4.3 GENERATED TRAFFIC

Forest covers 35 % of the area influenced by the new road (4,300 km^2), according to the survey by a German Forestry Mission. The commercially exploitable timber of moist semi-deciduous and moist evergreen species are estimated as follows:

TABLE 4-6 TIMBER RESOURCES IN PROJECT AREA

	Moist Semi-deciduous	Moist Evergreen	Total
Commercially Exploitable area			
(%)	7	24	-
(km^2)	105	361	466
Exploitable timber			
(m^3/km^2)	1,343	1,930	-
(m^3)	141,000	696,700	837,700

On assumption that the production cycle is 25 years on an average, the annually exploitable timber volume is estimated at 33,500 m^3. Such volume of timber is presumed to be extracted at gradually increasing rates, and the volume of extraction and generated traffic is estimated as tabulated on Table 4-7.

TABLE 4-7 TIMBER EXTRACTION AND TRAFFIC

Year	Annual Commercial Potential (m^3)	Annual Extraction (%)	(m^3)	A D T
1984	33,500	20	6,700	3
85	33,500	25	8,375	4
86	33,500	30	10,050	4
87	33,500	35	11,725	5
88	33,500	40	13,400	6
89	33,500	45	15,075	7
90	33,500	50	16,750	7
91	33,500	55	18,425	8
92	33,500	60	20,100	9
93	33,500	65	21,775	10
94	33,500	70	23,450	10
95	33,500	75	25,125	11
96	33,500	80	26,800	12
97	33,500	85	28,475	12
98	33,500	90	30,150	13
99	33,500	95	31,825	14
2000	33,500	100	33,500	15
1	33,500	100	33,500	15
2	33,500	100	33,500	15
3	33,500	100	33,500	15

$$ADT = \frac{\text{Annual Extraction} \times 0.8}{\text{Truck Capacity (10 t)}} \times 1/365 \times 2$$

Development for agriculture in the area influenced by the new road will also be accelerated due to opening of the new road, for marketing, as well as improvement of such cultivation techniques as application of improved seed, and varieties, application of fertilizer and insecticide, agricultural extension services, etc. The area for cultivation of major crops is estimated as follows:

TABLE 4-8 CULTIVATION AREA

	Lofa County /1	Area Influenced by New Road /2
Total area (km^2)	23,570	4,300
Cultivated area:		
(%)	2.3	2.3
(Ha.)	55,200	9,890
Rice	33,200 (60.1 %)	5,940
Coffee	6,750 (12.3 %)	1,220
Cocoa	5,450 (9.9 %)	980
Others	9,800 (17.7 %)	1,750

/1 Ministry of Planning and Economic Affairs
/2 Rates assumed to be proportionate to that of Lofa Country

The area of cultivation and the production of major crops in the Project area under with- and without project condition is estimated as shown on Table 4-9 to Table 4-12.

On the assumption that all the products of coffee and cocoa and a half of rice production will be transported to Monrovia area by 5-ton trucks, the traffic induced from agricultural development in the area influenced by the new road is estimated as summarized in Table 4-13.

TABLE 4-9 AREA OF CULTIVATION (RICE)

(ha.)

	Without Project	With Project			
		Upland		New	New
	Traditional Upland Rice/1	Tradit./2	Improv.	Upland	Swamp
1984	6,140	4,940	1,200	150	50
1985	6,340	3,940	2,400	300	50
1986	6,550	2,950	3,600	500	100
1987	6,760	1,760	5,000	1,000	150
1988	6,990	-	6,990	1,500	150
1989	7,220	-	7,220	2,000	200
1990	7,460	-	7,460	2,000	300
1991	7,700	-	7,700	2,000	500
1992	7,960	-	7,960	2,000	500
1993	8,220	-	8,220	2,000	500
1994	8,490	-	8,490	2,000	500
1995	8,770	-	8,770	2,000	500
1996	9,060	-	9,060	2,000	500
1997	9,360	-	9,360	2,000	500
1998	9,670	-	9,670	2,000	500
1999	9,990	-	9,990	2,000	500
2000	10,320	-	10,320	2,000	500
2001	10,660	-	10,660	2,000	500
2002	11,010	-	11,010	2,000	500
2003	11,370	-	11,370	2,000	500

Remarks: /1 increased at 3.3 % (equiv. to population increase rate) 5,940 ha. in 1978-83.

/2 traditional upland rice cultivation will be improved in 5 years.

TABLE 4-10 PRODUCTION OF RICE

(t)

Year	Without Project	With Project			
		Upland		Swamp	Total
		Tradit.	Impr./New		
1984	7,370	5,930	2,300	165	8,395
1985	7,610	4,730	4,590	165	9,485
1986	7,860	3,540	6,970	300	10,810
1987	8,110	2,110	10,200	500	12,810
1988	8,390	_	14,430	500	14,930
1989	8,660	_	15,670	660	16,330
1990	8,950	_	16,080	990	17,070
1991	9,240	_	16,490	1,650	18,140
1992	9,550	_	16,930	1,650	18,580
1993	9,860	_	17,370	1,650	19,020
1994	10,190	_	17,870	1,650	19,480
1995	10,520	_	18,310	1,650	19,960
1996	10,870	_	18,800	1,650	20,450
1997	11,230	_	19,310	1,650	20,960
1998	11,600	_	19,840	1,650	21,490
1999	11,990	_	20,380	1,650	22,030
2000	12,380	_	20,940	1,650	22,590
2001	12,790	_	21,520	1,650	23,170
2002	13,210	_	22,120	1,650	23,770
2003	13,640	_	22,730	1,650	24,380

Remarks: Traditional upland rice : 1.2 t/ha.
Improved upland rice : 1.7 t/ha.
New swamp rice : 3.3 t/ha.

TABLE 4-11 AREA AND PRODUCTION (COFFEE)

Year	Without Project		With Project						
	Area (ha)	Production (t) /1	Area Traditional	Area Improved	New Plantation	Production Traditional	Production Improved /2	Production New Plant. /2	Production Total
1984	1,220	233	1,020	200	200	180	_	_	189
85	1,300	240	900	4000	500	167	_	_	167
86	1,300	240	500	800	1,000	93	_	_	93
87	1,300	240	300	1,000	1,500	56	188	188	432
88	1,300	240	_	1,300	2,000	_	376	470	846
89	1,300	240	_	1,300	2,000	_	754	940	1,694
90	1,300	240	_	1,300	2,000	_	940	1,410	2,350
91	1,300	240	_	1,300	2,000	_	1,220	1,880	3,100
:	1,300	240	_	1,300	2,000	_	1,220	1,880	3,100
2003	1,300	240	_	1,300	2,000	_	1,220	1,880	3,100

TABLE 4-12 AREA AND PRODUCTION (COCOA)

	Without Project		With Project						
	Area (ha)	Production (t) /3	Area Traditional	Area Improved	New Plantation	Production Traditional	Production Improved /4	Production New Plant.	Production Total
1984	980	363	780	200	200	289	_	_	289
85	1,000	370	700	300	500	259	_	_	259
86	1,000	370	700	300	1,000	259	_	_	259
87	1,000	370	700	300	1,500	259	_	_	259
88	1,000	370	500	500	2,000	185	162	162	509
89	1,000	370	_	1,000	2,500	_	243	405	648
90	1,000	370	_	1,000	2,500	_	243	810	1,053
91	1,000	370	_	1,000	2,500	_	243	1,215	1,458
92	1,000	370	_	1,000	2,500	_	405	1,620	2,025
93	1,000	370	_	1,000	2,500	_	810	2,025	2,835
94	1,000	370	_	1,000	2,500	_	810	2,025	2,835
:									
2003	1,000	370	_	1,000	2,500	_	810	2,025	2,835

Remarks: /1 0.185 ton/ha
/2 0.94 ton/ha
/3 0.37 ton/ha
/4 0.81 ton/ha during 5-20th year.

TABLE 4-13 TRAFFIC OF AGRICULTURAL PRODUCTS

Year	Rice	Coffee	Cocoa	Total (ADT)
1984	5	1	1	7
85	6	1	1	8
86	6	1	1	8
87	8	1	1	10
88	9	1	1	11
89	9	2	1	12
90	10	3	2	15
91	10	4	2	16
92	11	4	3	18
93	11	4	4	19
94	11	4	4	19
95	11	4	4	19
96	12	4	4	20
97	12	4	4	20
98	12	4	4	20
99	13	4	4	21
2000	13	4	4	21
1	13	4	4	21
2	14	4	4	22
3	14	4	4	22

4.4 DIVERTED TRAFFIC

After the completion of the new Kpakuta - Wologisi - Bopolu road, a part of the traffic along the Kolahun - Voinjama road will be diverted to the new road. Although the detailed traffic survey (OD) has not been made, it is presumed that 10 % of passenger cars and 50 % of trucks along the Kolahun - Voinjama road have their origin or destination at Monrovia area, and that a half of such traffic will be diverted to the new road which is shorter than the existing road via Gbarnga by 150 km. The diverted traffic is estimated as tabulated on Table 4-14.

