEL IN DRILLHOLE DURING DRILLING
(DATA SHEET)

PROJECT KIKULETWA DAM HOLE No D.H.1 SHEET OF 1

LOCATION HEAD RACE CANAL
ELEAVTION 825.888 M
COORDINATE
ANGLE FROM HORIZONTAL -90°
BEARING OF ANGLE HOLE --
EQUIPMENT FOR WATER LEVEL MEASUREMENT DIPMETER (electrical)

DEPTH OF HOLE 20.00 m
DIAMETER OF HOLE 101/86 mm

COMMENCED 24-2-1988
COMPLETED 28-2-1988

MEASURED BY H. WAMEYO

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASURMENT	DEPTH OF WATER LEVEL (*-1)	ELAPSED TIME (*-2)	CEMENTING CASING	REMARKS
25-2	7:00	-0.20	NONE		NIL	BEFORE DRILLING
"	13:30	-5.10	-3.30	45min	"	BEFORE WATER TEST
"	16:15	-5.10	-1.45		"	AFTER WATER TEST
"	18:30	-8.10	-2.00	15min	"	AFTER WORK
26-2	7:00	-8.10	-7.45	13hr 55min	"	BEFORE DRILLING
"	10:30	-10.20	-3.50	15min	"	BERORE WATER TEST
"	17:00	-15.00	-4.60	15min	-10.50	BEFORE WATER TEST
"	18:00	-15.00	-9.15	1hr 15min	-10.50	AFTER WORK
27-2	7:00	-15.00	-13.00	14hr 15min	-10.50	BEFORE DRILLING
"	18:30	-20.00	-10.10	15min	-12.60	AFTER WORK
28-2	7:00	-20.00	-14.20	12hr 45min	-12.60	BEFORE WATER TEST
"	13:35	-20.00	-9.50		-12.60	AFTER WATER TEST
"	14:30	-20.00	-9.50		NIL	AFTER COMPLETION
29-2	8:00	-20.00	-14.10		"	

(*-1) Mark "None" when water level exists under the bottom of hole
(*-2) Elapsed time from shutting off of drilling water

FORMAT-1: RECORD OF WATER LEVEL IN DRILLHOLE DURING DRILLING
(DATA SHEET)

KIKULETWA DAM PROJECT HOLE No. KD-5 (SHEET OF 1

LOCATION HEAD RACE CANAL DEPTH OF HOLE 20.00 m COMMENCED 7-3-1988

ELEAVTION 829,683 m DIAMETER OF HOLE 101/86/76 mm COMPLETED 11-3-1988

COORDINATE

ANGLE FROM HORIZONTAL -90°

BEARING OF ANGLE HOLE

EQUIPMENT FOR WATER LEVEL MEASUREMENT DIPMETER(ELECTRICAL)

MEASURED BY H.WAMEYO

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASURMENT	DEPTH OF WATER LEVEL (*-1)	ELAPSED TIME (*-2)	CEMENTING CASING	REMARKS
7-3	7:00	NIL	NIL		NIL	BEFORE DRILLING
,,	18:00	-1.90	-0.80		NIL	AFTER DRILLING
8-3	7:00	-1.90	-1.20		NIL	BEFORE DRILLING
,,	13:30	-5.30	-3.10		NIL	BEFORE TEST
,,	16:00	-5.30	-0.60		NIL	AFTER TEST
,,	18:00	-9.80	-1.70		NIL	AFTER DRILLING
9-3	7:00	-9.80	-5.70		NIL	BEFORE DRILLING
,,	10:30	-9.80	-2.00		NIL	AFTER TEST
,,	18:00	-14.50	-1.70		NIL	AFTER DRILLING
10-3	7:00	-14.50	-4.90		NIL	BEFORE DRILLING
,,	14:50	-15.00	-4.10		NIL	BEFORE TEST
,,	16:10	-15.00	-4.20		NIL	AFTER TEST
,,	18:00	-17.55	-1.70		NIL	AFTER DRILLING
11-3	7:00	-17.55	-4.60		NIL	BEFORE DRILLING
,,	15:35	-20.00	-3.75		NIL	BEFORE TEST
,,	18:00	-20.00	-3.25		NIL	AFTER WORK
12-3	8:00	-20.00	-5.20			

(*-1) Mark "None" when water level exists under the bottom of hole.

(*-2) Elapsed time from shutting off of drilling water

FORMAT-1: RECORD OF WATER LEVEL IN DRILLHOLE DURING DRILLING
(DATA SHEET)

KIKULETWA DAM PROJECT HOLE No. KD-6 (SHEET OF)

LOCATION HEAD RACE CANAL DEPTH OF HOLE 20.00 m COMMENCED 4-3-1988

ELEAVTION 411,327 m DIAMETER OF HOLE 101/86/76 mm COMPLETED 6-3-1988

COORDINATE

ANGLE FROM HORIZONTAL -90°

BEARING OF ANGLE HOLE

EQUIPMENT FOR WATER LEVEL MEASUREMENT DIPMETER(ELECTRICAL)

MEASURED BY J.DIMBU

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASURMENT	DEPTH OF WATER LEVEL (*-1)	ELAPSED TIME (*-2)	CEMENTING CASING	REMARKS
4-3	7:00	NIL	NIL		NIL	BEFORE DRILLING
,,	18:00	-3.90	-0.85		NIL	AFTER DRILLING
5-3	7:00	-3.90	-2.45		NIL	BEFORE DRILLING
,,	10:45	-5.40	-1.20		NIL	BEFORE TEST
,,	17:20	-9.95	-5.40		-5.75	BEFORE TEST
,,	18:30	-9.95	-3.20		-5.75	AFTER WORK
6-3	7:00	-9.95	NONE		-5.75	BEFORE DRILLING
,,	11:30	-15.00	-4.20		-5.75	BEFORE TEST
,,	13:20	-15.00	-4.90		-5.75	AFTER TEST
,,	16:15	-20.00	-2.40		-5.75	AFTER TEST
,,	18:00	-20.00	-3.00		NIL	AFTER WORK
8-3	8:00	-20.00	NONE		NIL	

(*-1) Mark "None" when water level exists under the bottom of hole.

(*-2) Elapsed time from shutting off of drilling water

FORMAT-1: RECORD OF WATER LEVEL IN DRILLHOLE DURING DRILLING
(DATA SHEET)

KIKULETWA DAM PROJECT HOLE No. KD-7 (SHEET OF)

LOCATION HEAD RACE CANAL DEPTH OF HOLE 20.00 m COMMENCED 29-2-1988

ELEAVTION 807,593 m DIAMETER OF HOLE 101/86/76 mm COMPLETED 3-3-1988

COORDINATE

ANGLE FROM HORIZONTAL -90 °

BEARING OF ANGLE HOLE

MEASURED BY H.WAMEYO

EQUIPMENT FOR WATER LEVEL MEASUREMENT DIPMETER(ELECTRICAL)

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASURMENT	DEPTH OF WATER LEVEL (*-1)	ELAPSED TIME (*-2)	CEMENTING CASING	REMARKS
29-2	7:00	NIL	NONE		NIL	BEFORE DRILLING
,,	18:00	-5.00	-3.40	10min	NIL	AFTER WORK
1-3	7:00	-5.00	NONE	13hr10min	NIL	BEFORE WORK
,,	10:00	-5.00	-3.55		NIL	AFTER TEST
,,	18:00	-10.00	-4.00	15min	NIL	AFTER DRILLING
2-3	7:00	-10.00	-6.30	13hr15min	NIL	BEFORE WORK
,;	12:30	-10.00	-4.20		NIL	AFTER TEST
,,	18:00	-13.00	-5.50	2hr30min	NIL	AFTER WORK
3-3	7:00	-13.00	-6.50	15hr30min	NIL	BEFORE DRILLING
,,	9:45	-15.10	-4.10	15min	NIL	BEFORE TEST
,,	11:45	-15.10	-4.65		NIL	AFTER TEST
,,	16:30	-20.15	-4.00	30min	NIL	BEFORE TEST
,,	18:00	-20.15	-4.00		NIL	AFTER WORK
4-3	8:00	-20.15	-10.25		NIL	

(*-1) Mark "None" when water level exists under the bottom of hole.

(*-2) Elapsed time from shutting off of drilling water

FORMAT-1: RECORD OF WATER LEVEL IN DRILLHOLE DURING DRILLING
(DATA SHEET)

KIKULETWA DAM PROJECT HOLE No. KD-8 SHEET 1 OF 2

LOCATION HEAD TANK DEPTH OF HOLE 30.00 m COMMENCED 18-2-1988

ELEAVTION 779,570 m DIAMETER OF HOLE 101 mm COMPLETED 24-2-1988

COORDINATE

ANGLE FROM HORIZONTAL -90 ° MEASURED BY J.DIMBU

BEARING OF ANGLE HOLE

EQUIPMENT FOR WATER LEVEL MEASUREMENT DIPMETER(ELECTRICAL)

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASURMENT	DEPTH OF WATER LEVEL (*-1)	ELAPSED TIME (*-2)	CEMENTING CASING	REMARKS
18-2	8:15	-3.35	NONE	14hr15min	-1.50	BEFORE WORK
,,	13:20	-5.00	-2.60		-1.50	AFTER WATER TEST
,,	18:00	-7.50	-3.20	1hr	-1.50	AFTER WORK
19-2	8:00	-7.50	-4.50	15hr	-1.50	BEFORE WORK
,,	13:30	-10.00	-6.75	45min	-4.20	BEFORE WATER TEST
,,	17:30	-10.00	-6.60		-4.20	AFTER WATER TEST
20-2	8:00	-10.00	-9.30		-9.20	BEFORE WORK
,,	13:00	-13.75	-10.00	15min	-9.20	BREAK OFF
,,	18:00	-15.00	-12.75	2hr45min	-9.20	AFTER WORK
21-2	8:00	-15.00	NONE	16hr45min	-9.20	BEFORE WORK
,,	14:20	-15.00	-11.70		-9.20	AFTER WATER TEST
,,	17:00	-16.95	-11.80	15min	-12.70	AFTER WORK
22-2	7:45	-16.95	NONE	15hr	-12.70	BEFORE WORK
,,	13:00	-20.00	-14.60	1hr15min	-14.00	BREAK OFF
,,	15:00	-20.00	-17.50	3hr15min	-14.00	BEFORE WATER TEST
,,	18:00	-20.00	-9.22		-14.00	AFTER WATER TEST
23-2	8:00	-20.00	-18.00		-14.00	BEFORE WORK
,,	12:30	-23.00	-17.20	1hr10min	-14.00	BREAK OFF
,,	13:30	-23.00	-17.50	2hr10min	-14.00	BEFORE WATER TEST

(*-1) Mark "None" when water level exists under the bottom of hole.
(*-2) Elapsed time from shutting off of drilling water

FORMAT-1: RECORD OF WATER LEVEL IN DRILLHOLE DURING DRILLING
(DATA SHEET)

KIKULETWA DAM PROJECT HOLE No. KD-8 (SHEET 2 OF 2)

LOCATION HEAD TANK DEPTH OF HOLE 30.00 m COMMENCED 18-2-1988

ELEAVTION 779,570 m DIAMETER OF HOLE 101 mm COMPLETED 24-2-1988

COORDINATE

ANGLE FROM HORIZONTAL -90° MEASURED BY J.DIMBU

BEARING OF ANGLE HOLE

EQUIPMENT FOR WATER LEVEL MEASUREMENT DIPMETER(ELECTRICAL)

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASURMENT	DEPTH OF WATER LEVEL (*-1)	ELAPSED TIME (*-2)	CEMENTING CASING	REMARKS
23-2	19:00	-25.00	-22.50		-14.00	AFTER WORK
24-2	8:00	-25.00	-23.40		-14.00	BEFORE WORK
,,	12:30	-30.00	-21.65	15min	-14.00	BREAK OFF
,,	13:30	-30.00	-22.40		-14.00	BEFORE WATER TEST
,,	18:00	-30.00	-21.80		-14.00	AFTER WORK
25-2	8:00	-30.00	-26.10		-10.00	

(*-1) Mark "None" when water level exists under the bottom of hole.

(*-2) Elapsed time from shutting off of drilling water

FORMAT-1: RECORD OF WATER LEVEL IN DRILLHOLE DURING DRILLING
(DATA SHEET)

MKHULETWA DAM PROJECT HOLE No. KD-9 SHEET OF

LOCATION POWER STATION DEPTH OF HOLE 20.00 m COMMENCED 26-2-1988

ELEAVTION 730.741 DIAMETER OF HOLE 101/86 mm COMPLETED 29-2-1988

COORDINATE

ANGLE FROM HORIZONTAL -90 ° MEASURED BY J.DIMBU

BEARING OF ANGLE HOLE --

EQUIPMENT FOR WATER LEVEL MEASUREMENT DIPMETER(ELECTRICAL)

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASURMENT	DEPTH OF WATER LEVEL (*-1)	ELAPSED TIME (*-2)	CEMENTING CASING	REMARKS
26-2	18:00	-10.15	-3.40	2hr 10min	-3.05	AFTER DRILLING
27-2	8:30	-10.15	-3.80	16hr 40min	-3.20	BEFORE WATER TEST
"	12:30	-10.15	-3.80		-3.20	AFTER WATER TEST
"	18:30	-11.65	-3.75	3hr 30min	-3.20	AFTER WORK
28-2	8:00	-11.65	-3.80	17hr	-10.30	BEFORE DRILLING
"	15:25	-15.20	-3.40	1hr 5min	-10.30	BEFORE WATER TEST
"	18:00	-15.20	-3.80		-10.30	AFTER WORK
29-2	7:45	-15.20	-3.80		-10.30	BEFORE DRILLING
"	12:20	-20.00	-3.75	10min	-10.30	BEFORE WATER TEST
"	17:20	-20.00	-3.80		-10.30	AFTER WATER TEST
"	18:30	-20.00	-3.80		-10.30	AFTER WORK
1-3	8:00	-20.00	-3.80		NIL	

(*-1) Mark "None" when water level exists under the bottom of hole

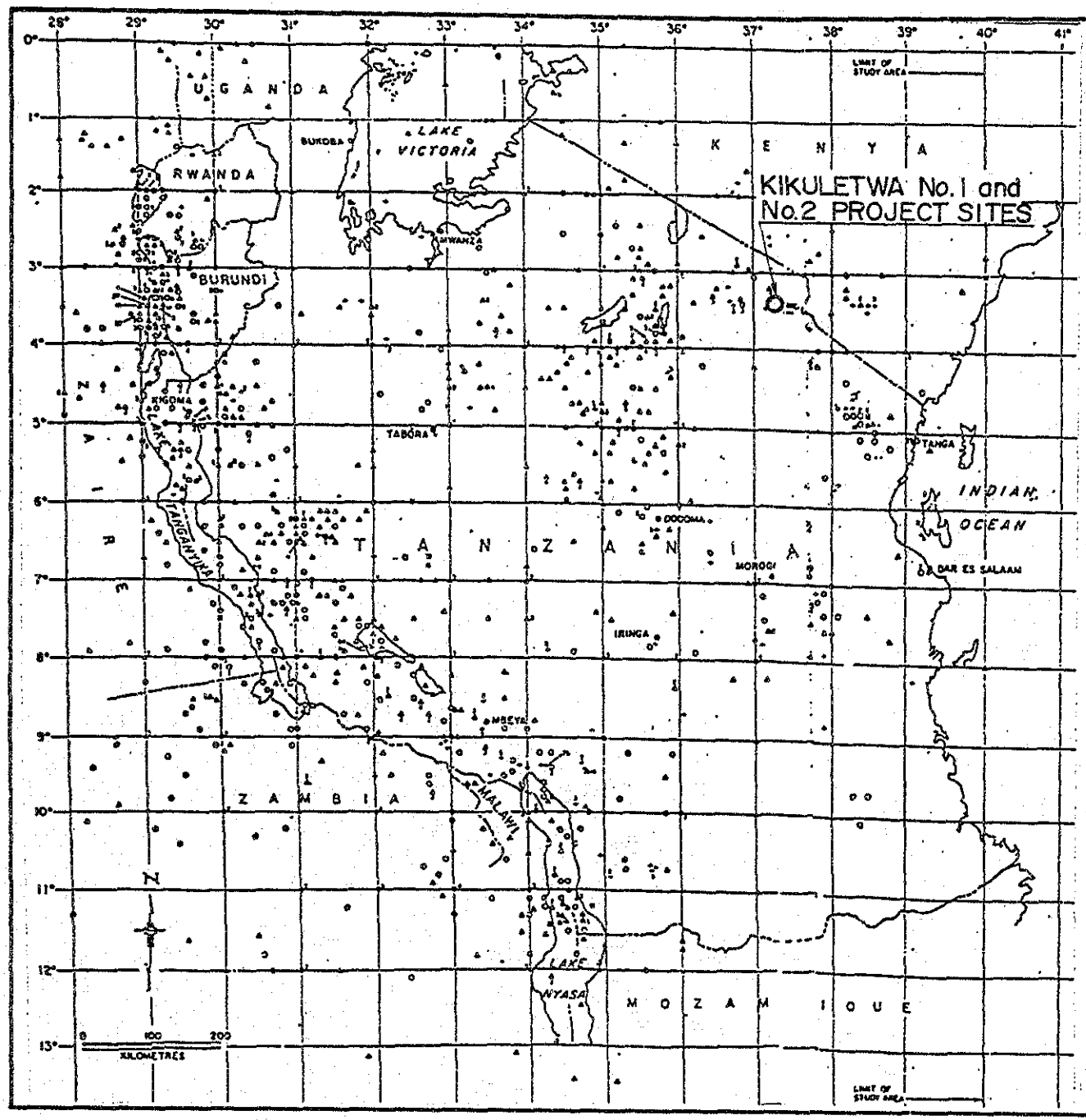
(*-2) Elapsed time from shutting off of drilling water

APP. III-4
EARTHQUAKE DATA IN TANZANIA

EARTHQUAKE DATA IN TANZANIA

The frequent earthquake zones in Tanzania are located in the West Rift Valley comprising the border of Tanzania with Zaire and Zambia and the East Rift Valley (Gregory Rift Valley) extending south from Nairobi in Kenya. The project area for Kikuletwa No. 1 and No. 2 hydropower projects are located in a region slightly off to the east of the latter zone.

Earthquake epicenters and seismic map in Tanzania are indicated in the attached figures.