4.5 TOTAL ESTIMATED TRAFFIC

The normal traffic, generated traffic and diverted traffic forecasted under Chapter 4.1 to 4.4 are summarized and shown on Table 4-15.

TABLE 4-14 DIVERTED TRAFFIC

Year	Nominal Traffic/1 Gba. - Voin. - Kola.					Diverted Traffic Sami. - Wol. - Bop. - Mon.				
	P/C	L/B	L/T	H/T	Total	P/C/2	L/B/2	L/T/3	H/T/3	Total
1984	108	230	36	7	381	5	12	9	2	28
85	114	244	38	8	404	6	12	10	2	30
86	121	259	40	8	428	6	13	10	2	31
87	129	274	43	9	455	6	14	11	2	33
88	136	291	45	9	481	7	15	11	2	35
89	145	308	48	10	511	7	15	12	3	37
90	153	327	51	10	541	8	16	13	3	40
91	161	343	54	11	569	8	17	14	3	42
92	169	360	56	12	597	8	18	14	3	43
93	177	378	59	12	626	9	19	15	3	46
94	186	397	62	12	657	9	20	16	3	48
95	196	417	65	13	691	10	21	16	3	50
96	205	438	68	14	725	10	22	17	3	53
97	216	460	72	14	762	11	23	18	4	56
98	226	483	75	15	799	11	24	19	4	58
99	238	507	79	16	840	12	25	20	4	61
2000	250	532	83	17	882	13	27	21	4	65
1	260	554	87	17	918	13	28	22	4	67
2	270	576	90	18	954	14	29	23	5	71
3	281	599	94	19	993	14	30	24	5	73

Remarks: /1 Ref. Phase-I Report (Table 6-3)
/2 Vo x 0.1 x 0.5
/3 Vt x 0.5 x 0.5

TABLE 4-15 TOTAL TRAFFIC FORECAST

(ADT)

Year	Wologisl - Kprkuta					Wol. - Kpelle				
	P/C	L/B	L/T	H/T	Total	P/C	L/B	L/T	H/T	Total
1984	5	30	21	2	58	37	19	18	80	154
85	6	30	23	2	61	38	19	19	82	158
86	6	32	23	2	63	39	21	20	84	164
87	6	33	25	2	66	39	22	21	87	169
88	7	35	26	2	70	41	24	22	91	178
89	7	39	28	3	77	42	24	26	143	235
90	8	40	30	3	81	43	25	27	146	241
91	8	42	32	3	85	44	27	29	150	250
92	8	44	33	3	88	44	28	29	153	254
93	9	45	35	3	92	46	30	31	157	264
94	9	47	37	3	96	46	31	32	157	266
95	10	49	38	3	100	48	33	33	160	274
96	10	51	40	4	105	48	34	34	162	278
97	11	52	42	4	109	50	36	36	164	286
98	11	54	44	4	113	51	38	38	167	294
99	12	56	47	4	119	52	39	39	169	299
2000	13	59	49	4	125	54	42	41	172	309
1	13	61	51	4	129	55	44	43	174	316
2	14	63	53	5	135	56	45	44	177	322
3	14	65	56	5	140	57	47	46	179	329

CHAPTER V

PRELIMINARY DESIGN

CHAPTER V

PRELIMINARY DESIGN

5.1 BASIC DATA

5.1.1 Topography

The topographic map on the scale of 1/20,000 along the new Wollgisi - Bopolu road and the Kpakuta - Wologisi road has been prepared during the course of this study. Aerial photographs were taken to cover 2,400 km^2 (7 flying course with total length of 270 km). Ground control survey for mapping was made by applying the NNSS system, and 1/20,000 maps at contour intervals of 10 m were prepared to cover 340 km^2 (9 sheets).

The survey at six major river crossing points (Ziliba river, Maaso creek, Wenzia river, Butulu creek, Molu river, Mafu river) was made on the scale of 1/500 with contour intervals of 1 m.

The topographic maps thus prepared have been used to decide the final alignment of the new road and to prepare preliminary design and cost estimate.

5.1.2 Soils and Materials

Soils along the route are mainly composed of brown or raddish brown laterite, accompanied by clayed and sandy soils. Gravel beds are observed in some parts of the river beds, as well as on the ground surface of 0.5-1 m in thickness. In hilly region, granite and gneiss makes sporadic outcrops, which are partly weathered intensively. The surface soils have been checked and analysed as shown on Table 5-1 and Fig. 5-1. It was found that such soils may be utilized for base course at appropriate moisture content, and gravelly laterite of modified CBR **20** will be utilized as pavement materials. River gravel and granite or gneiss rocks may be used as concrete aggregate for the construction of bridges and other structures.

5.1.3 Hydrology

In estimating the river discharge for the preliminary design of the structures, it was provisionally applied to use the following formula and mean monthly precipitation:

$$Q = C \sqrt[4]{A^3} \quad \text{(Dicken's formula)}$$

where, Q : discharge (m^3/sec)
A : catchment area (km^2)
C : coefficient:
2.77 at flat land
3.46 at hilly region
4.15 at mountain region

Table 5－1 RESULT・OF SOIL ANALYSIS

Sample %	0.074	0.420	2.000	4.760	25.40	Max Dia	Dia 60%	Dia 10%	Speci gravitg	L.L.	P.L	P.I	Classification A.A.S.H.O	Classification Casegrande
①	6.9	51.4	95.9	98.2	100	10.0	0.52	0.11	2.60	40.0	33.1	6.9	A－2－4	SM
②	1.3	9.5	17.5	29.7	91.8	50.0	9.5	0.52	2.66	40.6	25.9	14.7	A－2－6	GM
③	3.2	8.3	16.0	27.7	80.8	50.0	17.0	0.72	2.66	N.P.			A－1－a	GW
④	6.4	30.1	66.0	87.5	100	10.0	1.7	0.12		28.0	21.7	6.3	A－2－4	SM
⑤	1.2	6.9	39.6	64.3	98.2	30.0	4.6	0.47	2.76	38.5	19.6	18.8	A－2－6	SC
⑥	0.8	8.2	38.7	60.7	97.6	30.0	4.76	0.47		45.9	28.6	17.3	A－2－7	SM
1	0.8	7.7	24.9	52.1	96.0	30.0	5.8	0.58		37.1	22.9	14.2	A－2－6	SC
2	3.2	25.4	64.9	75.0	91.4	40.0	1.5	0.18	2.66	33.0	23.8	9.2	A－2－4	SM
3	30.9	66.0	97.0	100	100	5.0	0.37	—	2.65	—	—	—	—	—
4	1.1	7.1	28.8	41.9	93.3	40.0	8.5	0.55		42.0	27.9	14.1	A－2－7	GM

sampling

① ～ ⑥.Kpakuta ～ wologisi ～ Gondrahun

1 ～ 4.Bopolu ～ Gengba ～ Kpelle

Fig 5 – 1 Gradation Analysis Curve

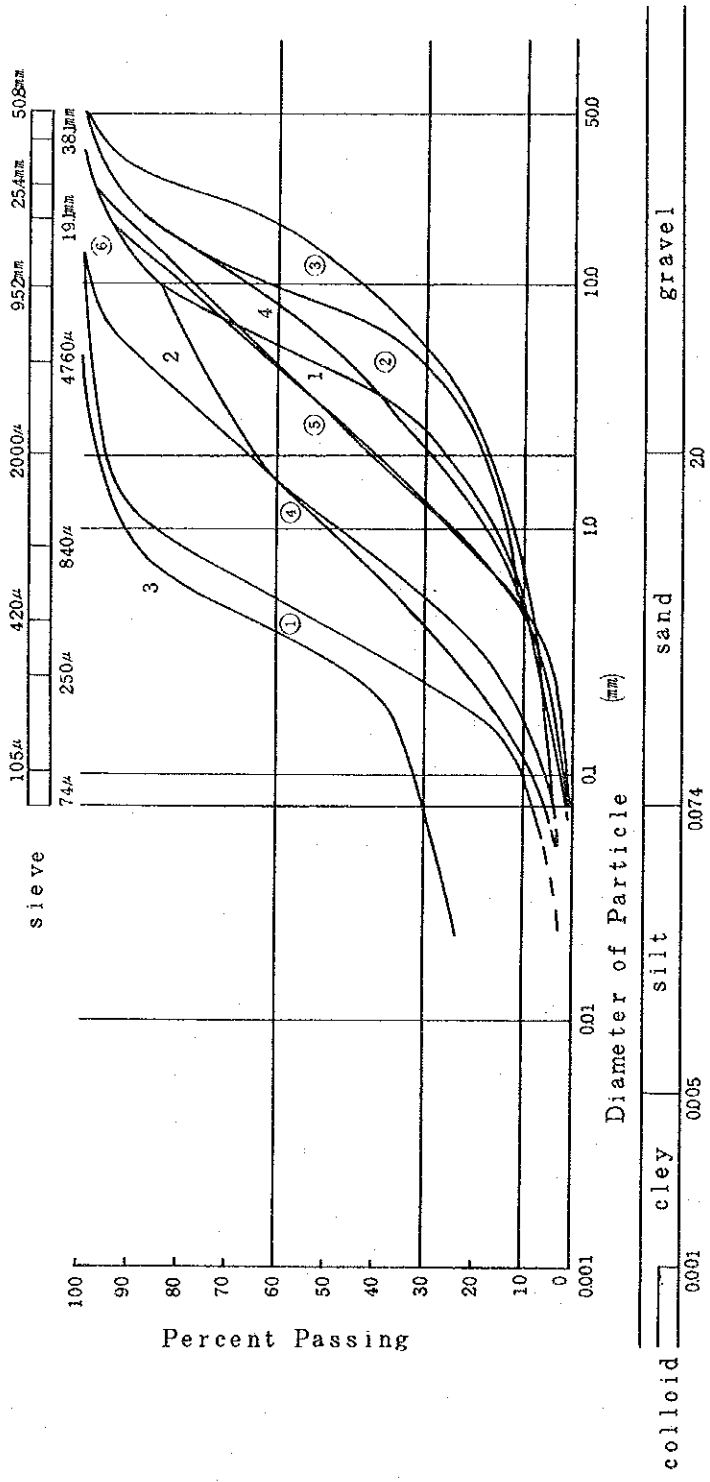


TABLE 5-2 MONTHLY MEAN PRECIPITATION

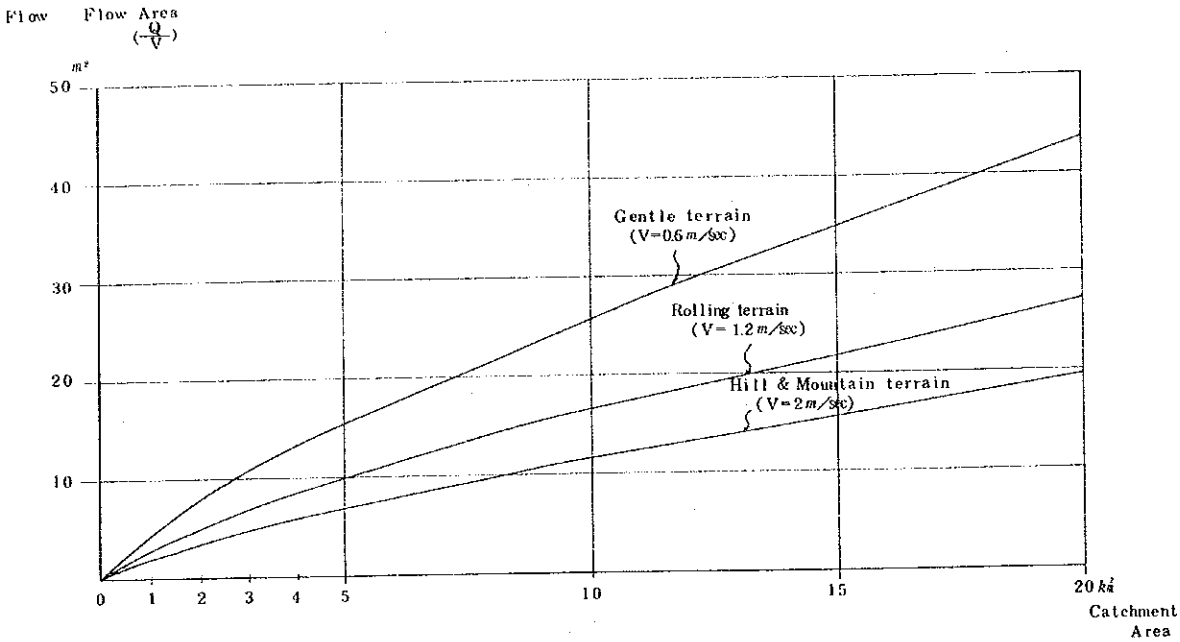
(inch)

Year	Bopolu	Kolahun	Voinjama
Jan.	0.92	0.44	0.65
Feb.	1.56	1.14	2.23
Mar.	4.83	4.66	5.71
Apr.	6.99	5.30	8.51
May	8.80	8.57	9.69
Jun.	10.41	12.22	14.02
Jul.	14.62	12.66	17.32
Aug.	14.19	14.66	15.49
Sep.	21.75	21.30	17.73
Oct.	12.88	14.01	12.10
Nov.	6.20	9.74	10.24
Dec.	2.16	2.91	2.44
Annual	105.29	107.61	116.33

Annual : Ten year average 1963-1972
Source : Ministry of public works

The discharge has thus been estimated preliminarily as summarized in Table 5-3. on the basis of the catchment area and flow area as shown on Fig. 5-2 to Fig. 5-4.

FiG 5－2 Catchment Area － Flow Area Diagram



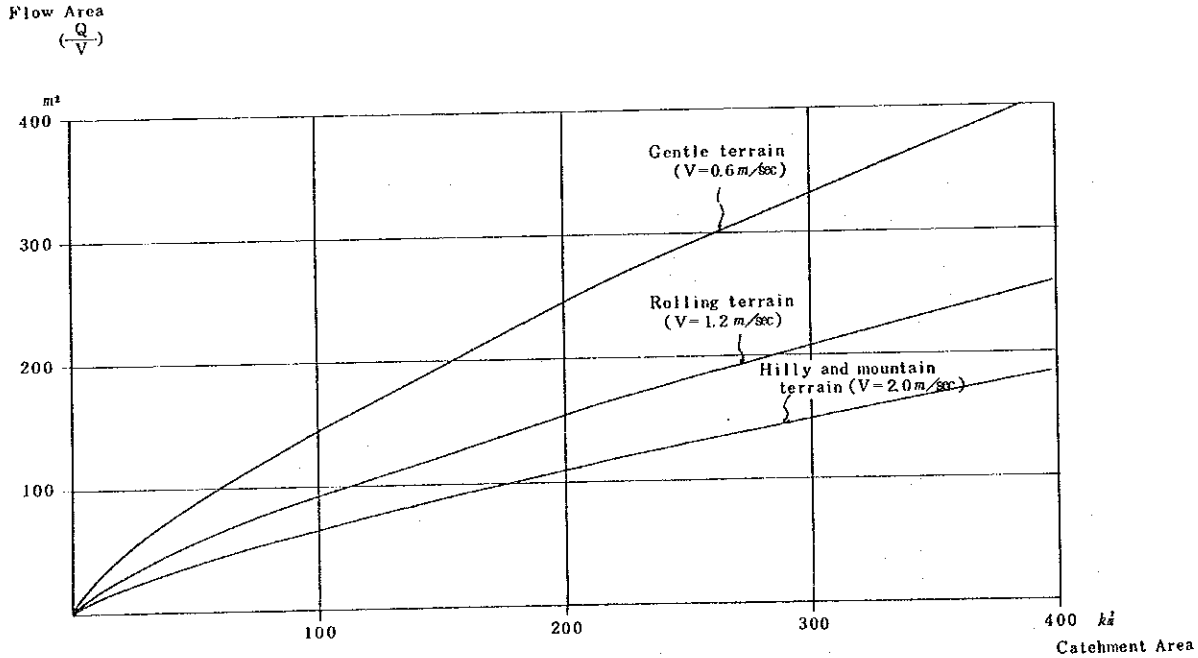


FIGURE 5-3 CATCHMENT AREAS

CATCHMENT BASIN NO.	CATCHMENT AREA (Km^2)	Remarks
①	4051.	Lofa Rv.
②	397.	Zelliba Rv.
③	88.	YaYa Creek
④	14.	Nomaja Creek
⑤	90.	
⑥	10.3	Ziaki Creek
⑦	5.	
⑧	17.	
⑨	8.	
⑩	112.	Wenzia Rv
⑪	3.	Maasa Creek
⑫	6.	Wahnzapa Rv.
⑬	31.	
⑭	212.	Wambo Creek
⑮	124.3	Goate Creek
⑯	11.	
⑰	169.3	Jonda Creek
⑱	9.	
⑲	9.	
⑳	9.	
㉑	16.3	
㉒	111.3	
㉓	21.	
㉔	80.	
㉕	6.	
㉖	47.	Bululu Creek
㉗	133.	
㉘	8.	