LEGEND

● CITY, TOWN

EARTHQUAKE MAGNITUDES (M_S = SURFACE MAGNITUDES)

- MAGNITUDE NOT REPORTED
- ○ $M_S < 6$
- ◉ $6 \leq M_S < 7$
- ■ $M_S \geq 7$

——— INTERNATIONAL BOUNDARY

NOTES

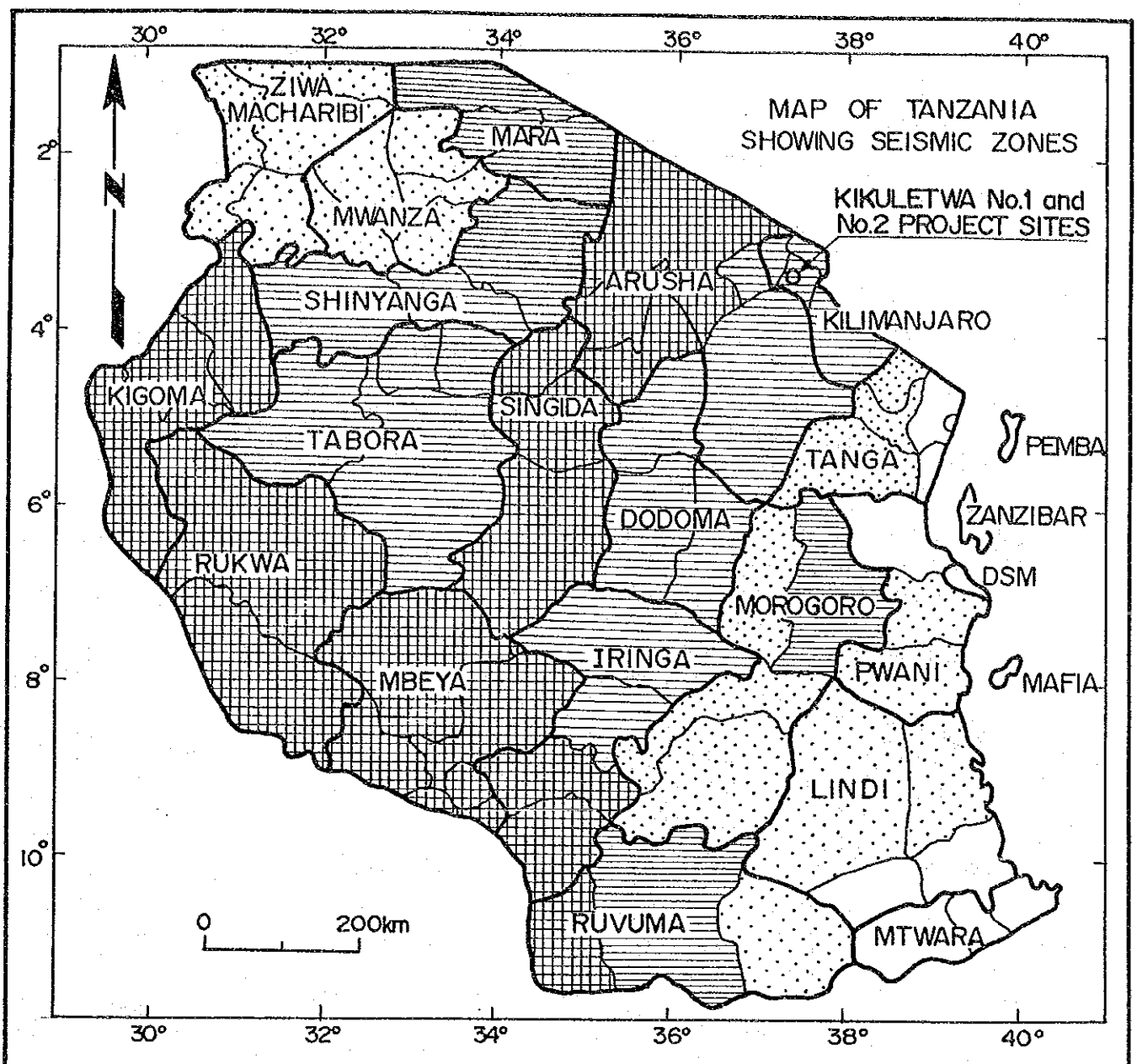
1. REPORTED LOCATIONS PLOTTED TO NEAREST 0.1°
2. MAGNITUDES ROUNDED TO NEAREST 0.1
3. NUMBER BESIDE PLOTTED SYMBOL (e.g. 3) REPRESENTS NUMBER OF EVENTS REPORTED AT SAME LOCATION.
4. WHERE MORE THAN ONE EVENT AT SAME LOCATION, SYMBOL OF GREATEST REPORTED MAGNITUDE IS PLOTTED.

SOURCES OF DATA

1. R. H. AMBRASEYS, "THE SEISMICITY OF STEFFLER'S GORGE, TANZANIA" JAN 1972, STEFFLER'S GORGE PRELIMINARY PROJECT REPORT MOWCONSULT A.S FOR TANESCO. PERIOD 1948-FEB 1971 AREA: 1°-12°S, 28°-40°E.
2. M. BATH, "SEISMICITY OF THE TANZANIA REGION," TECTONOPHYSICS VOL. 27, P. 353-379, 1975. PERIOD: 1960-APRIL 1974. AREA: 0°-12°S, 28°-40°E MAGNITUDES $M_L \geq 5.0$
3. J. D. FAIRHEAD, PERSONAL COMMUNICATION 26 AUG. 1983 PERIOD: JAN. 1963-DEC. 1970. AREA: 0°-14°S, 28°-40°E.
4. B. GUTENBERG & C.F. RICHTER, SEISMICITY OF THE EARTH AND ASSOCIATED PHENOMENA, PRINCETON UNIVERSITY PRESS 1954.
5. U.S. DEPARTMENT OF COMMERCE, N.O.S.A. EARTHQUAKE DATA FILE, JULY 23, 1983. PERIOD MAY 1919-MAY 1981. AREA: 0°-14°S, 28°-36°E. AUG. 22, 1984. PERIOD 1969-DEC. 1983. AREA: 0°-14°S, 27°-40°E.

Note :
The origin of this map is EARTHQUAKE EPICENTERS by TANZANIA ELECTRIC SUPPLY CO. LTD. (REDEVELOPMENT OF PANGANI FALLS)

JAPAN INTERNATIONAL COOPERATION AGENCY	
KIKULETWA No.1 EXISTING HYDROPOWER STATION AND KIKULETWA No.2 HYDROPOWER PROJECT	
EARTHQUAKE EPICENTERS IN TANZANIA	
APP-III.4(1)	JANUARY 1988



HAZARD LEVEL OF EARTHQUAKES Richter scale

- ZONE 0, rare or unknown, magditude M = 0 - 4
- ZONE 1, fairly week, less frequent, magnitude M = 3 - 5
- ZONE 2, moderately frequent, not violent, magnitude M = 5 - 6
- ZONE 3, frequent, strong, magnitude M = 6 - 7

Note :

The origin of this map is SEISMIC MAP OF TANZANIA (1978) by MINISTRY OF WORKS TANZANIA, BUILDING DIVISION.

JAPAN INTERNATIONAL COOPERATION AGENCY	
KIKULETWA No.1 EXISTING HYDROPOWER STATION AND KIKULETWA No.2 HYDROPOWER PROJECT	
SEISMIC MAP OF TANZANIA	
APP-8.4 (2)	JANUARY 1988

APP. III-5
GEOLOGICAL DATA OF POTENTIAL SITES EXCEPTING KIKULETWA NO.1 AND NO.2 SITES

RESULT OF FIELD RECONNAISSANCE SURVEY

Himo No.1 and No.2

	Himo No.1 (Existing)	Himo No.2 Schem A	Himo No.2 Schem B
Topography			
(Dam)	Left bank: Cliff, relative height of 20 m. Right bank: Gentle slope of 25 degrees. River width: Approximately 10 m. River gradient: 1/25		Left bank: Slope of 40 degrees. Three irrigation channels. Right bank: Slope of 30 degrees. One irrigation channel. River width: Approximately 15 m. River gradient: 1/40
(Headrace)	Cliff and flat plateau.		Gentle slope – plateau Gradient: 1/20. Gentle slope – Valley About 200 m in width, in the middle of proposed headrace channel.
(Head tank and penstock)	Steep slope, about 40 m in height. 40 degrees on the upper slope and 70 degrees on the lower slope.	Head tank: Gentle slope. Penstock: Slope of 40 degrees, and 20 m in height. Cliff in some places.	Head tank: Gentle slope of 20–30 degrees. Penstock: Slope of 45 degrees in some places. Ridge.
(Power station and tailrace)	Steep slope of 70 degrees. River gradient: 1/70.	Slope of 40 degrees. River gradient: 1/50	Gentle slope of 30 degrees. End of ridge. River gradient: 1/50.
Geology			
(Dam)	Basement rock: Basaltic rock, interbedded with thin scoria beds. Overburden: Talus deposit 3–4 m thick on the right bank. River deposit: 3–4 m thick		Basement rock: Basaltic rock. Weathered upper slope on both banks. Overburden: Scarcely. River deposit: 4–5 m thick
(Headrace)	Basement rock: Basaltic rock Overburden: Talus deposit 2–3 m thick along the valley in some places.		Basement rock: Basaltic rock Overburden: Thin washout deposit.
(Head tank, penstock and power station)	Basement rock: Basaltic rock. Overburden: Scarcely.	Basement rock: Basaltic rock. Weathered upper slope. Overburden: Washout deposit on the plateau.	Basement rock: Basaltic rock. Weathered . Overburden: Washout deposit on the plateau.

RESULT OF FIELD RECONNAISSANCE SURVEY

Himo No.1 and No.2

	Himo No.1 (Existing)	Himo No.2 Schem A	Himo No.2 Schem B
Materials			
(Aggregate)	Excavated materials available on the site.		
(Sand)	About 30 km downstream, near Nyumba Ya Mungu.		

Ihindi and Gulutu

	Ihindi	Gulutu
Topography		
(dam)	Left bank: Slope of 50 degrees. Right bank: Slope of 45 degrees. River width: Approximately 30 m. River gradient: 1/20	Left bank: Slope of 45 degrees. Right bank: Slope of 5-15 degrees. River width: Approximately 15 m. River gradient: 1/25
(Headrace)	Slope of 40-50 degrees, with 4-5 steep valleys.	Gentle plateau.
(Head tank and penstock)	Slope of 30-50 degrees. Ridge	Gentle slope of 15 degrees.
(Power station and tailrace)	Gentle slope of 15-30 degrees. River gradient: 1/10	Gentle slope of 10 degrees. River gradient: 1/30
Geology		
(Dam)	Basement rock: Gneiss, horizontal foliation. Overburden: Scarcely. River deposit: Boulders of ϕ 5 m in size.	Basement rock: Gneiss, horizontal foliation. Overburden: Talus deposit 2-3 m thick on the right bank. River deposit: 3-4 m thick.
(Headrace)	Basement rock: Gneiss, horizontal foliation. Overburden: Scarcely.	Basement rock: Gneiss, horizontal foliation. Overburden: Scarcely.
(Head tank, penstock and power station)	Basement rock: Gneiss, horizontal foliation. Overburden: Talus deposit 3-4 m thick.	Basement rock: Gneiss, horizontal foliation. Overburden: Scarcely.
Materials		
(Aggregate)	Excavated materials available on the site.	
(Sand)	About 5 km downstream, near Kihurio.	

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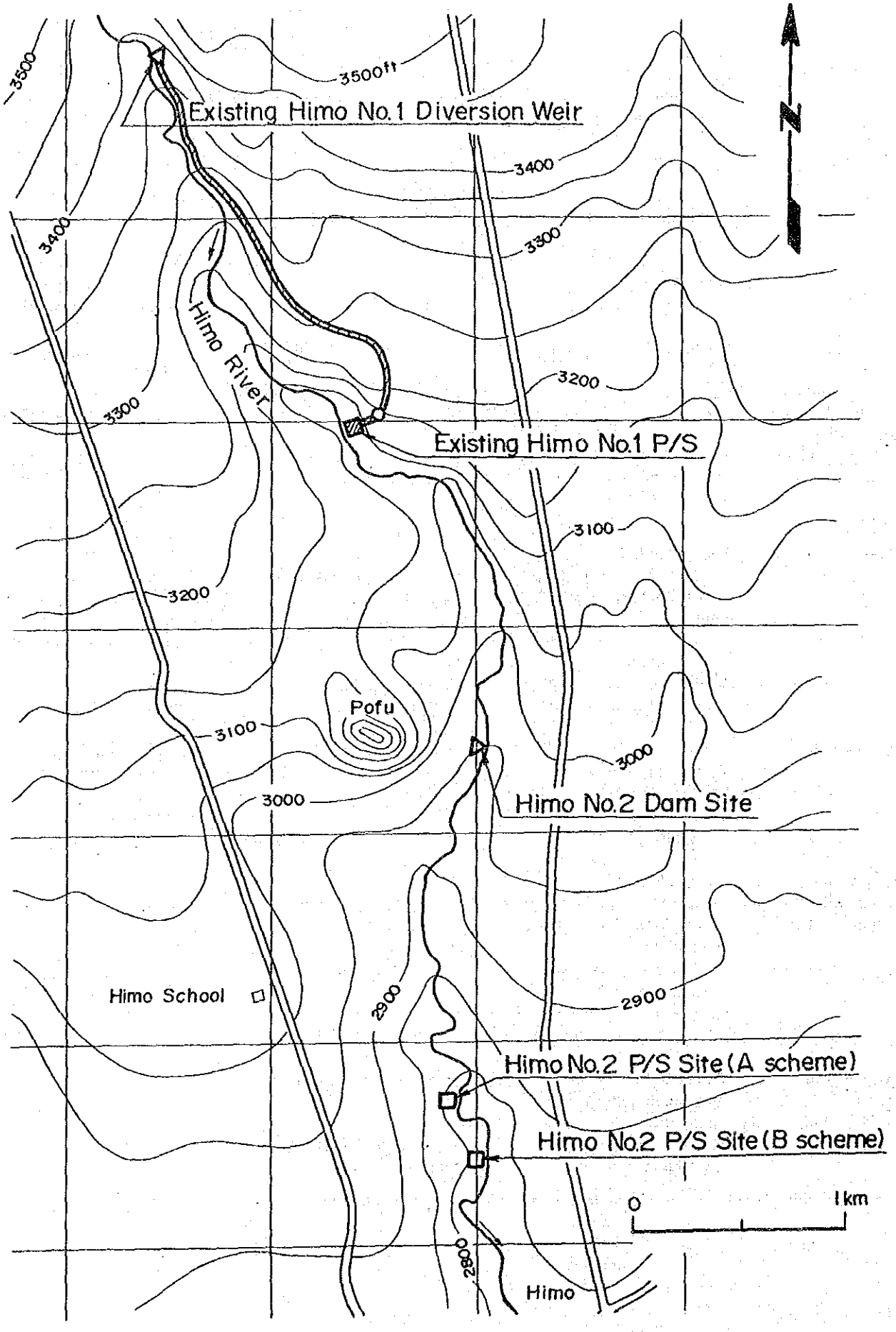
RESULT OF FIELD RECONNAISSANCE SURVEY

Ndungu, Hingilili, Bombo

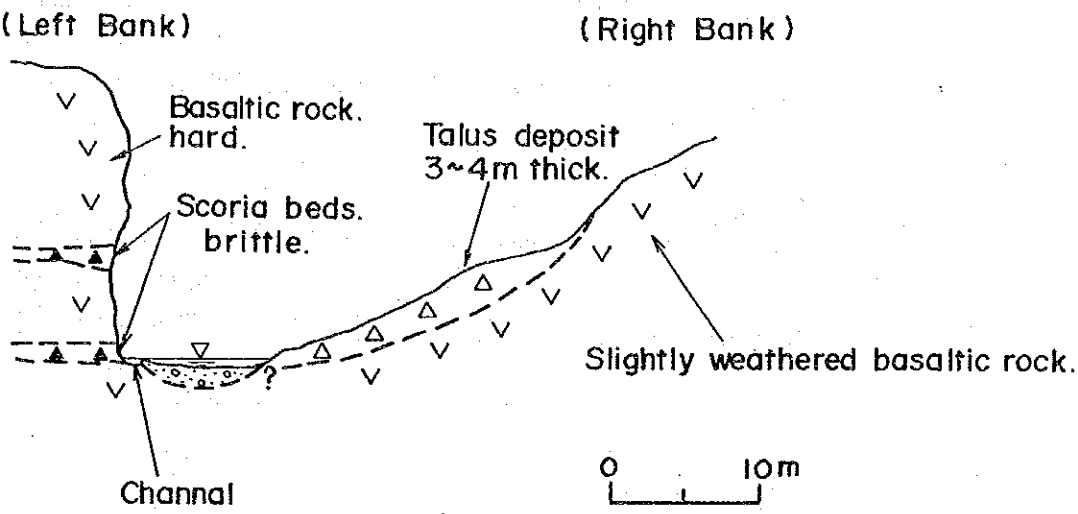
	Ndungu	Hingilili	Bombo
Topography			
(dam)	Left bank: Slope of 30 degrees. Right bank: Slope of 45 degrees. River width: 20 m River gradient: 1/15	Left bank: Slope of 30 degrees. Right bank: Gentle slope of 10 degrees. River width: 15 m River gradient: 1/10	Left bank: Steep slope of 60 degrees. Right bank: Slope of 40 degrees. River width: 10 m River gradient: 1/7
(Headrace)	Slope of 50-70 degrees.	Top of narrow ridge.	Slope of 30 degrees, crossing a valley
(Head tank and penstock)	Ridge slope of 50-70 degrees.	Ridge slope of 50 degrees.	gentle slope of 20-30 degrees
(Power station and tailrace)	Ridge slope of 50-70 degrees. River gradient: 1/10	Gentle slope of 5-10 degrees. River gradient: 1/10	Gentle slope of 20 degrees.
Geology			
(Dam)	Basement rock: Gneiss. Dip and strike of foliation, N-S,15°E. Overburden: Talus deposit, less than 2 m thick. River deposit: Scarcely.	Basement rock: Gneiss. Dip and strike of foliation, N15°W, 25°NE. Overburden: Surface soil 1 m thick. River deposit: Boulders ϕ 2-3 m size.	Basement rock: Gneiss, horizontal foliation. Overburden: Boulders ϕ 4 m size. River deposit: Scarcely.
(Headrace)	Basement rock: Gneiss, horizontal foliation. Overburden: Boulders ϕ2-3m size.	Basement rock: Gneiss, horizontal foliation. Overburden: Boulders ϕ 2-3 m size.	Basement rock: Gneiss, horizontal foliation. Overburden: Surface soil 1-3 m thick
(Head tank, penstock and power station)	Basement rock: Gneiss. Dip and strike of foliation, N50°W, 30 NE. Overburden: Scattered boulders ϕ 2-3 m size.	Basement rock: Gneiss, horizontal foliation. Overburden: Talus deposit 2-4 m thick.	Basement rock: Gneiss. Overburden: Talus deposit, more than 3 m thick.
Materials			
(Aggregate)	Excavated materials available on the site.	Excavated materials available on the site.	
(Sand)	About 3 km downstream, near Ndungu.	About 1 km downstream, near Gonja.	