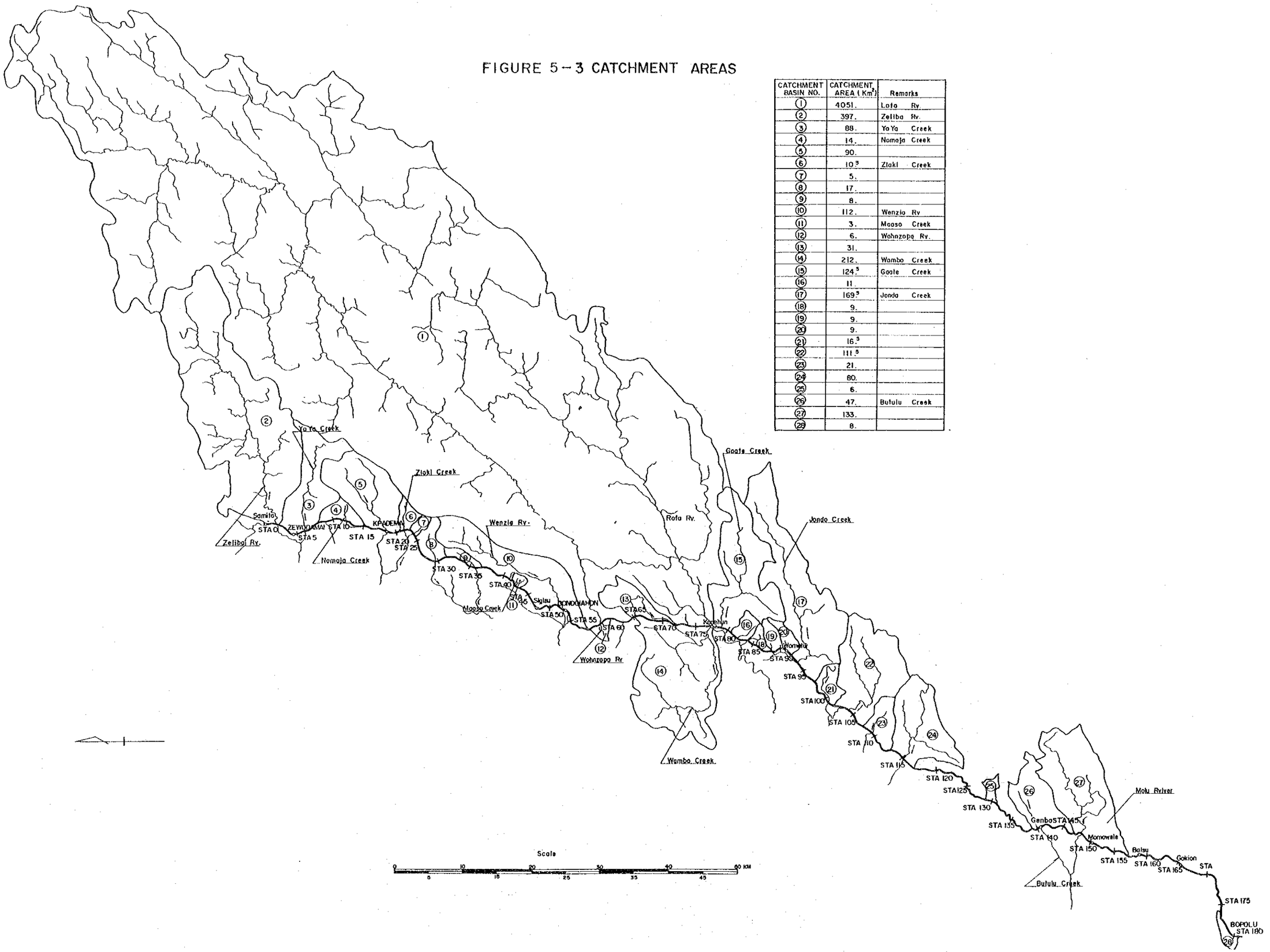


Table 5-3 DISCHARGE

No.	River Creek	Catchm. Area (km^2)	Topography					
			Flat V=0.6 m/sec		Hilly V=1.2 m/sec		Mount V=2.0 m/sec	
			Disch. (m^3/sec)	Flow area (m^2)	Discharge (m^3/sec)	Flow area (m^2)	Discharge (m^3/sec)	Flow area (m^2)
1	Lofa Rv.	4051.0	1406.5	2344.2	1756.9	1464.1	2107.3	1053.6
2	Zeliba Rv.	397.0	246.4	410.6	307.7	256.4	369.1	184.6
3	Yoya Creek	88.0	79.6	132.6	99.4	82.8	119.2	59.6
4	Noma Creek	14.0	20.0	33.4	25.0	20.9	30.3	15.0
5		90.0	80.9	134.9	101.1	84.3	121.3	60.6
6	Ziaki Creek	10.5	16.2	26.9	20.2	16.8	24.2	12.1
7		5.0	9.3	15.4	11.6	9.6	13.9	6.9
8		17.0	23.3	38.7	30.0	24.1	34.7	17.4
9		8.0	13.2	22.0	16.5	13.7	19.7	9.8
10	Wenzia Creek	112.0	95.4	158.9	119.1	99.3	142.9	71.4
11	Mausó Creek	3.0	6.3	10.5	7.9	6.5	9.5	4.7
12	Wahnzopa Rv.	6.0	10.6	17.7	13.3	11.1	15.9	7.9
13		31.0	36.4	60.7	45.5	37.9	54.5	27.2
14	Wambo Creek	212.0	153.9	256.5	192.2	160.2	230.6	115.3
15	Gaate Creek	124.5	103.2	172.1	129.0	107.5	154.6	77.3
16		11.0	16.7	27.9	20.9	17.4	25.1	12.6
17	Jando Creek	169.5	130.1	216.9	162.5	135.4	195.0	97.5
18		9.0	14.4	24.0	18.0	15.0	21.6	10.8
19		9.0	14.4	24.0	18.0	15.0	21.6	10.8
20		9.0	14.4	24.0	18.0	15.0	21.6	10.8
21		16.5	22.7	37.8	28.3	23.6	34.0	17.6
22		111.5	95.0	158.4	118.7	142.5	142.4	71.2
23		21.0	27.2	45.3	33.9	28.8	40.7	23.3
24		80.0	74.1	123.5	92.6	77.1	110.0	55.5
25		6.0	10.6	17.7	13.3	11.1	15.9	8.0
26		47.0	49.7	82.9	62.1	51.8	74.5	37.2
27		133.0	108.5	180.8	135.5	112.9	162.5	81.2
28		8.0	13.2	22.0	16.5	13.7	19.7	9.8

5.2 DESIGN CRITERIA

On the basis of the traffic forecast in Chapter IV, it will be appropriate to design the new road as a secondary road under the Road Standard in Liberia. Accordingly, the design speed is adopted to be 40 km/hr, but it was considered desirable to design the alignment to be capable of future improvement for the design speed of 60 km/hr at minimum additional costs. The carriageway width of the road will be 5.5 m for the two lanes. The geometric design criteria are summarized on Table 5-4.

TABLE 5-4 GEOMETRIC DESIGN CRITERIA

Design speed	40 km/hr
Right-of-way	40 m
Carriageway width	5.5 m
Shoulder width	0.75 m
Sight distance	75 m
Min. curve radius	60 m
Max. longitudinal grade	7 %
Max. cross fall	5.0 %
Max. combined grade	8.0 %
Shoulder cross fall	4.0 - 5.0 %
Bridge design load	HS20 - 44
Bridge carriage width	7.0 m

5.3 PRELIMINARY DESIGN OF ROAD

The improvement required for the existing roads has been defined on the basis of the field investigation and the design criteria as noted in Chapter 5.2. For the section to be newly constructed, the alignment has been designed in view of the topographic and soil condition, as well as continuity of alignment. Where the construction cost is not substantially increased, the minimum horizontal curve radius of 140 m and maximum gradient of 6 % has been applied to enable future improvement at the least additional cost for the design speed of 60 km/hr. The alignment (Plan and Profile) of the new road and the improvement of existing roads are shown on the 1/20,000 scale map in ANNEX-II appended to this report.

Earthwork is, in principle, designed as summarized hereunder.

a) Slope: embankment 1:1.5
cutting 1:0.5

Slope protection for erosion control is made by coble stone facing, only at the required section.

b) Base course:

Sandy laterite or gravelly laterite soils. (In case clayey laterite is used, moisture content should be carefully controlled.)

c) Embankment: By side borrow system

d) Side ditch: Earth ditch

Pavement design is to be prepared on the basis of the laterite soil condition. Clayey laterite will have CBR value of 3-5 % under wet condition, while gravelly laterite will have CBR value of 20-45 %. It is designed that pavement is made by two layer of laterite: upper layer (10 cm) with CBR 20-45 % and lower layer (10 cm) with CBR 10-20 %. The laterite pavement will loose its strength and cause damages on surface

in wet season, while it will raise dusts in dry season. To protect such damages it is designed to overlay by prime coat which will be rehabilitated once every ten years.

The typical cross section of the proposed road, as well as preliminary design of pipe culverts, cross ditch and box culverts, are shown on the Drawings (Dwg. 18 to Dwg. 20) in ANNEX-II.

5.4 PRELIMINARY DESIGN OF BRIDGES

For the new road construction and improvement of the existing road, it is necessary to design bridges over Lofa river and other streams. The Lofa river has, at the crossing point, discharge of 2,107 m^3/sec., which will require flow area of 1,503 m^2. With the clearance at high water level plus 2 m, the bridge will have length of 120 m.

Three types of bridge structures have been comparatively studied: RC Box girder type, Steel Warren truss type and Prestressed concrete box girder type. In view of the fact that the temporary river closure for bridge construction is practicable in the dry season, and that transportation of construction materials should be minimized for difficult access to the bridge site, and that the construction cost should be minimized as far as possible, it was selected to adopt RC Box girder type bridge for Lofa river crossing, as illustrated in Fig. 5-4.

For design of smaller bridges, it was designed to apply, in principle, following types of super and sub-structures:

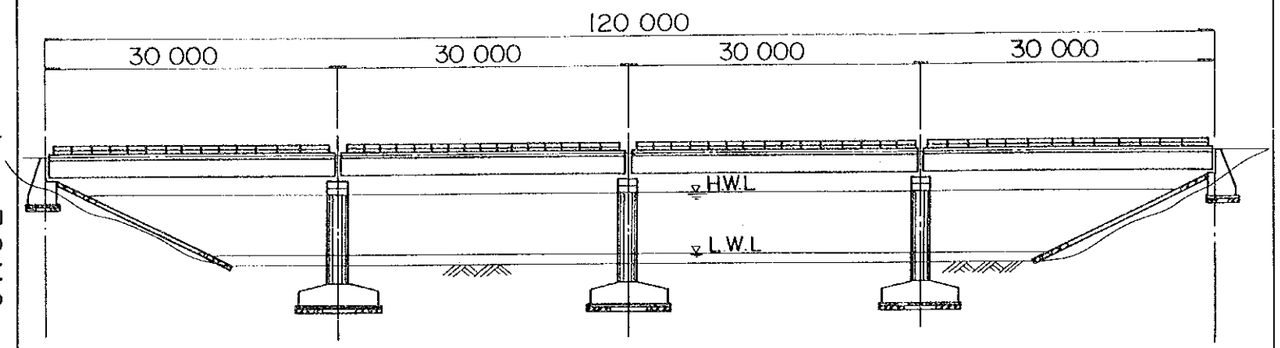
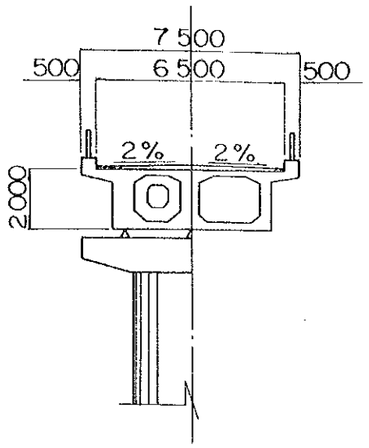
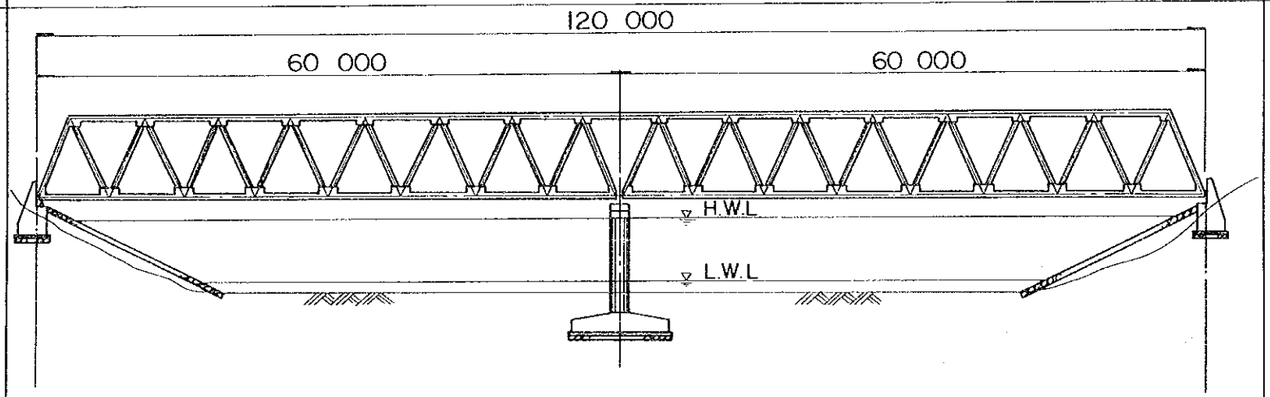
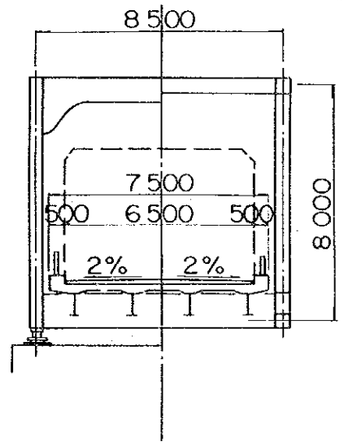
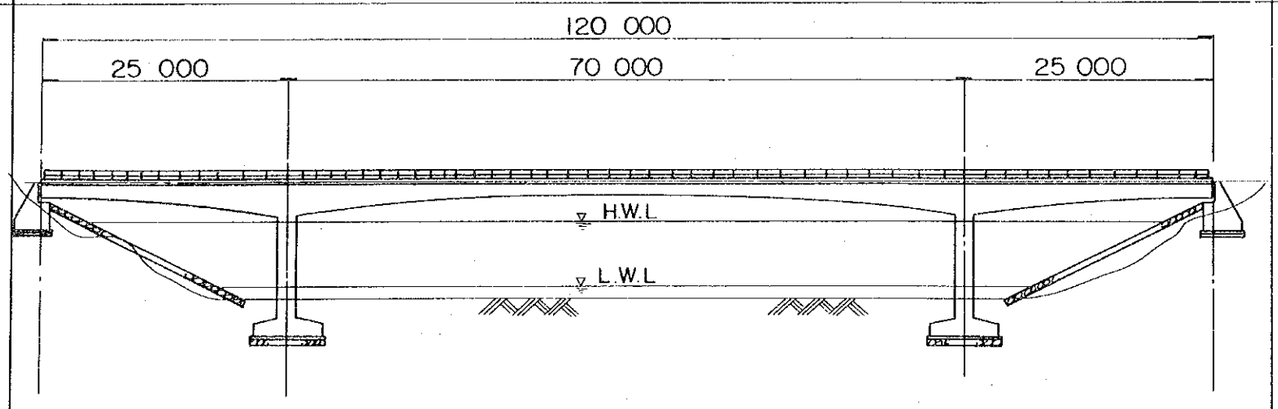
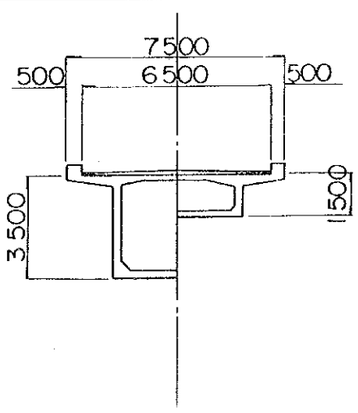
	Span Length or Height	Type
Superstructure	L ≦ 10m	RC slab
	10m < L ≦ 25m	RC T beam
Sub-structure	H ≦ 4m	Gravity
	4m < H ≦ 10m	Adverse T type
	10m < H	Counterfort type

The outline of the proposed bridges on the new road is summarized on Table 5-5. The Drawing No. 21 and 22 in ANNEX-II illustrate the standard bridge design.