Plan of Himo No.1 and No.2

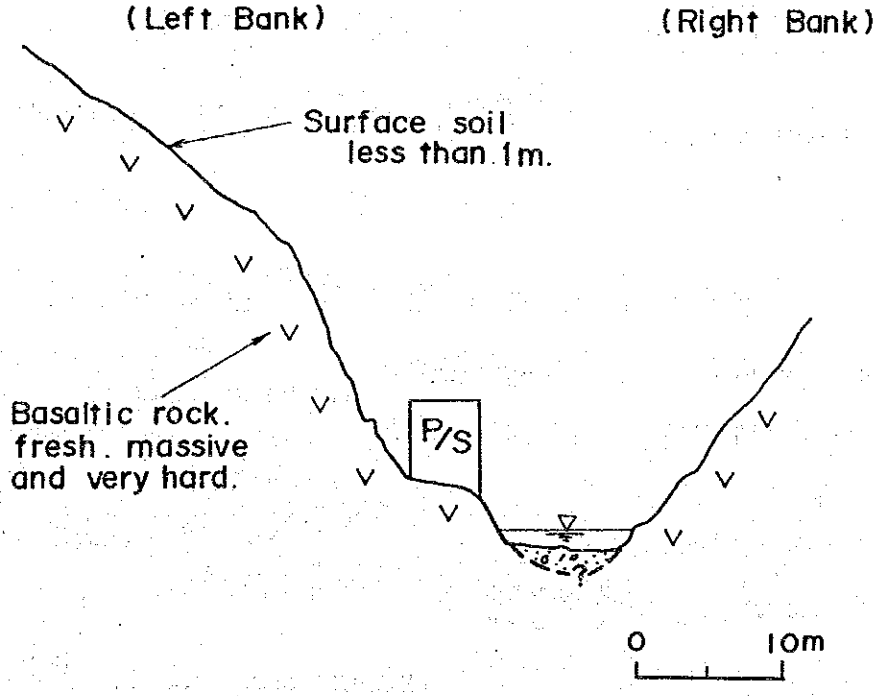


Geological Profile of Himo No.1 (Existing)

Diversion weir site

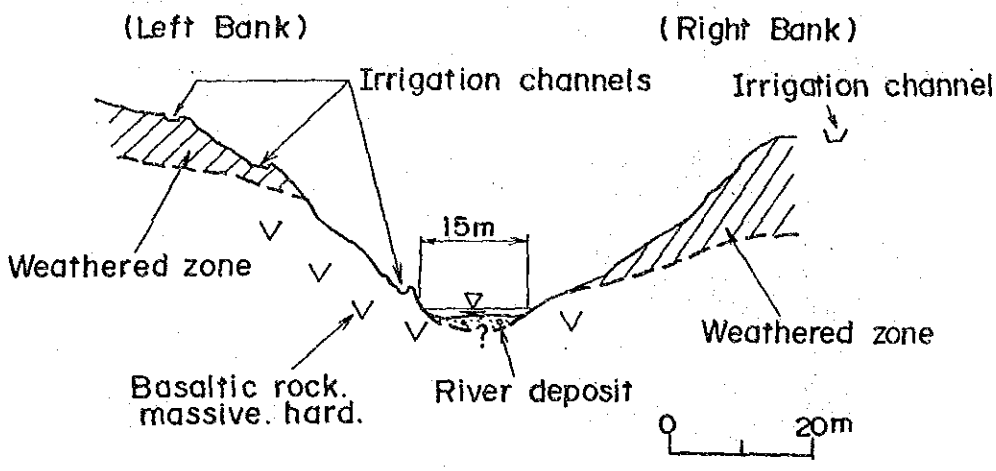


Penstock and P/S site

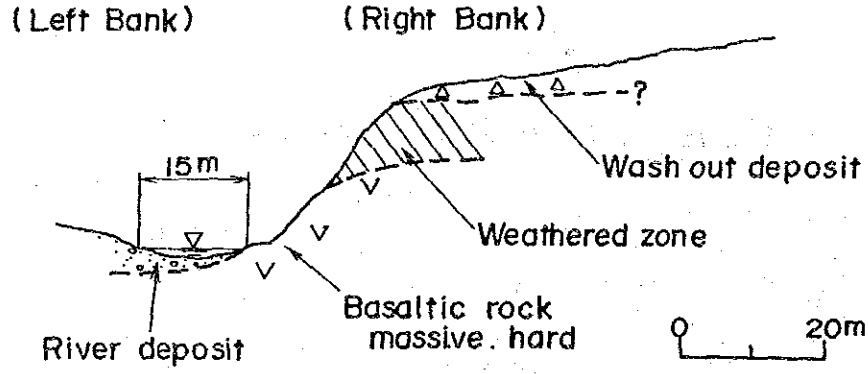


Geological Profile of Himo No.2

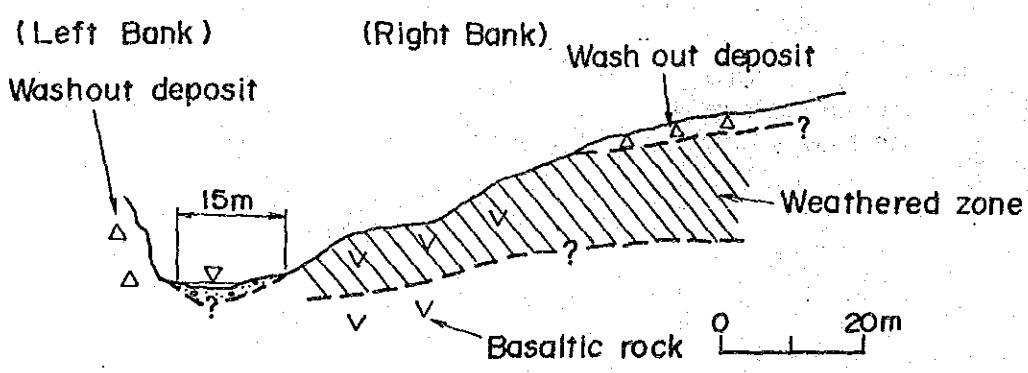
Dam site



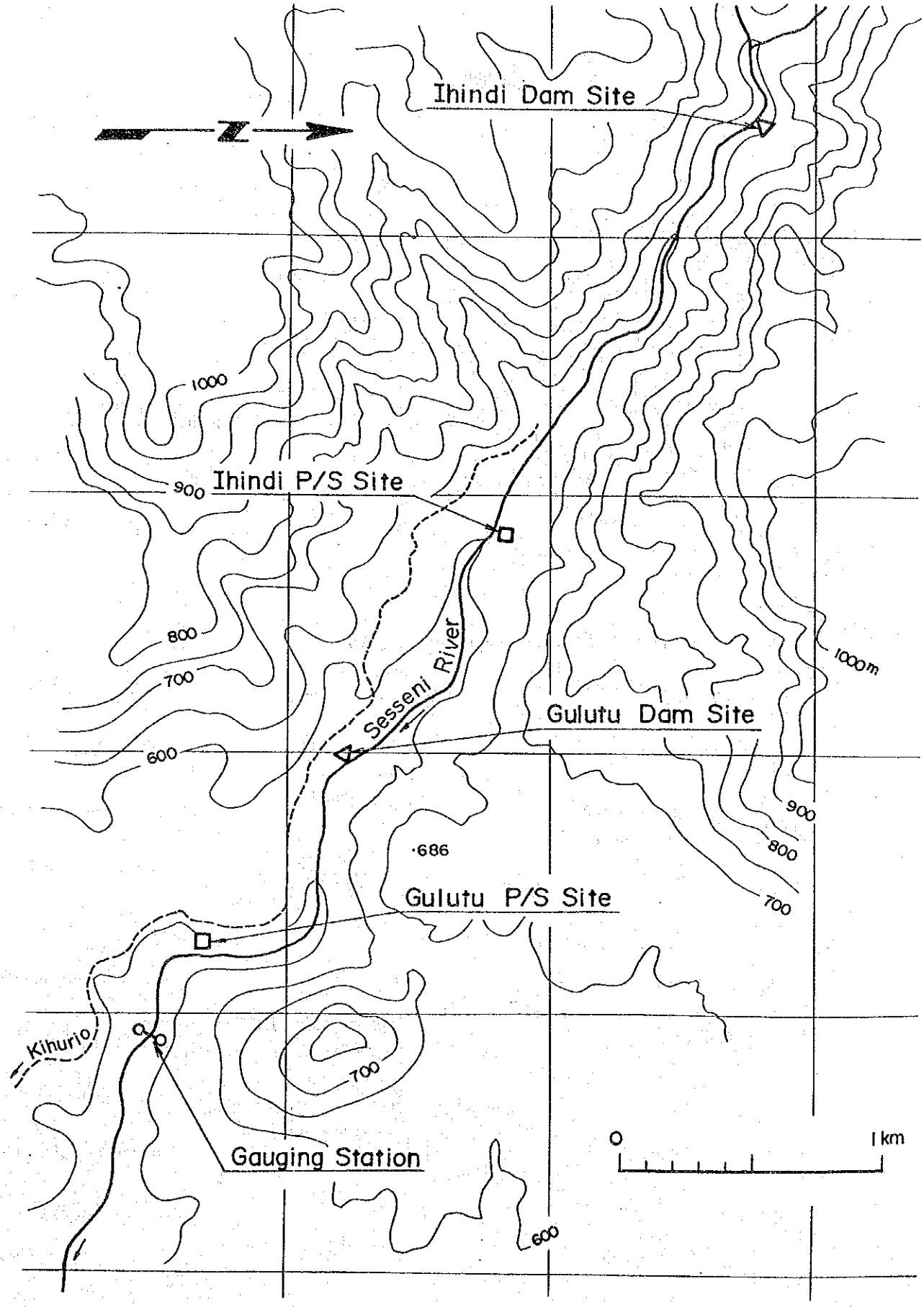
Penstock and P/S. site (A scheme)



Penstock and P/S site (B scheme)