Table 5-5 LIST OF PROPOSED BRIDGE

Station	Name of Bridge	Type of Bridge	Bridge Length	Carriageway Width	Remarks
Sta 1 + 100	Zeriba Rv. Br.	RC-T-Beam - Bridge	25.0	7.0	Replacement
5 + 950	Yaya Creek Br.	RC-Slab - Bridge	10.0	7.0	""
13 + 350	Nomaja Creek Br.	"	"	"	"
19 + 500		RC-T-Beam - Bridge	25.0	"	"
29 + 500		RC-Slab - Bridge	10.0	"	"
42 + 870	Maaso Creek Br.	RC-T-Beam - Bridge	20.0	"	"
48 + 100		RC-Slab - Bridge	10.0	"	"
57 + 650	Wenzia Rv. Br.	RC-T-Beam - Bridge	20.0	"	"
59 + 400	Wahnzepa Creek Br.	RC-Slab - Bridge	10.0	"	New Construction
77 + 300	Wambo Creek Br.	RC-T-Beam - Bridge	25.0	"	"
78 + 000	Lofa Rv. Br.	RC-Box-Girdger Br.	30.0 x 4 = 120	6.5	"
79 + 450	Gaate Creek Br.	RC-T-Beam - Bridge	20.0	7.0	"
92 + 200	Jondo Creek Br.	RC-T-Beam - Bridge	25.0	"	"
102 + 200		"	20.0	7.0	"
114 + 900		RC-Slab - Bridge	10.0	7.0	"
140 + 000	Butulu Creek Br.	"	"	"	Replacement
148 + 200	Molu Rv. Br.	RC-T-Beam - Bridge	25.0	7.0	"

Fig.5-2 COMPARATIVE STUDY FOR LOFA RIVER BRIDGE

	ALTERNATIVE PLAN (SCALE 5 10 20 30 meters)	CROSS SECTION (SCALE 1 2 3 4 5 10 meters)	CONSTRUCTION COST ($)	CONSRUCTION PERIOD (MONTHS)	JUDGEMENT
CASE - 1	 Type : RC - Box Girder		Superstruct. 690 930 Substruct. 329 000 Scour Protect. 12 540 Total Cost 1032 470	26	BEST
CASE - 2	 Type : Steel Warren Truss		Superstruct. 985 500 Substruct. 180 000 Scour Protect. 12 540 Total Cost 1178 340	18	BETTER
CASE - 3	 Type : Prestressed Concrete Box Gider		Superstruct. 1170 000 Substruct. 291 800 Scour Protect. 12 540 Total Cost 1474 340	22	GOOD

CHAPTER VI

CONSTRUCTION PLAN

CHAPTER VI

CONSTRUCTION PLAN

6.1 CONSTRUCTION QUANTITY

On the basis of the inventory survey of the existing road and preliminary design for the improvement and new road construction, the quantity of the construction works for the Kpakuta - Wologisi - Bopolu road have been estimated. The estimate of the quantities for each work has been made on the following basis:

a) Clearing and grubbing:

10 m in width on an average along the entire route

b) Common excavation:

to be made on the basis of horizontal alignment, corss section, road width and soil conditions

(For new road section, work quantity was estimated by electronic computer.)

c) Borrow excavation:

designed by side borrow system in principle, but at some sections, required borrow excavation has been estimated

d) Side ditch excavation:

estimated for excavation of unlined earth ditch

e) Prime coat: twice at 0.7 l/m^2 each

f) Cross ditch (CD):

CD 0.8 x 0.8 = 0.512 m^3/sec

0.512 m^3/sec CD 1.0 x 1.0 = 0.80 m^3/sec

g) Pipe culvert:

0.512 m^3/sec. ø 1.0m = 0.628 m^3/sec.

0.628 m^3/sec. ø 1.5m = 1.410 m^3/sec.

1.410 m^3/sec. ø 1.5 x 2 = 2.820 m^3/sec.

h) Box culvert:

2.82 m^3/sec 3.0 x 3.0 = 7.2 m^3/sec

7.2 m^3/sec 4.0 x 4.0 = 12.8 m^3/sec

12.8 m^3/sec (4x4) x 2 = 25.6 m^3/sec

i) Short-span bridge:

Span 10 m : RC slab type

Span 20-25 m : RC T beam type

Abutment : H = 4m or H = 6m

j) Long-span bridge (Lofa river bridge):

RC box girder type

4-span x 30m = 120 m

The work quantities estimated for each item of work are summarized in Table 6-1. The quantities for work section between Kpakuta and Lofa river bridge (Section-I) and between Lofa river bridge and Bopolu (Section-II) are also tabulated in Table 6-2 and 6-3.

Table 6-1 Summary of Construction Quantities

Work Item	Unit	Q'ty	Remarks
No.1 Site Clearance;			
- Clearing & Grubbing	ha	181.6	
No.2 Earth Works;			
- Common Excavation	m^3	1,506,200.0	
- Borrow Excavation	m^3	600,000.0	
- Side drain Excavation	m^3	90,500.0	
No.3 Pavement Works;			
- Surface Treatment	m^3	254,200.0	
- Prime Coat 85 - 100	kg	978,800.0	
No.4 Drainage;			
- Cross ditch (0.80 x 0.80)	$\ell \cdot m$	1,020.0	
- Cross ditch (1.00 x 1.00)	$\ell \cdot m$	290.0	
- Corrugated Steel Pipe ϕ 10 M	$\ell \cdot m$	190.0	
- Inlet & Outlet for Pipe ϕ 10 M	each	28	
- Corrugated Steel Pipe ϕ 1.5 M	$\ell \cdot m$	967.0	
- Inlet & Outlet for Pipe ϕ 1.5 M	each	184	
- Corrugated Steel Pipe ϕ 1.5M x 2	$\ell \cdot m$	179.0	
- Inlet & Outlet for Pipe ϕ1.5M x 2	each	36	
- Barrel of Box Culvert (3.0 x 3.0)	$\ell \cdot m$	101.0	
- Headwall of Box Culvert (3.0 x 3.0)	each	22	
- Barrel of Box Culvert (4.0 x 4.0)	$\ell \cdot m$	74.0	
- Headwall of Box Culvert (4.0 x 4.0)	each	18	
- Barrel of Box Calvert (4.0 x 4.0) x 2	$\ell \cdot m$	24.0	
- Headwall of Box Culvert (4.0x4.0)x2	each	6	
- Demolition of Wooden Culverts	$\ell \cdot m$		
No.5 Bridges; Rip Rap			
- 10m R.C. Slab	each	7	
- 20m R.C. T-Beam	each	4	
- 25m R.C. T-Beam	each	5	
- 30m Box Girder	each	4	
- Piers	each	3	
- Abutment H = 4m	each	16	
- Abutment H = 6m	each	18	
- Demolition of Wooden Bridges	$\ell \cdot m$	373	

Table 6-2 CONSTRUCTION QUANTITIES (I)

Section I (STA. 0 - STA. 77 + 900) From Kpakuta to Lofa River

WORK ITEM	Length (ℓ.m)	Nos	Excavation (m^3)	Concrete (m^3)		Reinforcing Steel (kg)	Sand & Gravel (m^3)	Area (ha)	Material (m^3 or kg)	Remarks
				Class A	Class C					
Clearing & Grubbing								77.9		
Common Excavation			646,100.0							
Borrow Excavation			257,400.0							
Side drain Excavation			38,800.0							
Surface treatment (Laterite paved)									109,000.0m^3	
Prime Coat									419,900.0kg	
Cross ditch 0.80 x 0.80	384.0		345.6		587.5	9,984.0	153.6			
Cross ditch 1.00 x 1.00	162.0		178.2		291.6	4,698.0	64.8			
Corrugated Steel Pipe ø1.0M	190.0									
Inlet & Outlet for Pipe ø 1.0 M		28	117.6		159.6	9,576.0	39.2			
Corrugated Steel Pipe ø 1.5 M	405.0									
Inlet & Outlet for Pipe ø 1.5 M		72	388.8		576.0	34,560.0	136.8			
Corrugated Steel Pipe ø 1.5M x 2	32.0									
Inlet & Outlet for Pipe ø 1.5 M x 2		8	75.2		97.6	5,856.0	28.0			
Barrel of Box Culvert 3.0 x 3.0	8.0		22.4		39.2	3,136.0	6.4			
Headwall of Box Culvert 3.0 x 3.0		2	40.4		44.8	2,688.0	10.6			
Barrel of Box Culvert 4.0 x 4.0	33.0		132.0		257.4	20,592.0	33.0			
Headwall of Box Culvert 4.0 x 4.0		8	191.2		244.0	14,640.0	41.6			
Barrel of Box Culvert (4.0 x 4.0) x 2	8.0		62.7		108.3	8,666.0	15.0			
Headwall of Box Culvert(4.0 x 4.0) x 2		2	93.8		105.0	6,300.0	19.0			
Demolition of Wooden Culverts										
10 m - R.C. Slab - Bridge	50.0	5		291.5		40,810.0				
20 m - R.C. T-Beam - Bridge	40.0	2		256.0		40,960.0				
25 m - R.C. T-Beam - Bridge	75.0	3		553.8		88,608.0				
30 m - Box-girder - Bridge										
Abutment H = 4m		10	701.0		588.0	17,640.0	44.0			
Abutment H = 6m		10	2,696.0		651.0	52,080.0	69.0			
Piers							28.8			
Rip Rap										
Demolition of Wooden Bridges										
Total			945,728.6	1,101.3	3,750.0	360,794.0	689.8	77.9	109,000 m^3 419,900 kg	

Table 6-3 CONSTRUCTION QUANTITIES (II)

Section II (STA 77+900 - STA 181+600) From Lofa River to Bopolu

WORK ITEM	Length ($\ell \cdot m$)	Nos	Excavation (m^3)	Concrete (m^3)		Reinforcing Steel (m^3)	Sand & Gravel (m^3)	Area (ha)	Material (m^3 or kg)	Remarks
				Class A	Class C					
Clearing & Grubbing								103.7		
Common Excavation			860,100.0							
Borrow Excavation			342,600.0							
Side drain Excavation			51,700.0							
Surface treatment (Laterite paved)									145,200.0m^3	
Prime Coat									558,900.0kg	
Cross ditch 0.8 x 0.80	637.0		573.3		974.6	16,562.0	254.8			
Cross ditch 1.00 x 1.00	129.0		141.9		232.2	3,741.0	51.6			
Corrugated Steel Pipe ø 1.0 M	0.									
Inlet & Outlet for Pipe ø 1.0 M										
Corrugated Steel Pipe ø 1.5 M	562.0									
Inlet & Outlet for Pipe ø 1.5 M		112	604.8		896.0	53,760.0	212.8			
Corrugated Steel Pipe ø 1.5 M x 2	147.0									
Inlet & Outlet for Pipe ø 1.5 M x 2		28	263.2		341.6	20,496.0	98.0			
Barrel of Box Culvert 3.0 x 3.0	93.0		260.4		455.7	36,456.0	74.4			
Headwall of Box Culvert 3.0 x 3.0		20	404.0		448.0	26,880.0	106.0			
Barrel of Box Culvert 4.0 x 4.0	41.0		164.0		319.8	25,584.0	41.0			
Headwall of Box Culvert 4.0 x 4.0		10	239.0		305.0	18,300.0	52.0			
Barrel of Box Culvert(4.0 x 4.0) x 2	16.0		125.4		216.6	17,331.0	30.1			
Headwall of Box Culvert(4.0 x 4.0) x 2		4	187.6		210.0	12.600.0	38.0			
Demolition of Wooden Culverts										
10m - R.C. Slab - Bridge	20.0	2		116.6		16.324.0				
20m - R.C. T-Beam - Bridge	40.0	2		256.0		40.960.0				
25m - R.C. T-Beam - Bridge	50.0	2		369.2		59,072.0				
30m Box-girder Bridge	120.0	4		757.6		151,520.0				
Abutment H = 4 m		6	420.6		352.8	10,584.0	26.4			
Abutment H = 6 m		8	2,152.0		520.8	41,664.0	55.2			
Piers		3	384.0		567.0	45,360.0	28.8			
Rip Rap										
Demolition of Wooden Bridge										
Total			1,260,320.2	1,499.4	5,840.1	597,194.0	1,069.1	103.7	145,200 m^3 558,900 kg	

6.2 CONSTRUCTION PLAN

The construction of the new Kpaluta - Wologisi - Bopolu road will involve new road construction of 75 km and improvement of existing road for about 107 km. The work is provisionally divided into two sections: Section-I from Kpakuta to Lofa river bridge and Section-II from Lofa river bridge to Bopolu.

TABLE 6-4 SUMMARY OF WORK FOR EACH SECTION

	Section I	Section II	Total
Length (km)	77.9	103.7	181.6
Earthwork (km)			
Improvement	57.270	49.565	106.835
New Road Const.	20.465	53.940	74.405
Total Length	77.735	103.505	181.240
Bridges (km)	0.165 (10)	0.195 (7)	0.360 (17)
Box Culvert (each)	6	17	23
Pipe Culvert (each)	36	70	106

Section I : From Kpakuta to Lofa river (STA 0 - STA 77+900)
Section II : From Lofa river to Bopolu (STA 77+900 - STA 181+600)

The earth work should be scheduled to be done during the dry seasons. It is provisionally planned to use buldozers of 21-ton class for the earth work of 180 m^3 per day. On condition that workable days in dry season are 23 days a month, it will require 22 buldozers for 24 months to complete all the earth work of 2.2 million m^3.

For the pavement work, it is scheduled to carry out the work in dry season and to prepare and store pavement materials of 254,000 m^3 in wet season.

For construction of the Lofa river bridge, it is required to construct, at the earliest, a pilot road for access to the bridge site. For construction of the RC box girder type bridge of 120 m in length, the construction period is estimated to be about 26 months. For smaller bridges, construction will take about 4.5 months per each site (2.5 months for substructure and 2 months for superstructure). To complete 16-bridge construction, it will take 27 months if bridge construction is carried out at three sites at one time.

For other structures, it is estimated to take the construction period as follows:

	Box Culvert	Pipe Culvert	Cross Ditch
Standard period of work per each structure	45 days	20 days	16 days
Total month required to complete all the works	18 months	21 months	21 months

On the basis of the above construction plan, the construction schedule for the project has been worked out as illustrated in Fig. 6-1 to Fig. 6-3.

Fig 6 – 1 IMPLEMENTATION SCHEDULE

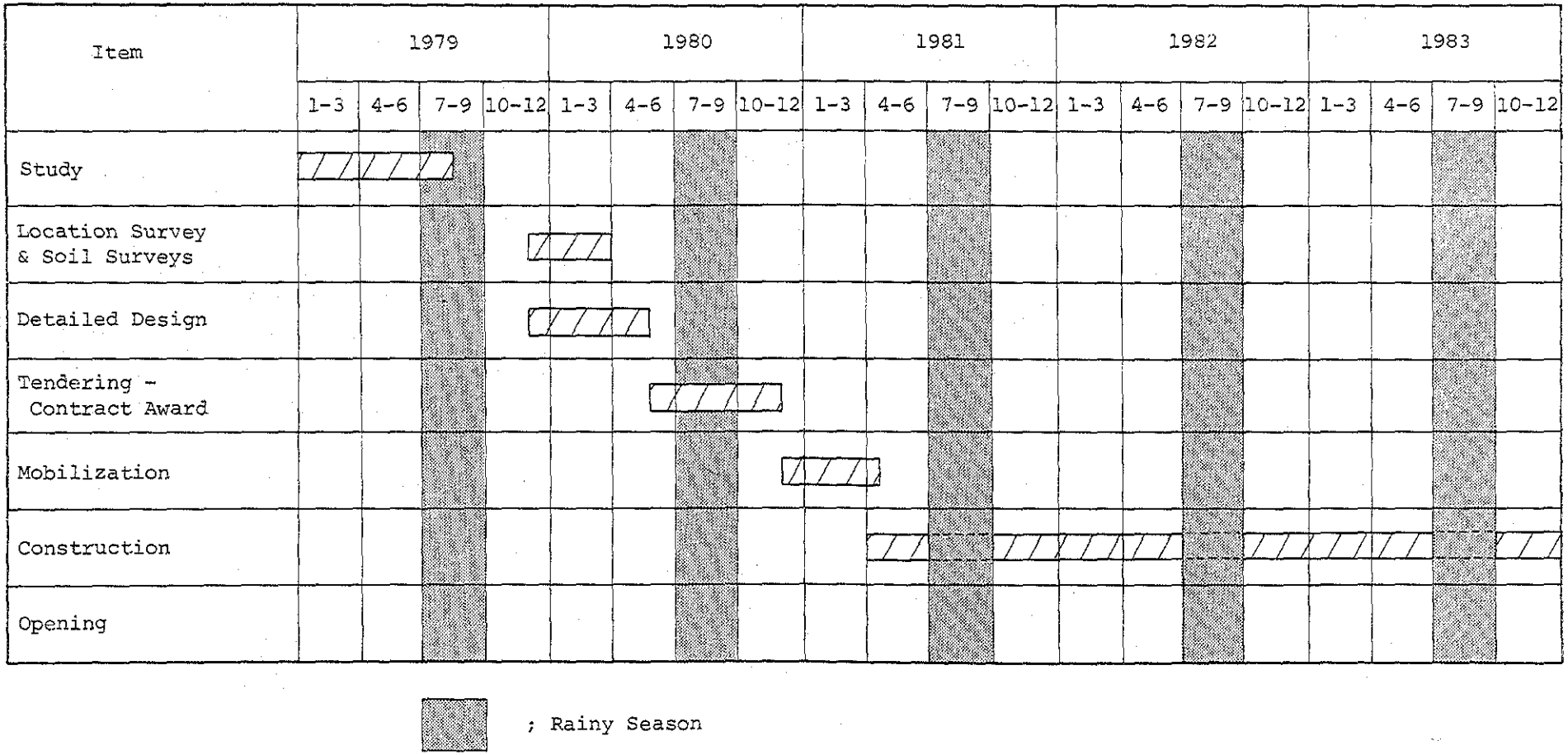


Fig 6 - 2 WORK SCHEDULE (I)