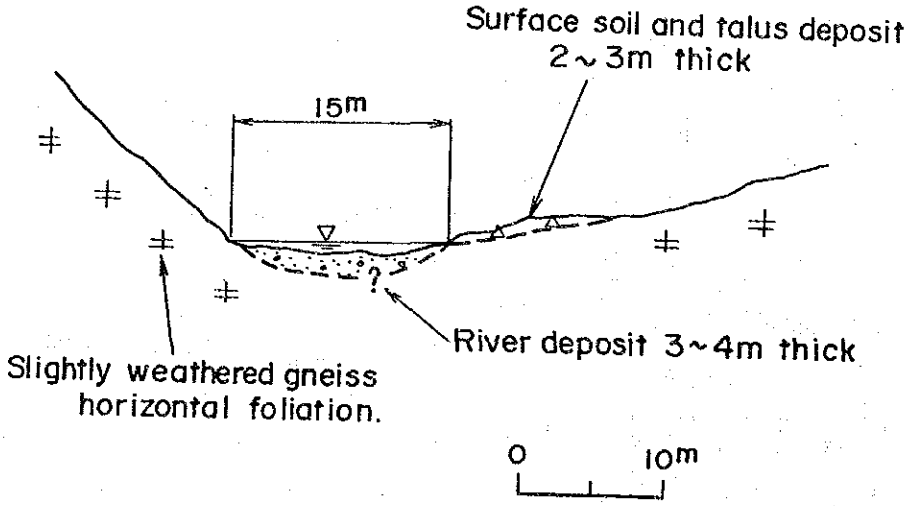


Plan of Ihindi and Gulutu

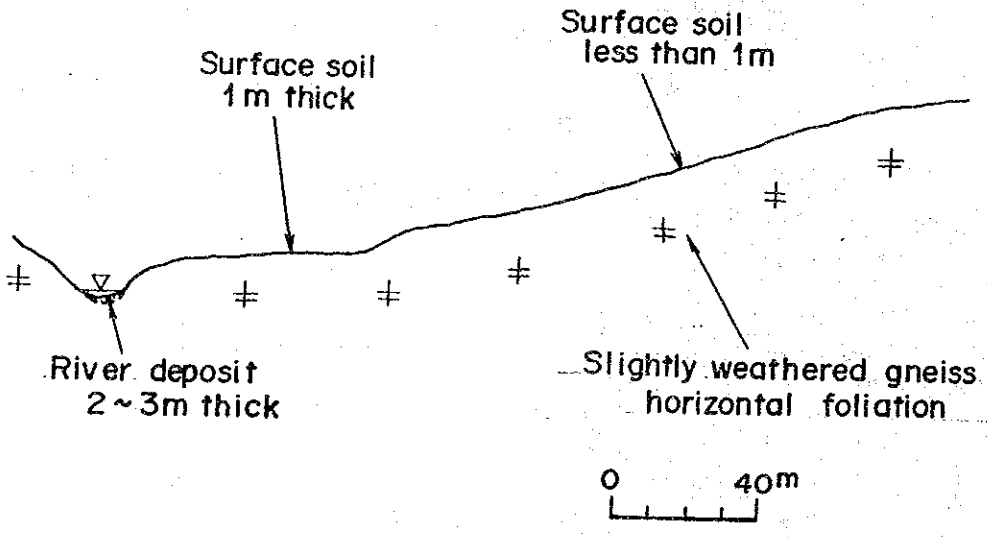


Geological Profile of Gulutu

Dam site

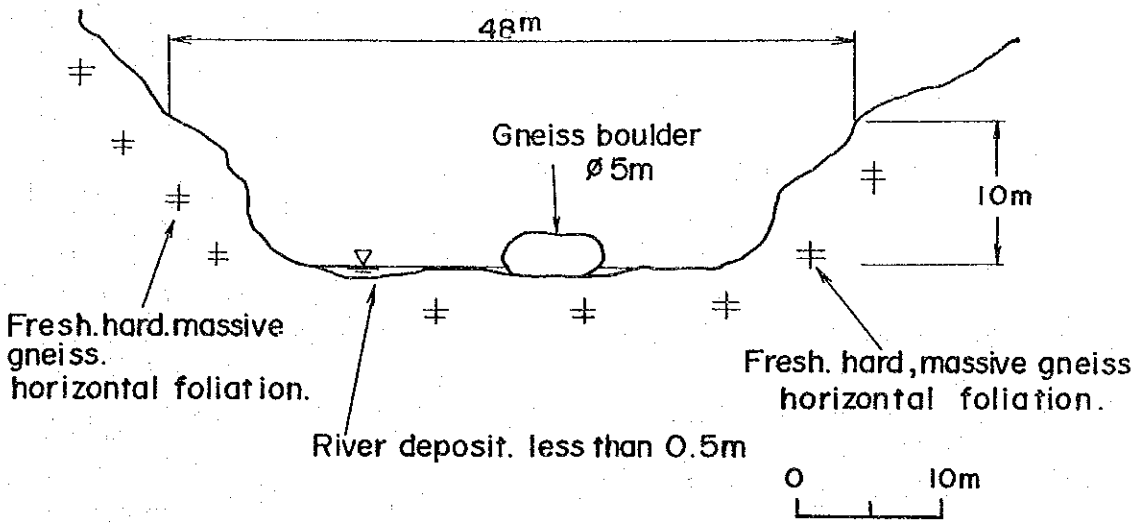


Penstock and P/S site

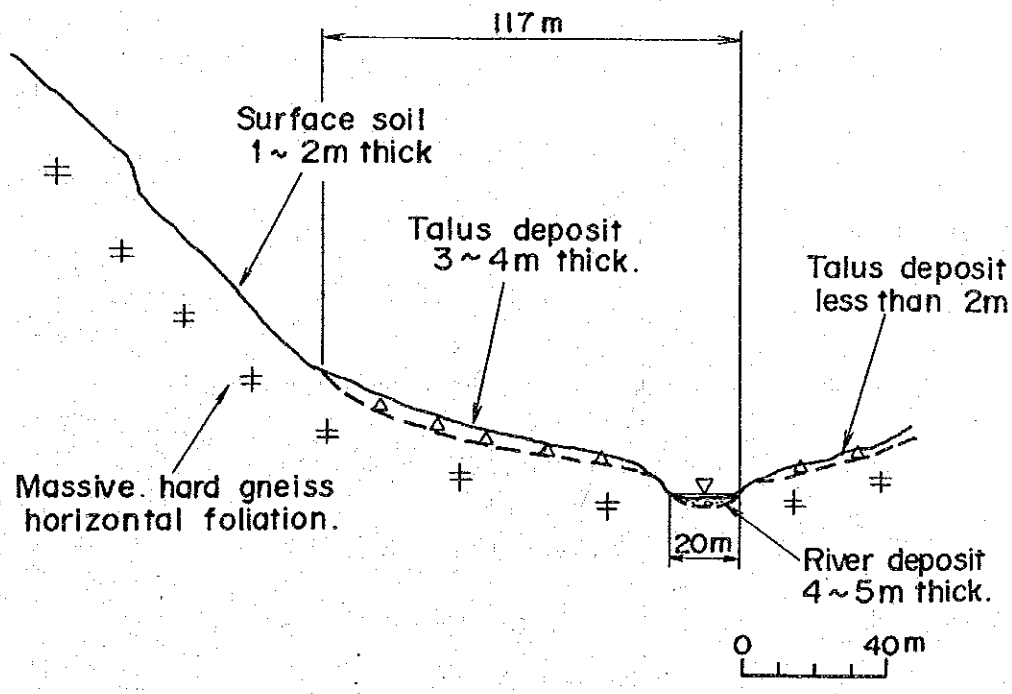


Geological Profile of Ihindi

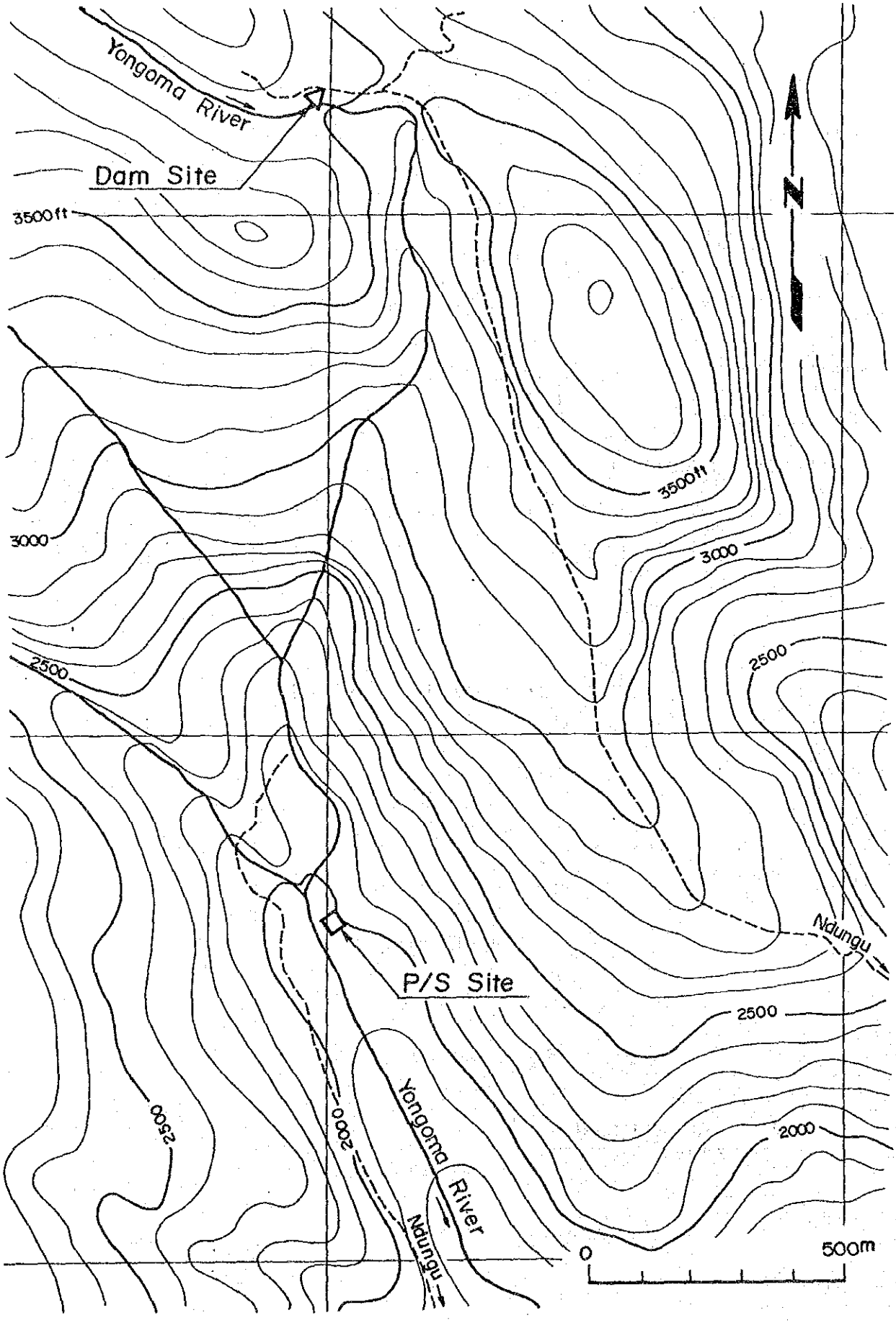
Dam site



Penstock and P/S site

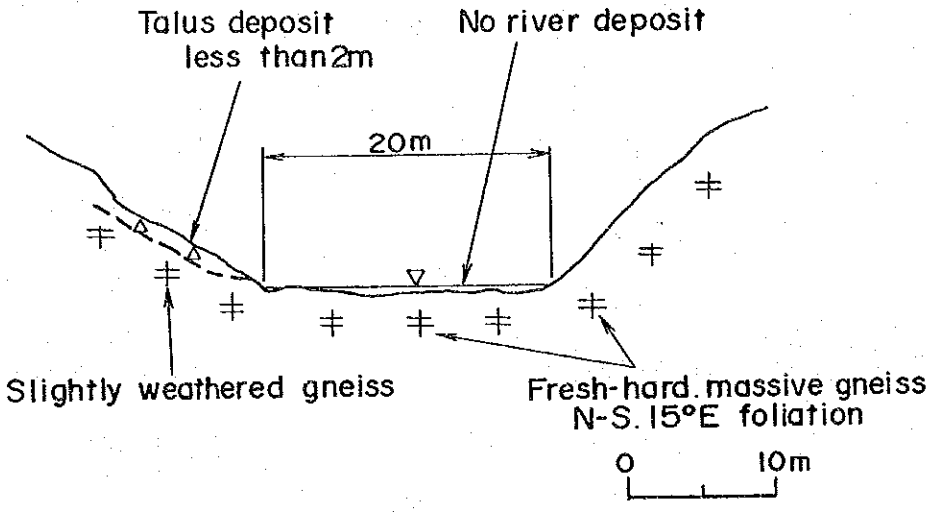


Plan of Ndungu

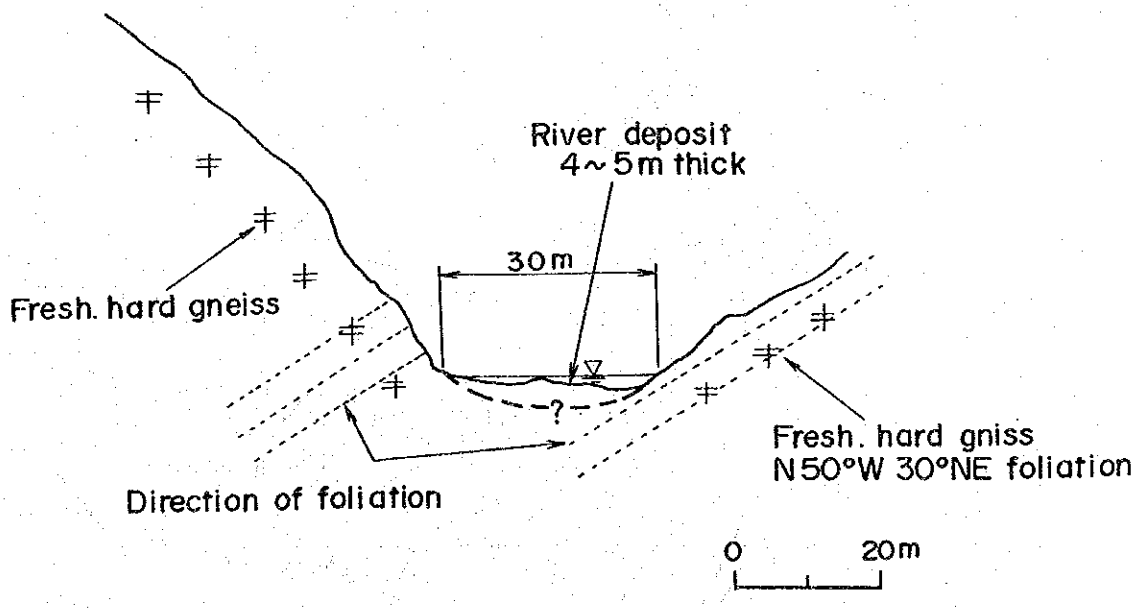


Geological Profile of Ndungu

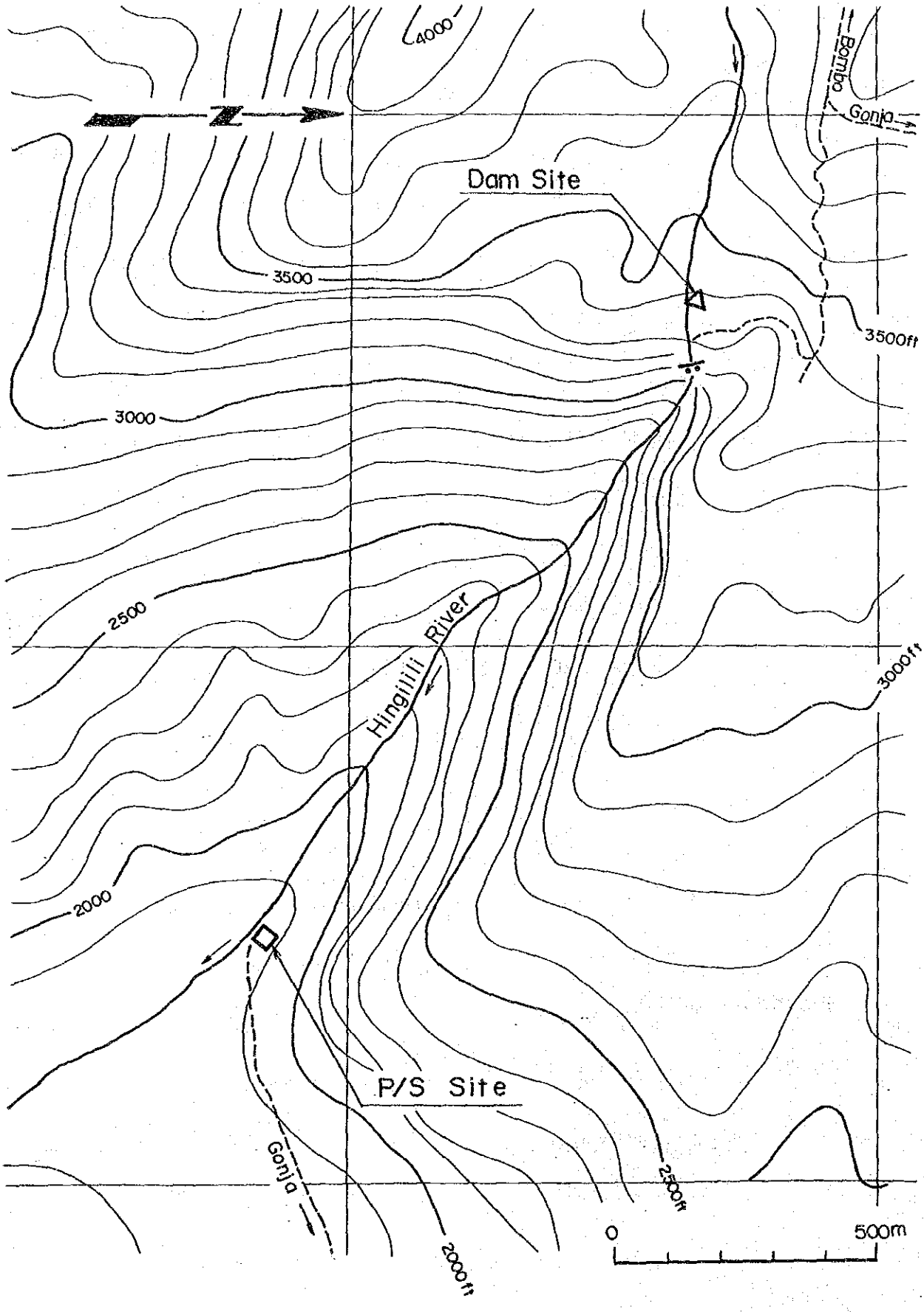
Dam site



Penstock and P/S site

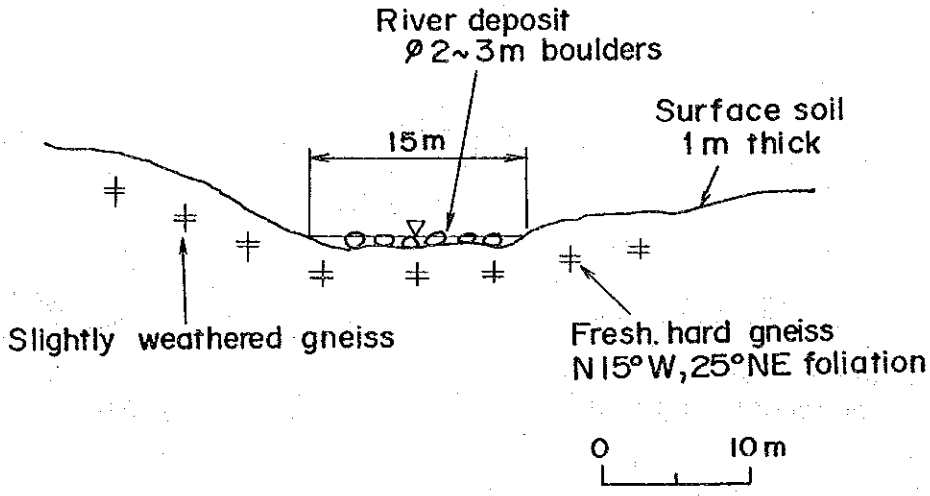


Plan of Hingilili

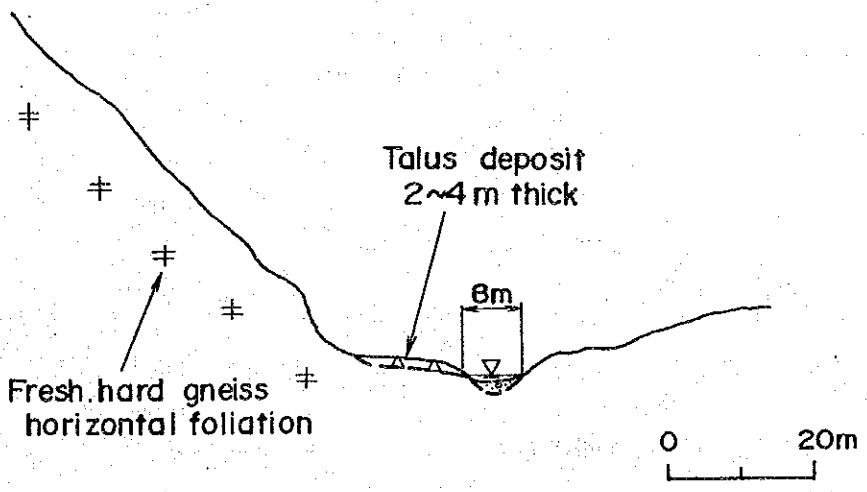


Geological Profile of Hingilili

Dam site

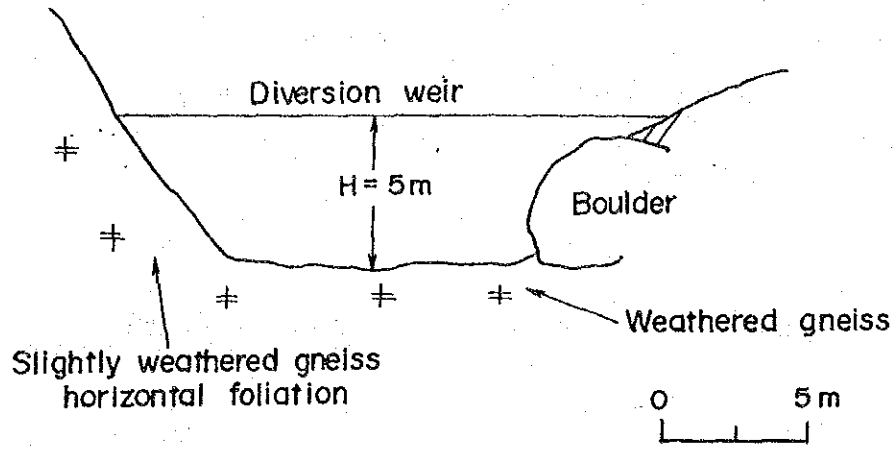


Penstock and P/S site

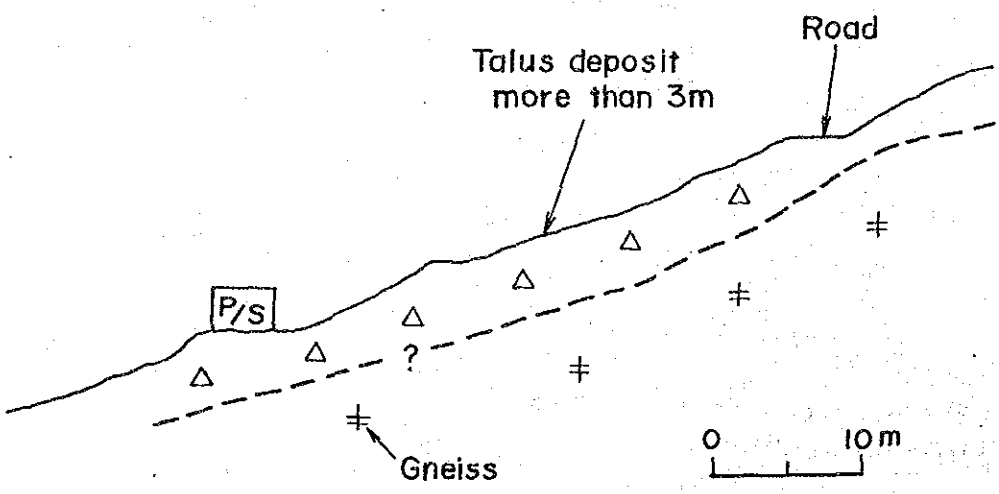


Geological Profile of Bombo (Existing)

Diversion weir site



Penstock and P/S site



APP. III-6
DATA OF TEST FOR CONCRETE AGGREGATE

13 POTENTIAL ALKALI — REACTIVITY OF AGGREGATES

13.1 General

This method covers chemical determination of the potential reactivity of an aggregate with alkalines in Portland Cement. Essentially the tests are performed on material retained on 1.2 mm sieve only. Finer material will react fast during the early age of concrete and will not cause harmful expansions. These tests are:

a) Preparation of samples
b) Petrological investigations
c) Chemical test on content of soluble silica
d) Determination of reactive flint content

13.1.1 *Preparation of test sample*

The aggregate in question shall be wet sieved to separate the fine material passing 1.18 mm sieve. The remaining material shall be dried and subsequently separated in the test fractions by dry sieving. i.e. 1.18 to 2.36 mm, 2.36 to 5.0 mm, 5.0 to 10.00 mm etc. The masses shall be determined and the percentages by mass (referred to the total mass of the sample retained on sieve 1.18 mm) shall be recorded. The tests according to clause 13.2, 3 and 13.4 shall only be performed on those test fractions with a mass greater than 10%.

13.1.2 *Applied test method*

After separating the sample into test fractions and discarding those fractions whose portion is smaller than 10% of the sample, the following tests are applied.

Test method	Clause
Petrological classification	13.2 all fractions above 4.8 mm
Chemical test on opal and other soluble silica including reactive flint	13.3.1 a) fractions 1.18 to 2.36 mm and 2.36 to 5.0 mm
Chemical test on opal and other soluble silica	13.3.1 b) particles selected according to clause 13.2 from fractions above 5.0 mm
Evaluation of reactive flint content	13.4 particles selected according to clause 13.2 from fractions above 5.0 mm

13.2 Petrological investigations

13.2.1 General

This test is performed on test fractions above 5.0 mm (see 13.1.2).

13.2.2 *Apparatus*

Balance, magnifier with lamp, and forceps

13.2.3 Sample sizes

test fraction (mm)	minimum amount (g)
5.0-10.0	200
10.0-20	1 000
20 -37.5	2 000

These sub-samples are separated from the prepared test fractions by splitting or quartering.

13.2.4 Test procedure

The particular sample is spread on a glass plate with a forcep or by hand and then the unique non-alkali-sensitive grains are picked out. From the remainder, the flints are separated. Finally all minerals known to be reactive [1] or questionable [2] should remain. The selected quantities of flint and opal plus opal containing and questionable minerals are weighed and given in percentage by mass of the total mass of the sample. The separated opal and the flint are subsequently tested according to clauses 13.3 and 13.4 respectively.

13.3 Chemical test to evaluate content of opaline minerals and other soluble silica.

13.3.1 *General*
The tests are carried out:

a) on the whole test fractions 1.18 to 2.36 mm and 2.36 to 5.0 mm and

b) with the larger test fractions 5.0 to 10.0 mm etc. only on the potentially reactive constituents selected according to clause 13.2.3.

The samples are treated with hot sodium hydroxide solution and subsequently washed with water and wet sieved. By this method those constituents which are disintegrated by NaOH are separated. The portion is being evaluated gravimetrically.

13.3.2 *Apparatus*
The following apparatus is required

13.3.2.1 *Balances*

Sample up to 100g: accurately to 0.01 g
sample above 100g: accurately to 0.1g.

13.3.2.2 *Waterbath* with temperature regulation 90°C ± 2°C.

13.3.2.3 *Glassware* — measuring cylinder, Beaker (chemical resistant glass), watch glasses to cover beakers, glass plate.

1 opal, chalcedony, chert, flint, volcanic glass, crystobalite, tricylmite or fused silica.

2 Clay rocks, siltstone, phyllites, mica, schists, granites, charnockites and granite gneisses.

13.3.2.4 Others — forceps, steel needle.

13.3.3 *Reagents*

NaOH solution 10% (100 g NaOH + water to give 1 000 ml)

NaOH solution 4% (40g NaOH + water to give 1 000 ml)
Phenolphtalein Indicator solution

13.3.4 *Sample size*

The test with sodium hydroxide is carried out:

a) On the entire test fractions 1.18 to 2.36 mm and 2.36 to 5.0 mm with 4% NaOH base. The quantity shall be 200 g obtained by spliting or quartering of the initial sample.

b) For the greater fractions 5.0 — 10 mm etc on the petrologically selected portion (see 13.2.3) of opaline and other reactive minerals with 10% NaOH base. For this test an amount of at least 0.5% by mass of the sample size required according to 13.2.2 is necessary.

If selection according to 13.3.3 yields less than 0.5% by mass, the test is not relevant.

13.3.5 *Test Procedure*

Before continuing the test, the samples should be sieved once more on the smaller sieve of the corresponding fraction.

The prepared sample (see 13.3.4) is weighed, filled into a beaker of apropriate size and heated in an oven up to 105°C. At the same time, the NaOH base is heated up to 90°C i.e. for fractions 1.2 - 2.4 and 2.4 - 4.8 - 4% NaOH sol, for fractions 4.8 - 9.5 and 9.5 - 19 etc 10% NaOH sol.

The required quantity of NaOH base should be not less than 2.5 times the mass of sample (ml).

As soon as the prescribed temperatures are obtained the base is poured over the aggregate sample and the mixture is kept on a water bath at 90 ± 2°C for 60 min.

After 15, 30, 45 min the sample is stirred vigorously.

In order to avoid evaporation losses, the beaker should be covered with a watch glass. After termination of heating period, the hot base is decanted in less than one minute and the beaker is filled up with cold tap water, subsequently, the so treated aggregate is spread on a sieve given in the table below and washed with tap water until the dissolved and disintegrated aggregate particles and the water does no longer contain any NaOH (check with Phenolphthalein indicator).

Those particles which pass the sieve are regarded as dissolved by NaOH.

TABLE 5 — Sieve sizes for decantation/washing

Test fraction (mm)	Sieve size (mm)
1.18 - 2.36	0.6
2.36 - 5.0	1.2
5.0 - 10.0	2.4
10.0 - 20.0	4.8
20.0 - 37.5	9.5

The washed and still wet aggregate samples of the fractions 5.0 mm to 10.0 mm and greater are spread on a glass plate and checked with the steel needle for grains which were not disintegrated but turned soft at the surface. Such soft particles are regarded as disintegrated and sorted out. This check must be finished before the aggregates are dried.

After sieving off and picking out disintegrated grains the remaining aggregate is dried completely (105°C).

After cooling in a desicator, the samples are weighed. The total loss in mass, is referred to the initial mass of the particular sample and given in percentage by mass.

The initial mass of the sample is taken:

- for test fractions 1.18 - 2.36 and 2.36 - 5.0 the actual amount used for the NaOH test.
- for test fractions 4.8 - 9.5 and greater the weighed amount for the petrological test (see 13.2).

For the test fractions 1.2 - 2.4 and 2.4 - 4.8 the tests are to be done twice, and the result reported shall be the average of the two results.

The loss in mass evaluated by this test method is a measure for the portion of opal-containing rocks, mainly opaline sandstones.

13.4 Determination of reactive flint[1] content

13.4.1 *General*

The reactivity of flint with alkali bases increases with decreasing gross density of the flint particles (gross density = mass over volume including pores)

The gross density is calculated according to clause 13.4.2 (weighing under water) with the grains of test fractions retained on 5.0 mm sieve sorted out according to 13.2 (The reactive flint contained in the fractions passing 8.8 is being considered with test according to 13.3 and thus its amount is included in the amount of opal containing materials).

13.4.3 Evaluation of average gross density of the flint particles.

[1] Flint is a variety of chert.

According to the test procedure described in Clause 13.3.5 the gross density is computed as follows:-

$$\rho_{av} = \frac{M\,\text{dry}}{M\,\text{ssa} - M\,\text{sw}}\ (\text{g/cm}^3)$$

Where ρ_{av} = the average gross density of particles

M dry = the mass of particles dried to constant mass at 105°C.

M ssa = the mass of particles saturated suraface dry weighed in air.

M sw = the mass of particles saturated weighed under water.

13.4.3 *Evaluation of content of reactive flint*

For the computation of the content of reactive flint the following formula is applied:

$$Fr = \frac{Fi\,(\rho_d - \rho_{av})\ v}{(\rho_d - \rho_r)\rho_{av}}$$

Fr is the amount of reactive flint

Fi is the amount of flint in individual test fractions

ρ_d is the gross density of dense flint in g/cm³

ρ_{av} is the average gross density of flint particles tested according to 13.4.2 in g/cm³

ρ_r = gross density reactive flint in g/cm³

For the gross density of the dense flint ρ_d = 2.6 g/cm³ is assumed and for the reactive flint ρ_r = 2.0 g/cm³ is assumed. Consequently the content of reactive flint is obtained by

$$Fr = \frac{Fi\,(8.67 - 3.33)}{\rho_{av}}$$

The content shall be computed in percentage by mass to an accuracy of 0.1%.

13.5 Assessment of sensitivity of the aggregate sample to alkali reaction.

The sensitivity of the aggregatge sample to alkali reaction shall be classified according to its content of soluble silicas and reactive flints. The sensitivity classes not objectionable, limited acceptable and objectionable are stated in the table below.

TABLE 6 — Sensitivity limits of aggregates

Constituents	Maximum contents in percentage by mass for the sensitivity classes		
	Not objectionable	Limited acceptable	Objectionable
Opaline sandstone and other soluble silica minerals in material retained on 1.2 mm sieve	<0.5%	0.5 to 2.0%	>2.0%
Reactive flint in material retained on 4.8 mm sieve	<3%	3.0 to 10.0%	>10.0%
5 × opal and other [line (1)] plus reactive flint [line (2)]	<4.0%	4.0 to 15.0%	>15%

NOTE — The above classification was adopted from German specifications and considers mainly the two most reactive minerals opaline and flint. Since no experience of respective records of reactive aggregates or harmful reactions in concrete are available in Tanzania, also other questionable minerals should be considered. If deemed to be necessary, further tests should be performed, e.g. ASTM C 289 or C 227.

13.6 Report

In addition to the general informations concerning date and place of sampling, supplier, specifications of sample etc. the report shall contain the following data:

- amount of test fractions 1.18 to 2.36 mm, 2.36 to 5.0 mm, 5.0 to 10.0 mm, 10.0 to 20 mm in percentage by mass (see 13.1.1).
- content of flint and opaline sandstone plus other opal containing rocks plus questionable constituents of the individual test fractions in percentage by mass.
- average gross density of flint particles for every individual test fraction in g/cm³.
- content of opaline sandstone and other opal containing rocks and other constituents containing soluble silica, indicated by the loss in the mass of the individual test fractions after testing in NaOH base including the softened particles (see 13.3., 13.5).
- content of reactive flint in percentage by mass (13.4.3)
- classification of the sensitivity of the aggregate sample
- particular remarks e.g. list of other questionable constitutents.

APPENDIX

Recommended Preventive measures against harmful alkali - aggregate reaction

The following table gives tentative recommendations for preventive measures depending on the sensitivity class of the aggregate and the environmental conditions

TABLE 7 — *Preventive measures*

Sensitivity class of Aggregate	Environmental Conditions		
	dry	moist	moist plus external supply of alkalis
non objectionable	none	none	none
limited acceptable	none	LA-cement	LA-cement
objectionable	none	LA-cement	Substitute Aggregates

LA-cement = Low Alkali — cement containing less than 0.6% alkali (as Na_2O — Equivalent).

ANNEX 1

Sieve Analysis of Aggregate

Project: Client:

Sample No.: Location:

Description: Operator:

Total mass of dry sample (Mt)..... g Date:

Test sieve	Mass retained M	Percentage retained	Cumulative percentage M x 100 / Mt	Specification Remarks limits passing
75 mm				
63 mm				
50 mm				
37.5 mm				
28 mm				
20 mm				
14 mm				
10 mm				
6.3 mm				
5 mm				
3.35				
2.36				
1.70				
1.18 mm				
~~600 µm~~ 850				
600 µm				
425 µm				
300 µm				
212 µm				
150 µm				
150 µm				
Passing 75 µm				
TOTAL				

NOTES

1) Omit those sieves which are not included in specifications.
2) For calculating cumulative percentage passing, start with 100 and go on deducting percentage retained on each successive sieve.
3) In remarks column indicate whether sample is in conformity with specification. In the case of fine aggregate indicate grading zone number.

UNIVERSITY OF DAR ES SALAAM DEPARTMENT OF CIVIL ENGINEERING

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BUILDING MATERIALS LABORATORY
TEST REPORT NO. CB 88/04
ALKALI - AGGREGATE REACTIVITY TEST

CLIENT: TANESCO
PROJECT: KIKULETWA HYDRO POWER SITE, KILIMANJARO

Sample indication	Test Fraction sample	Fraction sample mass	Fraction sub-sample mass	Fraction sample/ sub-sample mass after test	Loss in mass	% Loss by mass
-	mm	g	g	g	g	%
KITETO Pit No. 3	1.18 - 2.36	222.6	-	221.3	1.3	0.6
	2.36 - 5.0	353.9	-	351.9	2.0	0.6
	5.0 - 10.0	433.4	214.0	212.2	1.8	0.4
KARANGA Pit No. 3	1.18 -2.36	224.2	-	221.9	2.3	1.0
	2.36 - 5.0	282.5	-	278.2	4.3	1.5
	5.0 - 10.0	579.0	296.0	290.0	6.0	1.0
T.P.C.	1.18 - 2.36	226.7	-	223.3	3.4	1.5
	2.36 - 5.0	363.2	-	358.8	4.4	1.2
	5.0 - 10.0	594.5	283.9	279.3	4.6	0.8
NYUMBA YA MUNGU	1.18 - 2.36	232.0	-	231.1	0.9	0.4
	2.36 - 5.0	211.8	-	210.5	1.3	0.6
	5.0 - 10.0	219.3	219.3	216.0	3.0	1.4
HAI <1/4"	1.18 - 2.36	392.8	-	387.3	5.5	1.4
"	2.36 - 5.0	234.0	-	230.8	3.2	1.4
HAI 1/2"	5.0 - 10.0	500.3	260.1	257.9	2.2	0.4

Date.....

Signature.....

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CUSTOMER : TANESCO	REPORT No	SHEET No

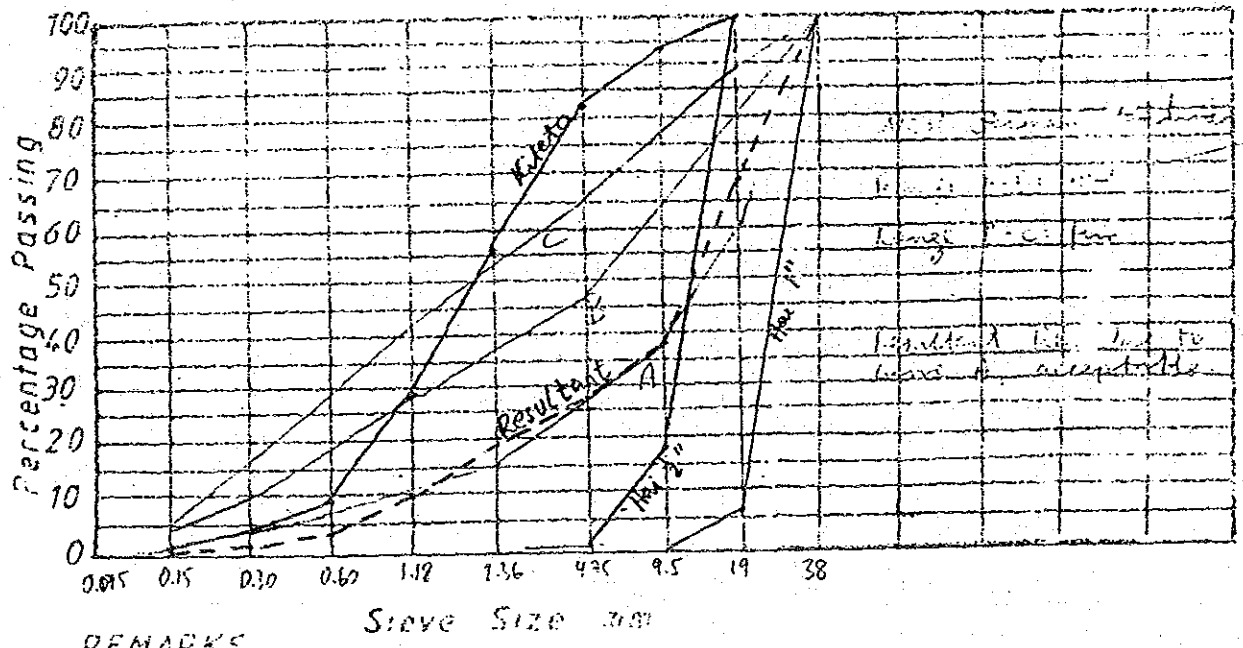
RESULTS OF SIEVE TEST

Sample Indication

Hai + Kiteto

SAMPLE	% Passing through sieves									
	0.075	0.150	0.300	0.600	1.200	2.360	4.750	9.500	19.00	38.10 mm
33% Hai ½"	—	—	—	—	—	0.1	0.3	6.0	33.3	33.3
33% Hai 1"	—	—	—	—	—	—	—	—	2.0	33.3
33% Kiteto Pit 12	—	0.2	1.3	3.0	9.7	18.6	27.3	31.3	33.3	33.3
Resultant	—	0.2	1.3	3.0	9.7	18.7	27.6	37.3	68.6	99.9

Grading Curves



REMARKS -

Mix Design, Absolute Volume Method

Total Vol of aggregates = 704 Litres $= \sum \frac{\text{Mass}}{\text{Density}} = \frac{\text{Kiteto}}{\frac{33.3M}{2.66}} + \frac{\text{Hai ½"}}{\frac{33.3M}{2.55}} + \frac{\text{Hai 1"}}{\frac{33.3M}{2.55}}$

$\rightarrow$ 99.9M = Total Mass of aggregates = 1820 kg

$\rightarrow$ Kiteto 33% $\rightarrow$ 607 kg

Hai ½" 33% $\rightarrow$ 607 kg

Hai 1" 33% $\rightarrow$ 607 kg

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CONCRETE MIX DESIGN

Plant/ Site: Kikuletwa : good site supervision Structural Element: unknown

Requirements:

Specified Characterist. Strength 25 MN/m²

Quality Control: Standard Deviation ....4.... MN/m² ; Current Margin 6.6 MN/m²

Target Mean Strength 31.6 MN/m²

Workability: medium

Durability: severe : min. 320 kg cement / m³ Concrete

Other Special Requirements:

Materials:

Cement: OPC

Producer

Type/ Strength:

Admixtures:

Type / Specification

Aggregates Hai + Kiteto

	Fraction	Type	Moisture abs. after 30mm	Density
Kiteto A_1	0 / 4.7 mm	sand	8.2%	2.66
Hai ½" A_2	4.7 / 19 mm	gravel	0.9 %	2.55
Hai 1" A_3	9.5 / 38 mm	gravel	0.9%	2.55
A_4	/ mm			

Grading Curve attached Max. Size 38 mm

Fineness Modulus 6.3

Calculation of Mix Proportion per 1m³

W/C-Ratio: 0.56

	Dry Weight kg/m³	Density kg/litre	Absolute vol. ltr	Water Absorption %	Water Absorption kg	Corrected wet weight
Cement Content C	320	3.15	102	—	—	—
Water Content W	179	1.00	179	—	—	240
Pore Content 1.5%P		—	15	—	—	—
Aggregate total A 100%			704		—	
by weight: 33% A_1 %	607	2.66		8.2%	50	
33% A_2 %	607	2.55		0.9%	5.5	
33% A_3 %	607	2.55		0.9%	5.5	
A_4 %						
Design Density of fresh Concrete	2320		1000			

Mix Proportions (parts by weight) C/W/A = 1/0.75/5.69

Proportions for a Mix of ...24... ltr:

Cement: ...7.68... kg

Water ...4.30 kg

Corr. Water + 1.46 kg

Actual Water 5.76 kg

Aggregates (Wet)

A_1 ...14.57... kg

A_2 ...14.57... kg

A_3 ...14.57... kg

A_4 ..... kg

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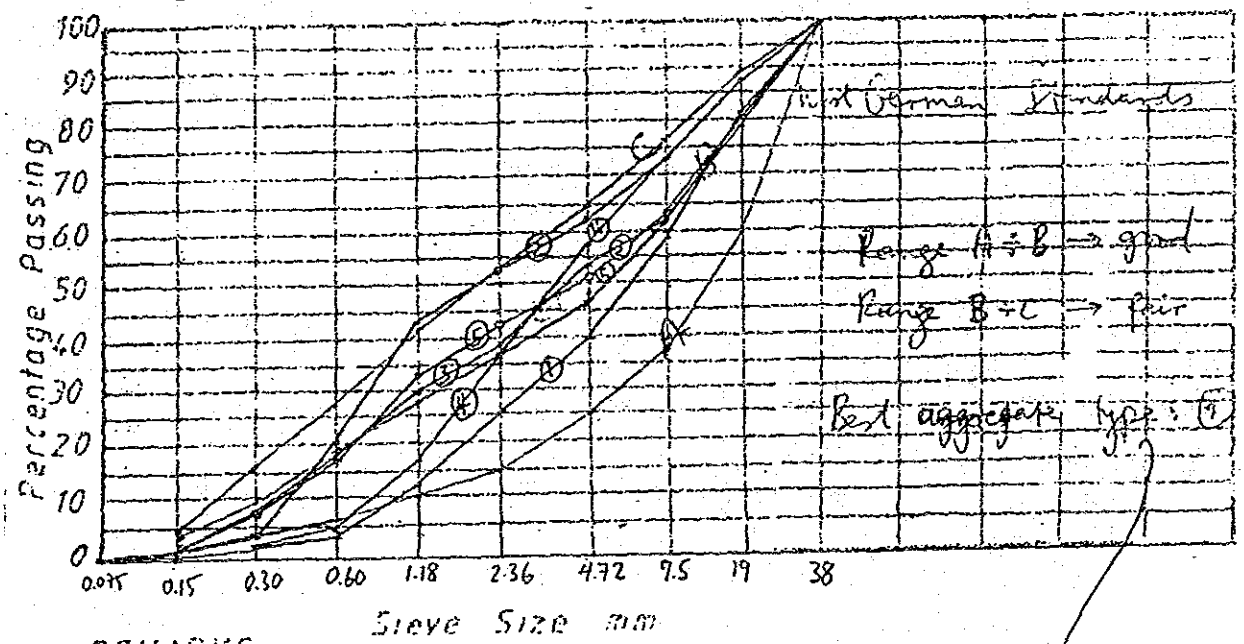
RESULTS OF SIEVE TEST

Sample Indication

Karanga : samples ≤ 38 mm.

	SAMPLE	% Passing through sieves									
		0.075	0.150	0.300	0.600	1.200	2.360	4.750	9.500	19.00	38.100 mm
Pit	3 bag 1 — 1	0.2	2.4	1.7	3.8	12.5	25.1	39.7	58.5	81.4	100
Pit	5 — 2	0.1	0.6	3.7	20.4	43.9	52.4	62.2	73.1	87.7	100
Pit	1 bag — 3	0.2	1.2	7.5	17.5	29.8	38.6	48.8	62.5	78.9	100
Pit	1 — 4	0.1	0.5	2.0	4.4	17.1	36.8	57.4	73.6	88.5	100
Pit	3 bag 1 — 5	0.4	0.9	7.5	17.9	33.4	42.4	51.5	63.4	80.2	100

Grading Curves



REMARKS -

Which is from Pit Nr 3, bag 2.

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CONCRETE MIX DESIGN

Plant/ Site: Kikuletwa. Good site supervision expected Structural Element: Unknown

Requirements:

Specified Characterist. Strength: 25 MN/m²

Quality Control: Standard Deviation ..... 4 MN/m² ; Current Margin 6.6 MN/m²

Target Mean Strength: 31.6 MN/m²

Workability: Medium

Durability: Severe → min 320 kg cement/m³ concrete.

Other Special Requirements:

Materials:

Cement: OPC

Producer

Type/ Strength:

Admixtures:

Type / Specification

Aggregates Kayanga

	Fraction	Type	Water abs. after 30 min	Density
A_1	0 / 38 mm	mixed	8.9%	2.45
A_2	/ mm			
A_3	/ mm			
A_4	/ mm			

Grading Curve attached Max. Size 38 mm

Fineness Modulus 5.8

Calculation of Mix Proportion per 1 m³

W/C-Ratio: 0.56

	Dry Weight kg/m³	Density kg/litre	Absolute vol. litr	Water Absorption %	Water Absorption kg	Corrected wet weight
Cement Content C	321	3.15	102	—	—	—
Water Content W	180	1.00	100	—	—	250
Pore Content 1.5% P	—	—	15	—	—	—
Aggregate total A 100%						
100% A_1 %	1918	2.45	783	8.9%	70	
A_2 %						
A_3 %						
A_4 %						
Design Density of fresh Concrete	2419		1000			

Mix Proportions (parts by weight) C/W/A = 1/0.78/5.98

Proportions for a Mix of 24 ltr.

Cement: 7.70 kg

Water 4.32 kg

Corr. Water + 1.68 kg

Actual Water 6.0 kg

Aggregates (Wet)

A_1 46.0 kg

A_2 ..... kg

A_3 .....

A_4 ..... Kg

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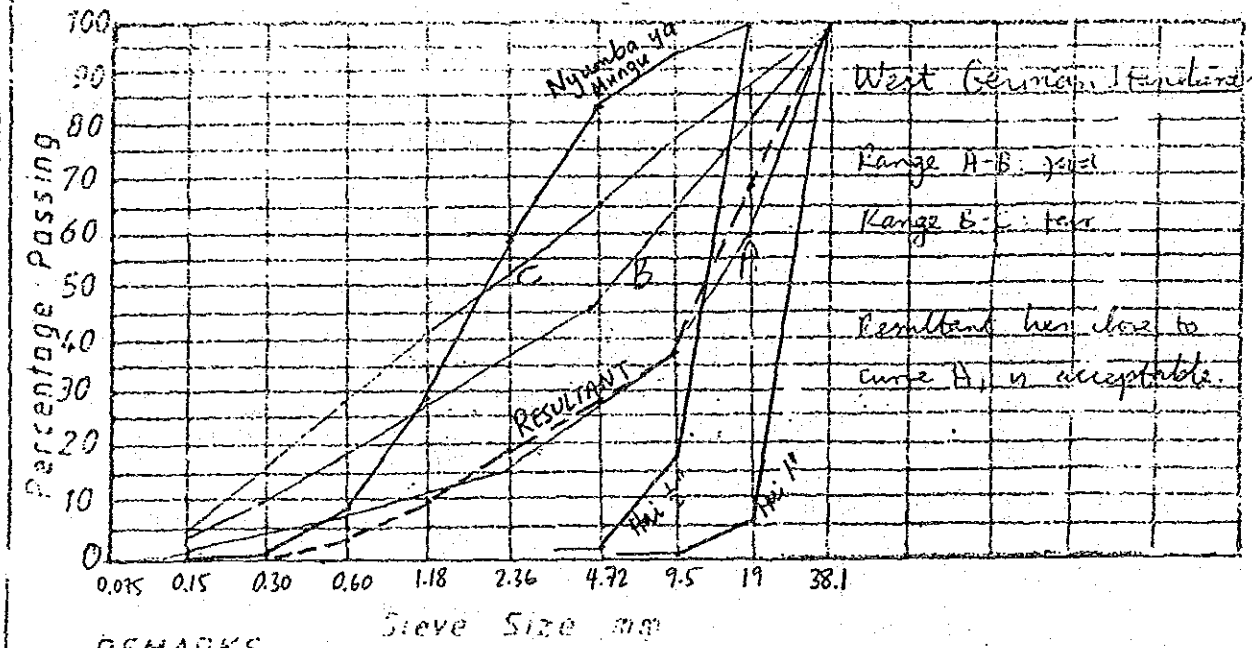
RESULTS OF SIEVE TEST

Sample Indication

Hai + Nyumba ya Mungu

SAMPLE	% Passing through sieves									
	0.075	0.150	0.300	0.600	1.200	2.360	4.750	9.500	19.00	38.100 mm
33% Hai ½"	–	–	–	–	–	0.1	0.3	6.0	33.3	33.3
33% Hai 1"	–	–	–	–	–	–	–	–	2.0	33.3
33% Ny.M.	–	0.1	0.3	2.8	9.5	18.9	27.6	31.3	33.3	33.3
Resultant	–	0.1	0.3	2.8	9.5	19.0	27.9	37.3	68.6	99.9

Grading Curves



REMARKS -

Mix Design, Absolute Volume Method : assume 100M kg of all aggregates.

Total Volume of aggregates = 704 = $\Sigma \frac{\text{Mass}}{\text{Density}} = \frac{33.3M}{2.71} + \frac{33.3M}{2.55} + \frac{33.3M}{2.55}$

N.y.M. Hai ½" Hai 1"

$\Rightarrow$ 100 M = 1831 kg/m^3 $\rightarrow$ 610 kg each of N.y. Mungu, Hai ½" and Hai 1".

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CONCRETE MIX DESIGN

Plant/ Site: Kikuletwa: good site supervision Structural Element: unknown

Requirements:

Specified Characterist. Strength: 25 MN/m²

Quality Control: Standard Deviation ..... 4 MN/m² ; Current Margin 6.6 MN/m²

Target Mean Strength: 31.6 MN/m²

Workability: medium

Durability: severe : min. 320 kg cement / m³ Concrete

Other Special Requirements:

Materials:

Cement: OPC

Producer

Type/ Strength:

Admixtures: -

Type / Specification

Aggregates Hai + Nyumba ya Mungu

	Fraction	Type	Moisture abs. after 30 min	Density
N.y.M. A_1	— / 4.7 mm	sand	3.7%	2.71
Hai ½" A_2	4.7 / 19 mm	gravel	0.9%	2.55
Hai 1" A_3	9.5 / 38 mm	gravel	0.9%	2.55
A_4	/ mm			

Grading Curve attached Max. Size 38 mm

Fineness Modulus 6.3

Calculation of Mix Proportion per 1 m³

W/C-Ratio: 0.56

	Dry weight kg/m³	Density kg/litre	Absolute vol. ltr	Water %	Water Absorption kg	Corrected wet weight
Cement Content C	320	3.15	102	—	—	—
Water Content W	179	1.00	179	—	—	213
Pore Content 1.5% P	—	—	15	—	—	—
Aggregate total A 100%			704			
N.y.M. A_1 33 %	610	2.71		3.7%	23	
Hai ½" A_2 33 %	610	2.55		0.9%	5.5	
Hai 1" A_3 33 %	610	2.55		0.9%	5.5	
A_4 %						
Design Density of fresh Concrete	2329		1000			

Mix Proportions (parts by weight) C/W/A = 1 / 0.67 / 5.72

Proportions for a Mix of ... 24 .. ltr:

Cement: ... 7.68 kg

Water ... 4.30 kg

Corr. Water + 0.82 kg.

Actual Water 5.12 kg

Aggregates (Wet)

A_1 ... 14.64 kg.

A_2 ... 14.64 kg.

A_3 ... 14.64 kg

A_4 ..... ~~kg~~

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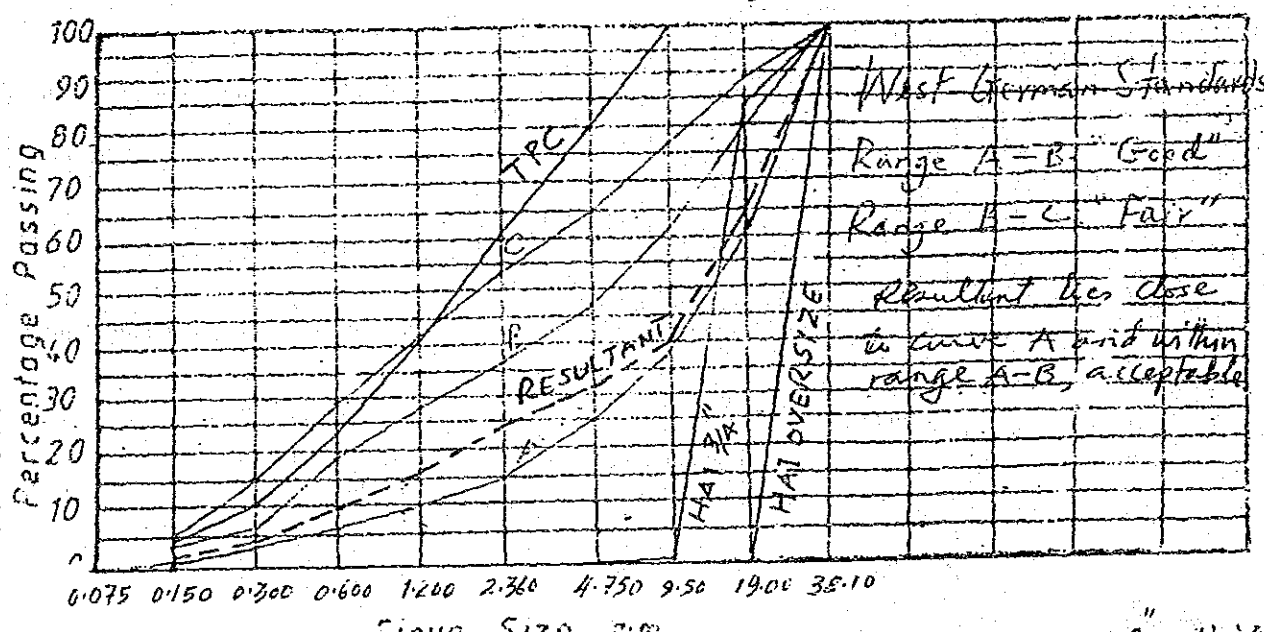
RESULTS OF SIEVE TEST

Sample Indication

HAI + TPC

SAMPLE	Percentage Passing Through Sieves									
	0.075	0.150	0.300	0.600	1.200	2.360	4.750	9.500	19.00	38.10
30% Hai %										30
30% Hai ¾"								0.3	24.9	30
40% TPC	0.4	1.6	4	9.2	16.4	24.4	32	40	40	40
Resultant	0	2	4	9	16	24	32	40	65	100

Grading Curves



REMARKS -

TPC Hai ¾" Hai %

Mix Design, Absolute Volume Method

Total Vol. of aggregates = 704 litres = $\sum \frac{\text{mass}}{\text{Densities}} = \frac{40M}{2.52} + \frac{30M}{2.55} + \frac{30M}{2.55}$

$= 39.60M \Rightarrow M = 17.87$

$\rightarrow 100M$ = Total mass of aggregates = 1787 kg

TPC	40% →	715 kg
Hai ¾"	30% →	536 kg
Hai oversize	30% →	536 kg

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CONCRETE MIX DESIGN

Plant/ Site: Kikuletwa - good site supervision Structural Element: unknown

Requirements:

Specified Characterist. Strength 25 MN/m²

Quality Control: Standard Deviation 4 MN/m² ; Current Margin 6.6 MN/m²

Target Mean Strength 31.6 MN/m²

Workability: Medium

Durability Severe: min 320 kg Cement / m³ concrete

Other Special Requirements:

Materials:

Cement: Producer OPC

Type/ Strength:

Admixtures:

Type / Specification

Aggregates Hai + TPC

	Fraction	Type	Moisture (30 min abs.)	Density
TPC A_1	19.5 mm		10.6	
Hai 3/4" A_2	9.5/38 mm		0.9	
Hai 0/5 A_3	19 /38 mm		0.9	
A_4	/ mm			

Grading Curve attached Max. Size 38 mm

Fineness Modulus 6.1

Calculation of Mix Proportion per 1 m³

W/C-Ratio: 0.56

		Dry Weight kg/m³	Density kg/litre	Absolute vol. litre	Water Absorb. %	Water Absorb. kg	Corrected wet weight
Cement Content	C	320	3.15	102	—	—	—
Water Content	W	179	1.00	179	—	—	260
Pore Content	1.5%P		—	15	—	—	—
Aggregate total A	100%			704		—	
by weight: 30% A_1	%	536	2.52		10%	71.5	
30% A_2	%	536	2.55		0.9%	4.8	
40% A_3	%	715	2.55		0.9%	4.8	
A_4	%						
Design Density of fresh Concrete		2286		1000			

Mix Proportions (parts by weight) C/WA = 1 : 0.8 : 5.58

Proportions for a Mix of 24 ltr:

Cement: 7.68 kg

Water 4.30 kg

Corr. Water - 1.9% kg.

Actual Water 6.24 kg

Aggregates (Wet)

A_1 12.9 kg

A_2 12.9 kg

A_3 17.2 kg

A_4 ..... kg

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APP. Ⅳ
WATER RIGHT IN PROJECT AREA

Registerd Water Right in Project Area

River	Name of Scheme	Location	Water Source	Regist. No. and Date	Holder	Amount	Structure	Purpose
R. Yongoma								
1.	Ndungu Sisal Estate	Ndungu Village	R. Yongoma	No.891 (05.Feb.1852)	Ndungu Sisal Estate	2.72 cusec (77.0 lit/sec) 5.55 cusec (157.1 lit/sec)	Intake weir Penstock	Domestic Use & Sisal Fafcory Hydropower
2.	Ndungu Water Supply	Ndungu, Kalimawe & Msufini Villages	R. Yongoma	No.2515 (02.Jul.1969)	Village (District)	76,800 G.P.D (4 lit/sec)	Intake weir Pipeline	Domestic Use
3.	Mroyo Furrow	Msufini Villages	R. Yongoma	No.1177 (?)	Village (District)	2 cusec (56.1 lit/sec)	Natural Intake	Irrigation
4.	Kalimawe Compensation	Ndungu Villages	R. Yongoma	No.1178 (14.Nov.1958)	Village (District)	6 cusec (169.8 lit/sec)	Intake weir	Irrigation for 126 ha
	Subtotal					16.4 cusec (464.5 lit/sec)		
R. Sesseni								
1.	Kihurio	Usambara Kankokoro Mrerekongei, Mgandu Villages	R. Sesseni	No.2640 (17.Oct/1970)	Village (District)	50,000 G.P.D (2.5 lit/sec)	Intake Pipeline	Domestic use

River	Name of Scheme	Location	Water Source	Regist. No. and Date	Holder	Amount	Structure	Purpose
R. Hingilili								
1.	Gonja Water Supply	Maore, Mpirani & Kadando Villages	R. Hingilili	No.2514 (16.Oct.1970)	Village (District)	176,600 G.D.P (9.3 lit/sec)	Intake weir Pipeline	Domestic use
2.	Gonja Irrigation	Maore Village	R. Hingilili	No.798 (?)	Village	2 cusec (56.6 lit/sec)	Natural Intake	Irrigation
3.	Gonja Irrigation	Maore, Mpirani & Kadando Villages	R. Hingilili	No.2295 (24.Nov.1964)	District	—	Kiruka & Tia dams, diversion tunnel to Bwaya river	Irrigation for 400 ha (under planning)
4.	Gonja Sugar Estate	Mpirani Village	R. Hingilili	?	Gonja Sugar Estate	2 cusec (56.6 lit/sec)	—	Irrigation for Approx. 500 ha (not used at present)
	Subtotal					4.34 cusec (123 lit/sec)		
R. Himo								
1.	Hydropower	3~4km upstream from Moshi-Tavata Rd.	R. Himo	?	Himo Sisal Estate	18 cusec	Intake, canal head tank	Hydropower
2.	Himo Irrigation	ditto	R. Himo	?	?	13 cusec	Intake, canal	Irrigation
3.	Himo Sisal Estate	ditto	Atributary on the left bank	?	Himo Sisal Estate	5 cusec	Intake, canal	Irrigation

APP. V
COMPENSATION DATA IN TANZANIA

VIWANGO VIPYA (1985/86) VYA FIDIA YA MAZAO NA MITI YA MISITU ILIYOPANDWA

Ulipaji wa Fidia

(i) Fidia italipwa kwa mtu mwenye mazao yaliyopandwa ambayo yako katika ardhi au sehemu iliyochukuliwa na inayochukuliwa na inayotakiwa kwa shughuli za kijiji, kampuni, shirika na za serikali kwa jumla na hivyo kumkosesha mkulima kipato chake cha kawaida.

(ii) Fidia italipwa tu kwa mazao yaliyopandwa kabla sehemu ya ardhi haijachukuliwa kwa madhumuni maalum.

(iii) Atakayehusika na kulipa fidia hiyo ni mtu, kijiji, kampuni, shirika, chama au wizara inayohusika na uchukuaji wa ardhi hiyo.

(iv) Fidia italipwa katika muda usiozidi mwaka mmoja tangu kuchukuliwa kwa sehemu ya ardhi inayohusika. Fidia isipolipwa katika muda huo, itabidi alipwe kutumia viwango vya fidia vitakavyokuwa vinatumika wakati malipo ya fidia yanapofanyika.

(v) Ieleweke kwamba mkulima ambaye shamba lake limechukuliwa itabidi apewe sehemu nyingine ya kulima. Kwa kawaida ardhi haina fidia isipokuwa kama kuna maendeleo yaliyofanyika kama vile usawazishaji, matuta ya kinga (contours), bwawa n.k. Fidia kwa madhumuni haya ni tofauti na ile inayolipwa kwa ajili ya mazao ambayo viwango hivi vipya vinahusika.

(vi) Malipo ya fidia ya mazao yatafanywa kwa kupitia ofisi za Wakurugenzi wa Maendeleo Wilayani.

(vii) Kwa madhumuni ya fidia, "mmea" ueleweke kama shina moja na wala si mche au matawi. Pamoja na hayo, kutokana na uotaji wake, mianzi mitatu itachukuliwa kama shina moja.

(viii) Fidia iliyoonyeshwa kwa mazao ya kudumu italipwa kwa mazao yaliyopevuka. Fidia itakuwa asilimia 50 ya viwango hivyo iwapo mimea itakuwa imeanza kuzaa (au imetimiza miaka 3 tangu kupandwa) lakini bado kufikia kutoa mavuno ya wastani. Kwa mimea ambayo bado kuzaa, fidia itakuwa asilimia 25 ya viwango vilivyoonyeshwa. Fidia kwa miche iliyoko kitaluni itakuwa asilimia 10 ya hivyo viwango iwapo haitqwezekana kuihamisha. Mimea ambayo itakuwa mikongwe na haitoi mazao yanayoridhisha itakuwa na fidia ya asilimia 25 ya viwango au inayolingana na fidia ya miti ya kuni, kutegemea ipi iliyo kubwa.

(ix) Kwa mazao ainа ya pareto, migomba, miwa, minanasi, mipapai na tangawizi ambayo yatakuwa [illegible] usiozidi mwaka mmoja, fidia itakuwa as[illegible] [illegible] mazao [illegible] [illegible] mapema zaidi kuliko mwaka na miaka [illegible]

FIDIA K/A MAZAO YA [illegible]

COMPENSATION OF IMPORTANT CROPS

MAZAO Crops	Old rates FIDIA YA 1982/83 Sh/Hecta	New rates FIDIA MPYA 1985/86 Sh/Hecta
1. NAFAKA CEREALS		
Mahindi Maize	1,575.00	5,775.00
Mpunga - (wa bondeni-irrigated paddy - Milimani (Flood-plain)	4,500.00 2,100.00	12,000.00 5,600.00
Mianzi Bamboo (up-land)	1,200.00	3,000.00
Ngano Wheat	2,500.00	6,000.00
Ulezi Millet	1,050.00	4,180.00
Uwele Millet	650,00	3,000.00
2. MBEGU ZA MAFUTA		
Alizeti - Nyeusi	2,900.00	8,400.00
Sunflower - Jupita		7,400.00
- Mchanganyiko		6,700.00
Karanga Ground nuts (peanuts)	3,480.00	10,740.00
Nyonyo (Carior)	935,00	2,700.00
Ufuta	2,423.00	6,250.00
3. AINA YA MAHARAGE LEGUMES		
Choroko	2,250.00	7,740.00
Maharage Beans	1,750.00	6,000.00
Mbaazi	975.00	3,360.00
Mikunde	1,375.00	4,740.00
Njugumawe	1,875.00	6,220.00
4. AINA YA MIZIZI ROOTS/FIBRES		
Magimbi	3,500.00	3,735.00
Mihogo cassava	4,200.00	4,500.00
Viazi vitamu	3,000.00	3,195.00
Viazi vikuu	6,600.00	7,065.00
5. MBEGU SEEDS/GREENS		
Babia	7,350.00	15,000.00
Bilinganya	10,000.00	20,000.00
Kabichi Cabbage		20,000.00
Mchicha		8,000.00
Nyanya Tomatoes		50,000.00
Vitunguu Onions		40,000.00
Karoti Carrots		20,000.00
Mahoga Cucumber		22,500.00
Matikitimaji		24,000.00
6. MENGINE OTHERS		
Pamba cotton	2,250.00	6,500.00
Tumbaku - Mvuke	13,500.00	28,425.00
tobacco - Moto	7,435.00	15,145.00
- Burley	4,450.00	5,034.00

.../3...

FIDIA YA M/Z/O YA KUDUMU
COMPENSATION OF PERMANENT CROPS

① Plants per Hectare Average Shs (Current) ≃ 1yr	② Compensation per Hectare (Shs)	Each/Every Plant (Tree)	Old rates FIDIA YA SASA 1982/83 For each tree Kila mmea (mti) Shs.	for each hectare Kila Hekta Shs.	New rates FIDIA MPYA 1985/86 New Compensation Rate(s) Kila mmea (Mti) Shs.	Mimea katika Hekta Wastani Shs.	Fidia kwa Hekta Shs.
						①	②
1. Mazao ya Biashara Cash Crops							
Katani (Sisal)			15	60,000/=	45	4,000	180,000/=
Mibuni (Coffee)-ikipwandwa na migomba			175	148,750/=	450	850	382,500/=
-ikipandwa pekee			175	-	450	1,075	483,750/=
Michai (tea)			20	200,000/=	56	10,000	560,000/=
Minazi (coconut palm)			215	26,875/=	564	125	70,500/=
Mikakao (Cocoa)			215	129,000/=	564	600	338,400/=
Mikorosho (Cashew)			215	21,500/=	564	100	56,400/=
Miwa (Sugar cane)			10	125,000/=	22	12,500	275,000/=
Miwati (Wattle)			15	15,000/=	45	1,000	45,000/=
Pareto (Pyrethrum)			5	200,000/=	6	40,000	240,000/=
2. Matunda Fruits							
Embe mafuta (avocado)			175	13,125/=	450	75	33,750/=
Michenza (tangerine)				-	225	250	56,250/=
Michungwa (orange)			175	43,750/=	450	250	112.500/=
Miembe (mango)			175	13,125/=	450	75	33,750/=
Mifenesi (jack fruit)			175	13,125/=	450	75	33,750/=
Migomba (Plantain, banana)			85	63,750/=	225	750	168,750/=
Mikware (oyster nut)			85	12,750/=	225	150	33,750/=
Mikongomanga (pammegrase)			85	21,250/=	225	250	56,250/=
Minanasi (pincapple)			5	50,000/=	11	10,000	110,000/=
Mipapai (pawpaw)			45	36,000/=	112	800	89,600/=
Mipera (guava)			45	6,750/=	112	150	16,800/=
Mistaferi (custard apple)			45	15,750/=	112	350	39,200/=
Mitende (date palm			215	26,875/=	564	125	70,500/=
Midimu, Milimau, (lime, lemon)			85	21,250/=	225	250	56,250/=
3. VIKOLEZO Seasonings							
Iliki (Cardamom)			85	68,000/=	225	800	180,000/=
Mdalasini (Cannamom)			20	30,000/=	56	1,500	84,000/=
Mikungumanga			85	12,750/=	225	150	33,700/=
Pilipilimanga (black pepper)			20	30,000/=	56	1,500	84,000/=
Pilipili-hoho (sweet pepper)			-	-	56	1,500/=	84,000/=
Tangawizi (ginger)			10	150,000/=	22	15,000	330,000/=
4. MENGINE Others							
Michikichi (oil palm)			175	26,250/=	450	150	61,500/=
Mianzi (bamboo)			10	-	22	-	
Mizabibu (grape vine)			85	154,700	225	1,820	409,500/=
Misufi (Kapok)			45	-	112	-	-
Mlozi (indian almond)			45	-	112	-	-
Mafura, mizeituni (Ethiopian Mahageny)			175	-	450	-	-

.../4...

FIDIA YA MITI YA MISITU ILIYOPANDWA
COMPENSATION OF FOREST OF PLANTATION RESOURCES

SEHEMU A:

Aina ya miti/magogo imeonyeshwa katika sehemu ya pili (second schedule) ya sheria ya Misitu. Fidia italipwa kwa mita ya ujazo kipimo halisi juu ya ganda (M).

Fungu la 1: Magogo (Logs)

Aina ya Magogo Type of logs	Old rates Fidia (1981) (Shs.)	New rates Fidia Mpya
I	850.00	1,020.00
II	175.00	210.00
III	120.00	144.00
IV	80.00	96.00
V	60.00	72.00
VI	40.00	48.00

Vipimo vya ujazo vya magogo vitakadiriwa kutokana na mzingo wa kati na urefu kufuatana na jedwali za ujazo wa magogo.

Fungu la 2: Nguzo (Poles)

Daraja 1

Zaidi ya cm 15 lakini si zaidi ya cm 20 za kipenyo(diameter) juu ya ganda katika sehemu ya shina (butt).

Nguzo za mashambani (plantation poles) ..... Shs.1.00 kwa kila mita ya urefu.

Nguzo zilizo na kipenyo zaidi ya cm 20 sehemu ya shina zitapimwa kama magogo na kufidiwa kwa viwango vilivyowekwa. Nguzo zitakazofidiwa kwa urefu zitapimwa hadi sehemu ya ncheni yenye kipenyo kisichopungua cm 5 juu ya ganda.

Fungu 3: Fito (Withies)

Nguzo zenye kipenyo chini ya cm 5 sehemu ya shina zitafidiwa Shs.2/= kwa kila mzigo mmoja au kila fito zisizozidi 50.

Fungu 4: Kuni (Firewood)

Fidia ya kuni itatolewa kufuatana na uwingi kama ifuatavyo:-

(i) Kuni za msituni pamoja na miti migumu iliyopandwa ..... Shs.2.00 kila fungu ya mita ya ujazo.

(ii) Kuni za mashambani ..... Shs.2.00 kila fungu la mita ya ujazo (miti laini).

Fungu 5: Mkaa

Fidia ya kuni zitumikazo kutoa mkaa italipwa kufuatana na kiwango kilichowekwa kulingana na uwingi wa kuni. Njia nyingine, fidia italipwa kwa kiwango cha Shs.4.00 kila gunia likichukuliwa kuwa na uzito wa kilo 28.

Fungu 6: Umondo (Raffia fibre) Shs.220.00 kwa kilo 1,000.

../5...

一六七折

Fungu 7: Mbegu za Miche

Mbegu ..... Fidia italingana na gharama ya ukusanyaji wa mbegu

(a) Miche

Mche mmoja usio wa mapambo (non-ornamental) ..... Shs.2/= kila mche

(b) Miche ya mapambo ..... Shs.3/= kwa kila mche

(c) Miti ya Krismas .....Shs.10/= kwa kila mita ya urefu.

Fungu 8: Mazao ya Mikoko (Mangrove produce)

(i) Magogo, ikiwa pamoja na nguzo zenye kipenyo kinachozidi cm thelathini sehemu ya usawa wa mita 1.3 juu ya ardhi kufuatana na viwango vilivyowekwa katika mafungu I na V ya magogo.

(ii) Nguzo

Daraja I ..... Kipenyo cm 20 shinani - 30 sehemu ya usawa wa mita 1.3 juu ya ardhi	Shs.160.00 kwa kila 20 (score) au kulingana na sehemu ya kipimo hiki (pro rata)
Daraja II ..... ~~cm 15 - 20 kipenyo sehemu ya shina~~	Shs.100.00 kwa kila 20 (Score) au kulingana na sehemu ya kipimo hiki
Daraja III ..... cm 10 - 15 kipenyo sehemu ya shina	Shs.60.00 kwa kila 20 au kulingana na sehemu ya kipimo hiki.
Daraja IV ..... cm 5 - 10 za kipenyo sehemu ya shina	Shs.30.00 kwa kila 20 au kulingana na sehemu ya kipimo hiki.
~~Daraja V~~ ..... si zaidi ya cm 4 za kipenyo shinani	Shs.20.00 kwa kila 20 au kulingana na sehemu ya kipimo hiki.

Fungu 9:

Viwango vya fidia kwa ajili ya miti ya misitu ambayo haikuonyeshwa katika sehemu ya A na B vitaamuliwa na Mkurugenzi wa Misitu.

SEHEMU B:

Fidia kwa mazao ya misitu iliyopandwa (plantation forest produce) iwapo itakatwa i.. itakuwa ~~kama~~ ifuatavyo:-

.../6..

Fungu 1: Miti laini (Softwood)

Chini cm 10 (juu ya ganda)	Shs.70.00 mita ya ujazo (juu ya ganda)
Cm 10 - 20	Shs.80.00 " " " "
Cm 21 - 25	Shs.90.00 " " " "
Cm 26 - 30	Shs.100.00 " " " "
Cm 31 - 35	Shs.110.00 " " " "
Cm 36 - na zaidi	Shs.120.00 " " " "

Fungu 2: Miti migumu (Hardwood)

Kipenyo sehemu ya Kimo cha kifua (cm juu ya ganda)	Shs/mita ya ujazo kipimo halisi juu ya ganda			
Chini ya cm 20	Fidia kama nguzo	Fidia kama nguzo	Fidia kama nguzo	Fidia kama nguzo
21 - 30	60	150	50	50
31 - 40	75	200	75	100
41 - 45	120	300	100	100
46 - 50	180	300	125	100
Zaidi ya 50	180	300	150	100

APP. VI
HYDRAULIC CALCULATION

APP. VI

HYDRAULIC CALCULATION

(1) OPEN CANAL

(2) CULVERT

(1) Hydraulic Calculation of Open Canal

The most economical cross section of open canal is designated to flow the maximum discharge under the condition which makes wetted perimeter be minimum for a given cross section.

That is:

Cross Section of Canal : $A = (B + mho)ho$

Bottom of canal : $B = (A/ho) - mho$

Wetted Perimeter : $P = B + 2\sqrt{1+m^2}\,ho$

$$P = \frac{A}{ho} + ho\,(2\sqrt{1+m^2} - m)$$

Assuming that cross section of canal (A) is given, the relation of bottom width (B) and water depth (ho) for the most economical cross section is derived as follows.

$$B/ho = 1/2\,(\sqrt{1+m^2} - m)$$

On the other hand, uniform flow is given by the following equation.

$$\frac{Q.n}{\sqrt{So}} = AR^{2/3} = \frac{\{\frac{ho}{B} + m\,(\frac{ho}{B})^2\}^{5/3}}{(1 + 2\sqrt{1+m^2}\,\frac{ho}{B})^{2/3}} \times B^{8/3}$$

$$= K \times (\frac{ho}{B}) \times B^{8/3}$$

K-value for the most economical cross section is:

$$K = \frac{Q.n}{B^{8/3}\sqrt{So}} = \frac{2 \times \sqrt{1+m^2} - m}{2^{10/3} \times (\sqrt{1+m^2} - m)^{8/3}}$$

In case that the following canal data are given, K-value and bottom width for the most economical cross section is respectively calculated as follows.

Hydraulic slope (1/So)	: 1/1,000
Roughness coefficient (n)	: 0.014
Discharge (Q)	: 17.9 cu.m/sec
Side slope of canal (m)	: 0.3

Then,

$$K = \frac{2\sqrt{1+m^2} - m}{2^{10/3} \times (\sqrt{1+m^2} - n)^{8/3}}$$

$$= \frac{2 \times \sqrt{1+0.3^2} - 0.3}{2^{10/3} \times (\sqrt{1+0.3^2} - 0.3)^{8/3}} = 0.390$$

$$B = \left(\frac{Q.n.\sqrt{So}}{K}\right)^{3/8}$$

$$= \left(\frac{17.9 \times 0.014 \times \sqrt{1000}}{0.390}\right) = 3.09$$

Based on the above-said calculation, the width of bottom canal (B) is 3.0 m.

Calculation of Discharge for Open Canal

$A = (B + mho) \times ho = (3 + 0.3ho) \times ho$

$P = B + 2ho\sqrt{1+m^2} = 3 + 2.088 \times ho$

$R = A/P$

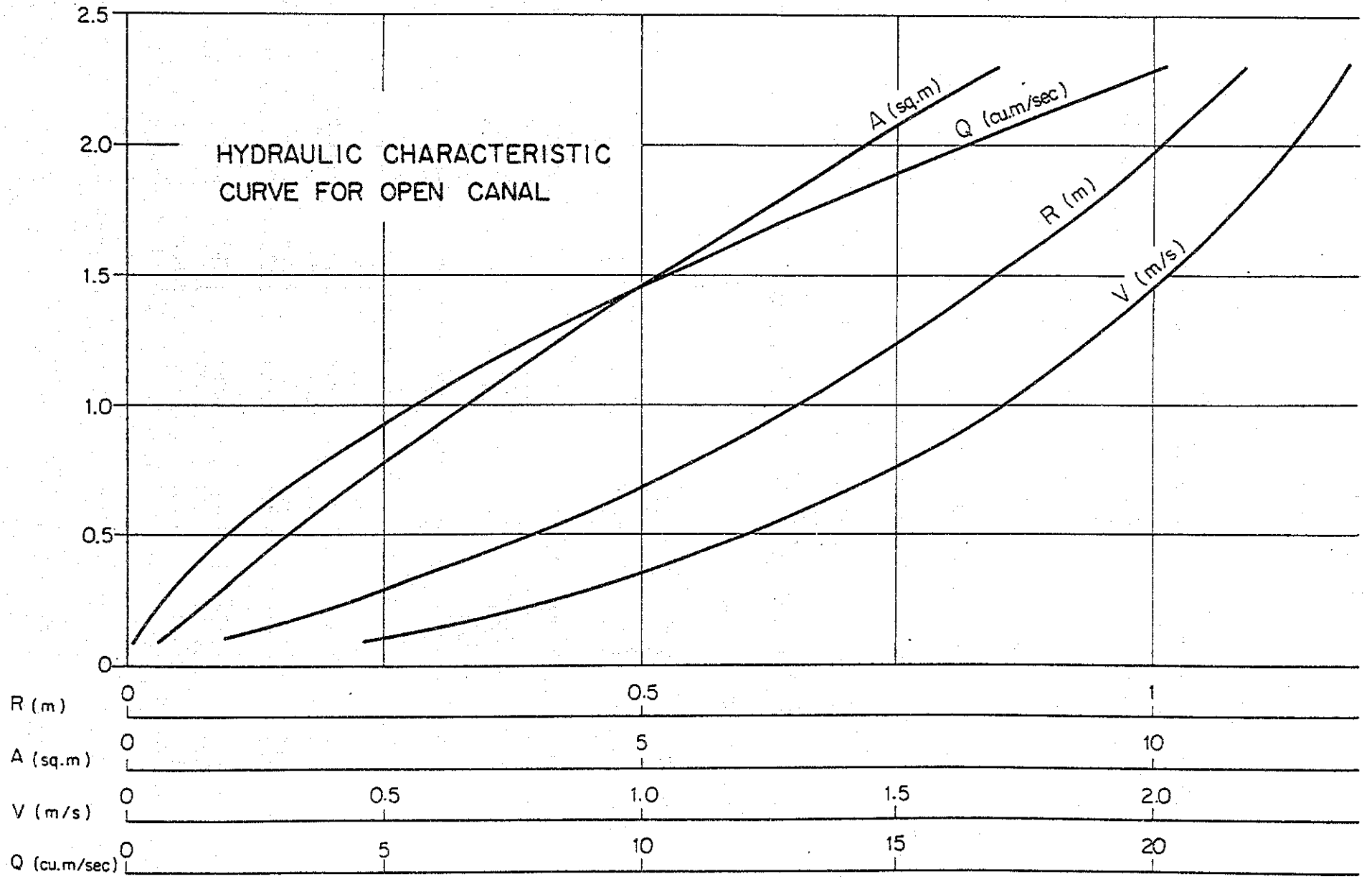
$I^{1/2} = (1/1,000)^{1/2} = 0.0316$

$1/n = 1/0.014 = 71.4286$

$V = 1/n \times R^{2/3} \times I^{1/2}$

$= 2.257 \times R^{0.667}$

H	A	R	V	Q
0.10	0.303	0.094	0.466	0.141
0.20	0.612	0.179	0.716	0.438
0.30	0.927	0.256	0.910	0.843
0.40	1.248	0.325	1.066	1.331
0.50	1.575	0.389	1.202	1.894
0.60	1.908	0.449	1.323	2.524
0.70	2.247	0.504	1.429	3.211
0.80	2.592	0.555	1.524	3.950
0.90	2.943	0.603	1.611	4.740
1.00	3.300	0.649	1.692	5.582
1.10	3.663	0.692	1.766	6.467
1.20	4.032	0.732	1.833	7.391
1.30	4.407	0.771	1.898	8.363
1.40	4.788	0.808	1.958	9.374
1.50	5.175	0.844	2.022	10.464
1.60	5.568	0.878	2.069	11.522
1.70	5.967	0.911	2.121	12.565
1.80	6.372	0.943	2.170	13.830
1.90	6.783	0.974	2.218	15.043
2.00	7.200	1.003	2.262	16.283
2.10	7.623	1.032	2.305	17.570
2.20	8.052	1.060	2.346	18.894
2.30	8.487	1.088	2.388	20.264


HYDRAULIC CHARACTERISTIC
CURVE FOR OPEN CANAL
A (sq.m)
Q (cu.m/sec)
R (m)
V (m/s)
2.5
2.0
1.5
1.0
0.5
0
R (m)
0
0.5
1
A (sq.m)
0
5
10
V (m/s)
0
0.5
1.0
1.5
2.0
Q (cu.m/sec)
0
5
10
15
20

(2) Hydraulic Calculation of Culvert

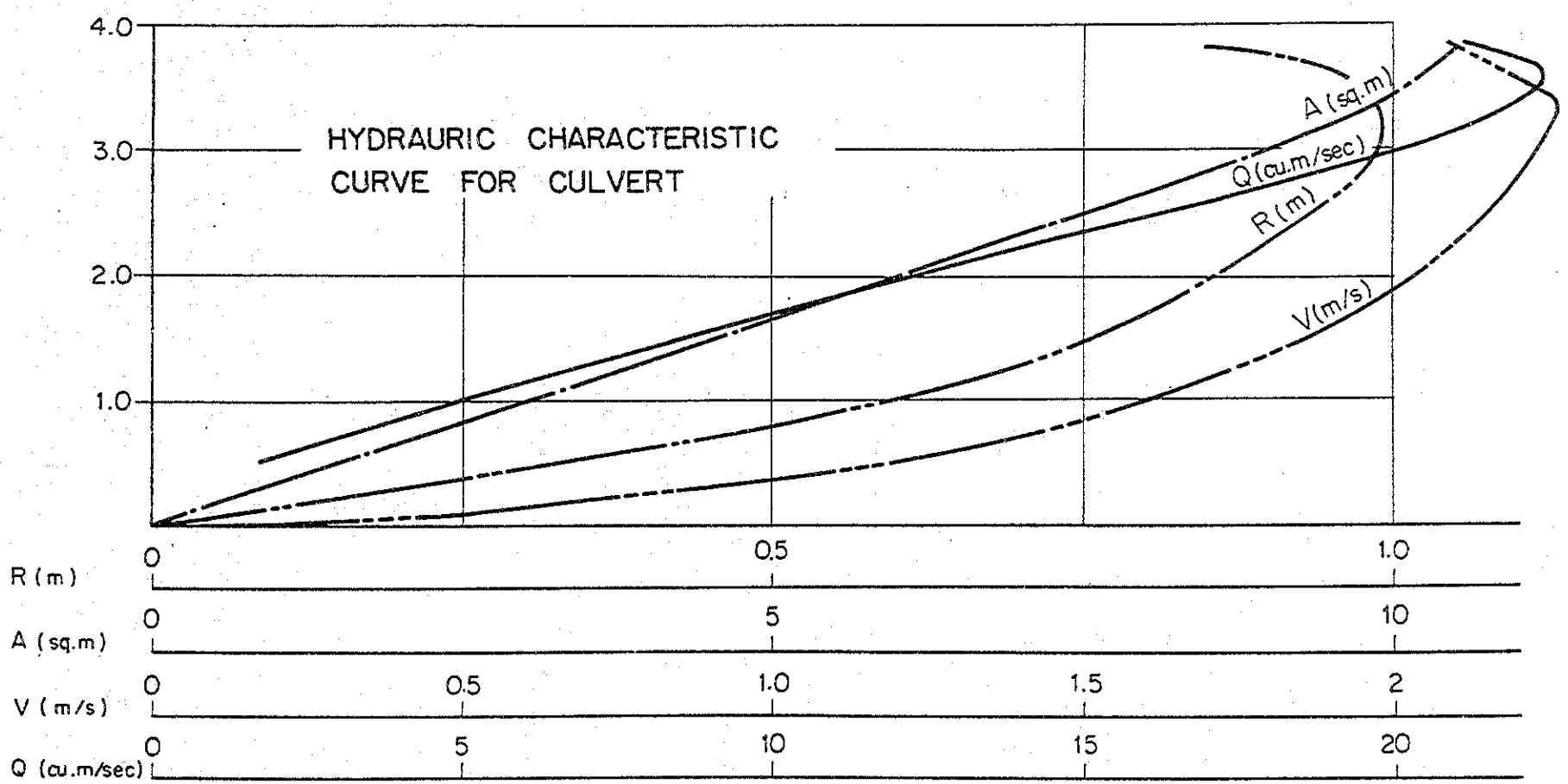
Bottom width of canal : $B = 2x = 3m$
Depth of canal : $H = 2x + \delta = 3.8$ cm
Radius of upper circulator portion : $\gamma_0 = x = 1.5$ m
Height of lower rectangular portion: $hl = x + \delta = 2.30$ m
Cross section : $Ao = 3.571x^2 + 2x\delta = 10.435$
Perimeter of cross section : $Po = 7.142x + 2\delta = 12.313$
Cross section area of flow : $A = Ao - (\theta ox^3 - ho\sqrt{x^2-ho^2})$
Wetted perimeter : $P = Po - 2\theta ox$

θo = rad θo

$\sin (90° - \theta o) = \frac{ho}{x}$

Calculation of Discharge for Culvert

H	A	R	$R^{3/2}$	V	Q
0.5	2.5	0.375	0.52	1.174	1.761
1.0	8.0	0.600	0.7113	1.605	4.816
1.5	4.5	0.750	0.825	1.862	8.379
2.0	6.0	0.857	0.902	2.036	12.214
2.3	6.9	0.908	0.938	2.114	14.592
2.4	7.192	0.914	0.942	2.125	15.288
2.5	7.505	0.937	0.957	2.160	16.210
2.6	7.794	0.950	0.966	2.180	16.993
2.7	8.08	0.961	0.974	2.198	17.773
2.8	8.372	0.971	0.981	2.213	18.531
2.9	8.654	0.978	0.986	2.225	19.255
3.0	8.921	0.985	0.990	2.234	19.932
3.1	9.181	0.989	0.992	2.239	20.556
3.2	9.427	0.989	0.993	2.241	21.128
3.3	9.660	0.987	0.991	2.237	21.060
3.4	9.878	0.981	0.987	2.228	22.005
3.5	10.066	0.970	0.980	2.212	22.264
3.6	10.232	0.952	0.968	2.184	22.354
3.7	10.362	0.924	0.949	2.142	22.194
3.8	10.434	0.847	0.896	2.022	21.100


HYDRAURIC CHARACTERISTIC
CURVE FOR CULVERT
4.0
3.0
2.0
1.0
A (sq.m)
Q (cu.m/sec)
R (m)
V (m/s)
R (m)
0
0.5
1.0
A (sq.m)
0
5
10
V (m/s)
0
0.5
1.0
1.5
2
Q (cu.m/sec)
0
5
10
15
20

APP. VII
TOPOGRAPHICAL MAP

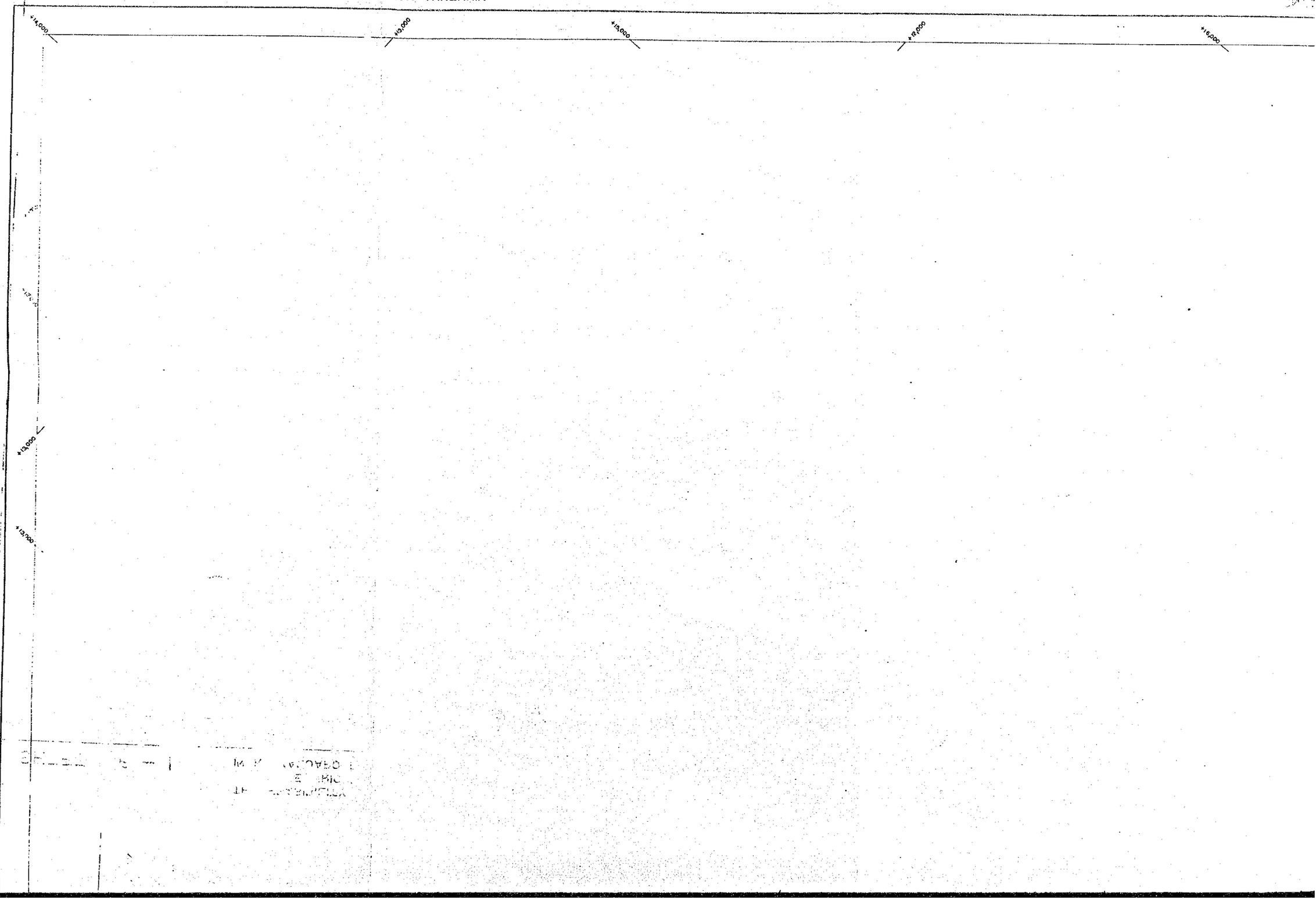
APP. VII

TOPOGRAPHICAL MAP

(1)	TOPOGRAPHICAL MAP (Scale 1 : 5,000)	6 reduced sheets
(2)	TOPOGRAPHICAL MAP (Scale 1 : 500)	3 reduced sheets

SHEET 6 – 1

THE FEASIBILITY STUDY ON SMALL-SCALE
HYDROELECTRIC POWER DEVELOPMENT PROJECT
IN KILIMANJARO REGION TANZANIA



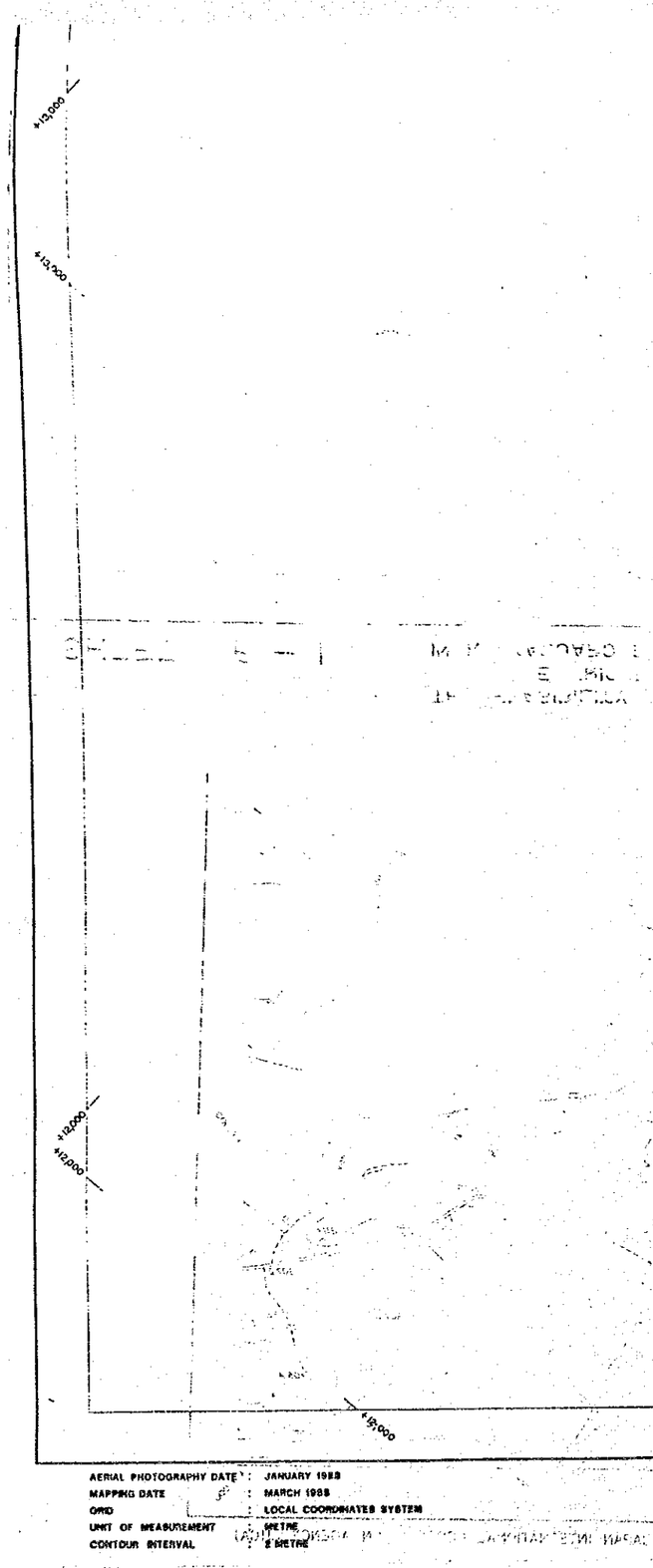
ON SMALL-SCALE
DEVELOPMENT PROJECT
TANZANIA

+15,000
+20,000
+16,000
+11,000
+16,000
+1,000
+15,000

INDEX TO ADJOINING SHEETS

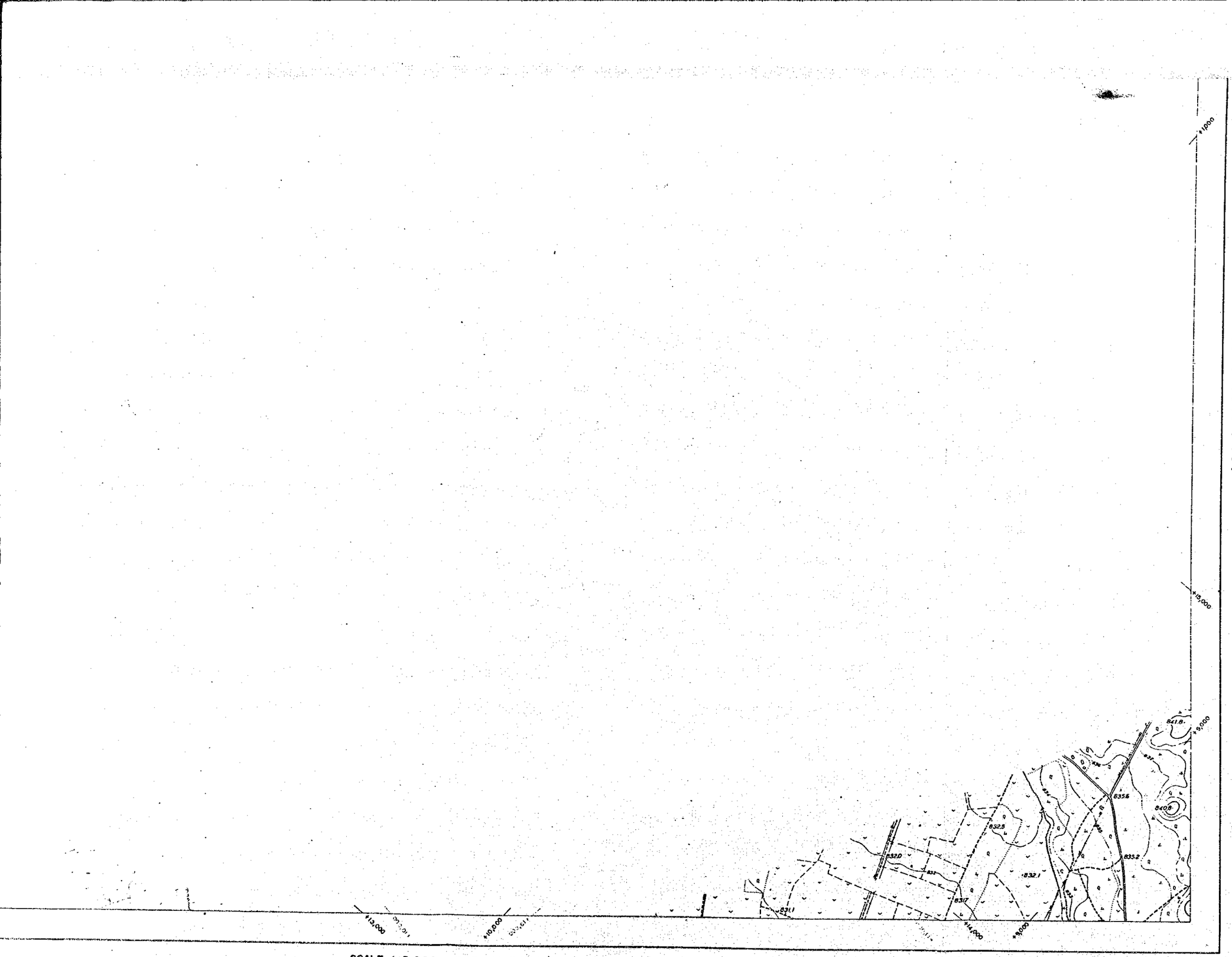
6-1	6-2	6-3
6-4	6-5	6-6

LEGEND



AERIAL PHOTOGRAPHY DATE : JANUARY 1988
MAPPING DATE : MARCH 1988
GRID : LOCAL COORDINATES SYSTEM
UNIT OF MEASUREMENT : METRE
CONTOUR INTERVAL : 5 METRE

SCALE 1:5,000



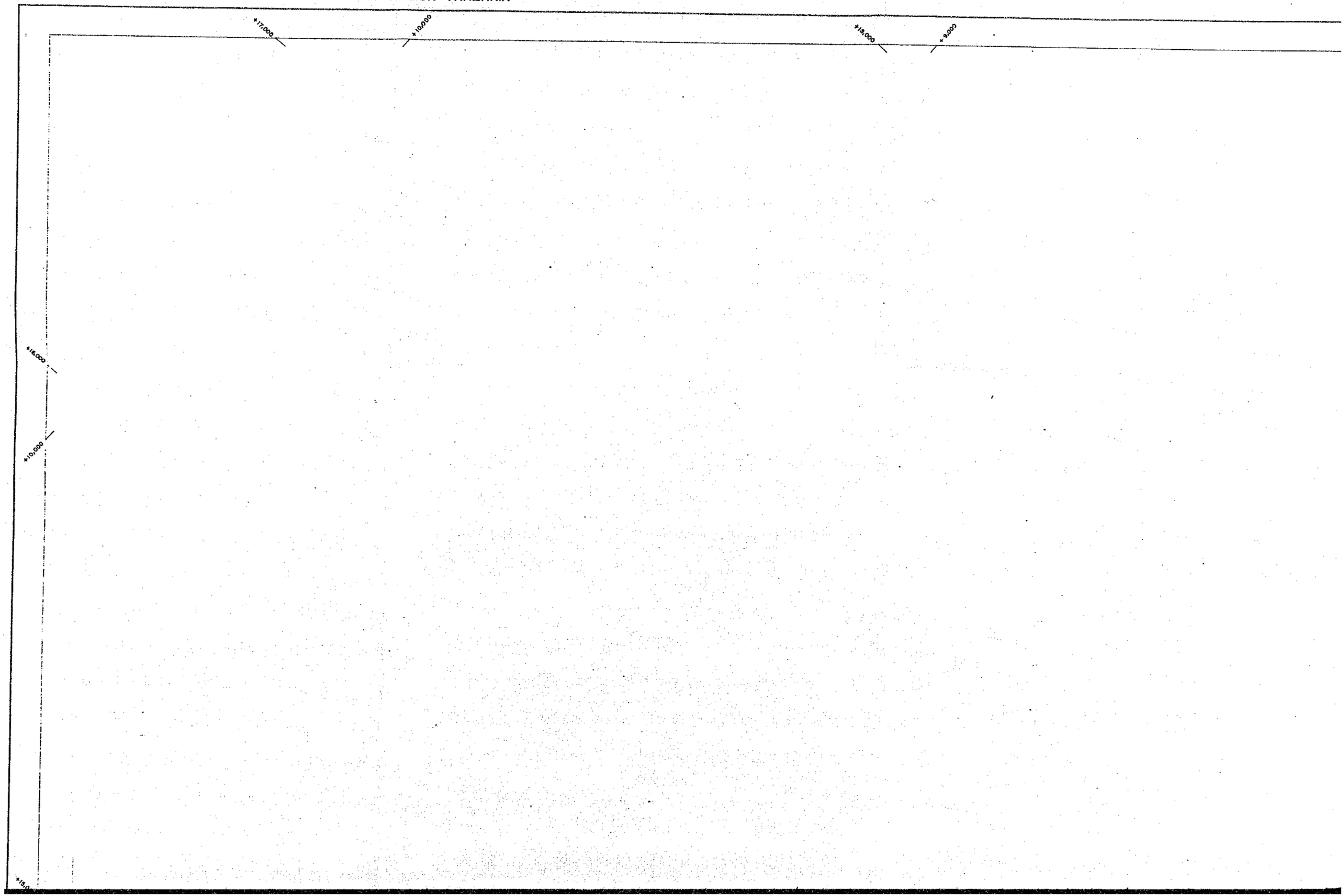
SCALE 1:5,000

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

SHEET 6 – 1

SHEET 6 – 2

THE FEASIBILITY STUDY ON SMALL-SCALE
HYDROELECTRIC POWER DEVELOPMENT PROJECT
IN KILIMANJARO REGION TANZANIA



ON SMALL-SCALE
DEVELOPMENT PROJECT
TANZANIA

INDEX TO ADJOINING SHEETS

6-1	6-2	6-3
6-4	6-5	6-6

LEGEND

AERIAL PHOTOGRAPHY DATE : JANUARY 1988
MAPPING DATE : MARCH 1988
GRID : LOCAL COORDINATES SYSTEM
UNIT OF MEASUREMENT : METRE
CONTOUR INTERVAL : 2 METRE

SCALE 1:5,000