Section I (STA 0 - STA 77+900) From Kapakuta to Lota River

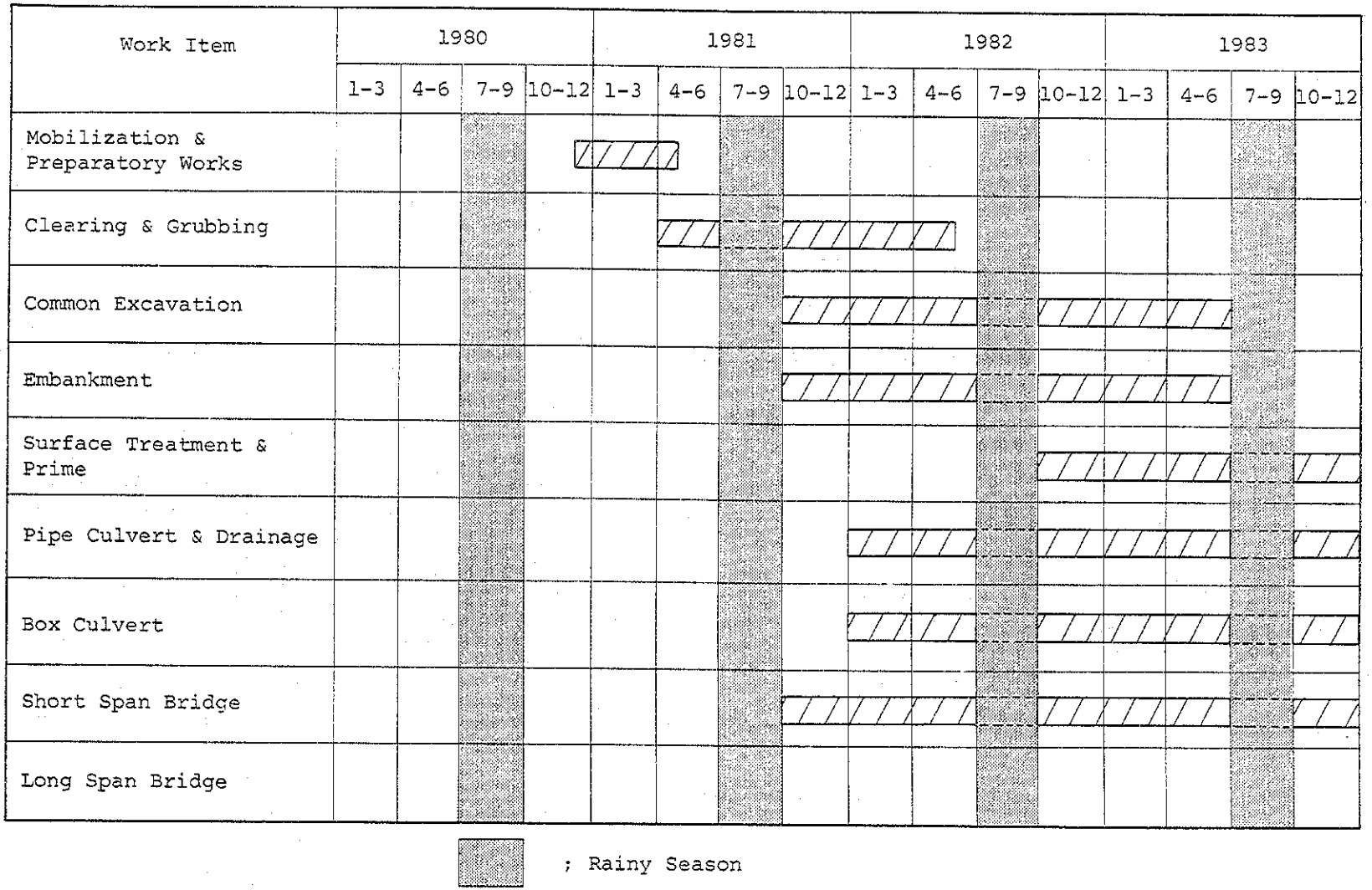
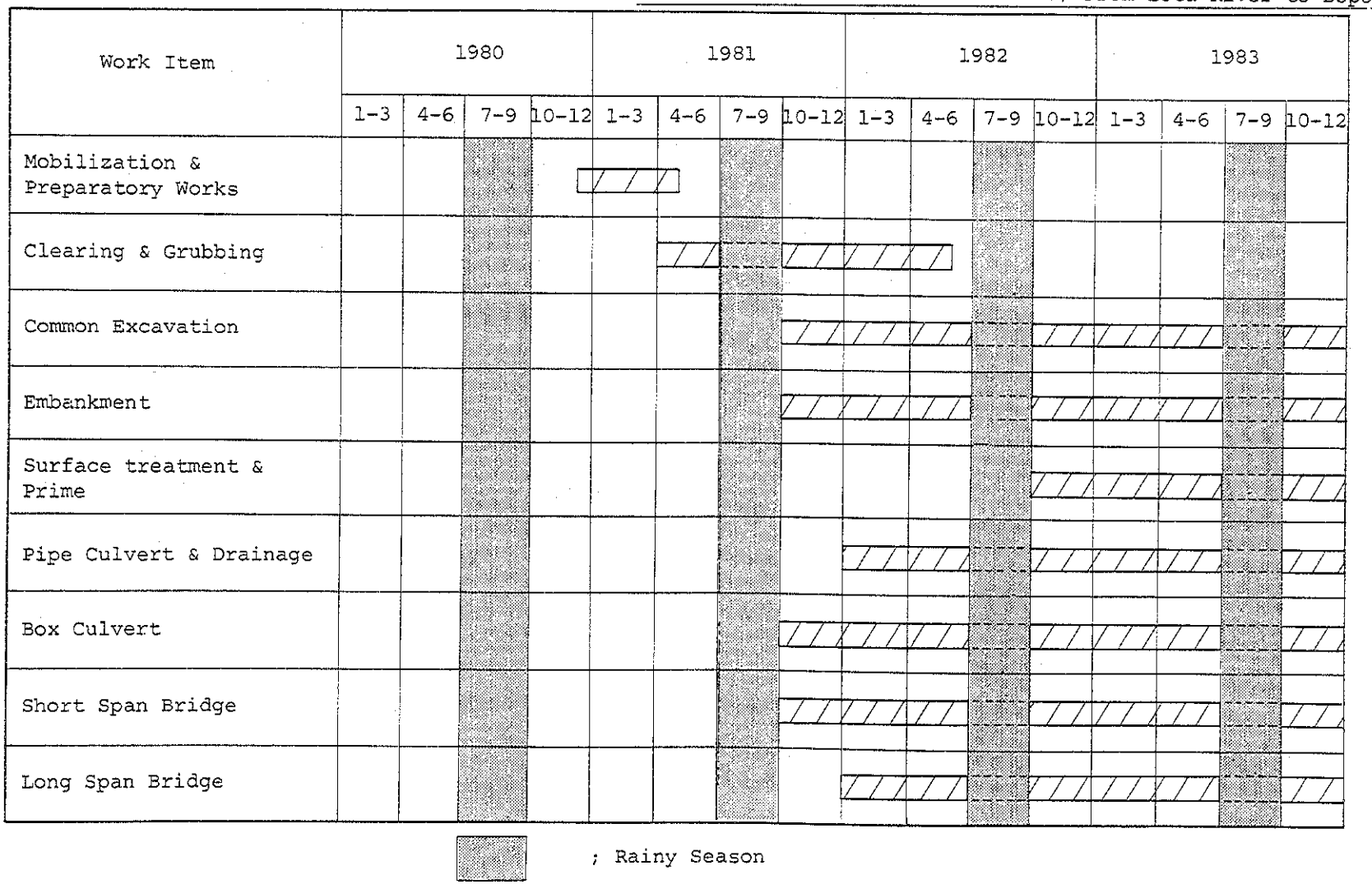


Fig 6 – 3 WORK SCHEDULE (II)

Section II (STA77+900 - STA181+600) From Lota River to Bopolu



6.3 CONSTRUCTION COST

On the basis of the work quantities estimated under Chapter 6.1 and the field survey of construction cost, the preliminary estimate of the construction cost of the project has been made as summarized in Table 6-5.

In total, the construction of the new Kpakuta - Wologisi - Bopolu road will cost about US$25.7 million.

6.4 MAINTENANCE COST

Periodical maintenance and repair of the new road should be carried out, covering of pot-holes, cleaning of culverts and ditches, repair of slope erosion and maintenance of major structures. In addition, overlay of prime coat will have to be made once every 10 years. Such cost of maintenance and repair works is estimated as summarized hereunder.

	Unit Rate	Estimated Cost
Periodical maintenance	$ 1,100/km	$199,000/year
Overlay after 10 years	$17,000/km	$3,077,000

TABLE 6-5 SUMMARY OF CONSTRUCTION COSTS

Unit: 1000 US$

Description /1	Estimated Cost		
	Local Cost	Foreign Cost	Total
1) Site Clearance	217	509	726
2) Earth Works	2,039	4,758	6,797
3) Pavement Works	642	1,870	2,512
4) Drainage	981	2,279	3,260
5) Bridges	1,006	2,196	3,202
6) Miscellaneous	58	518	576
Sub-Total	4,943	12,130	17,073
Engineering/Supervision	643	1,577	2,220
Physical Contingency	671	1,645	2,316
Price Contingency	1,173	2,878	4,051
Total Estimated Cost	7,430	18,230	25,660

/1 Excluding cost of land acquisition

TABLE 6-6 BREAKDOWN OF CONSTRUCTION COSTS

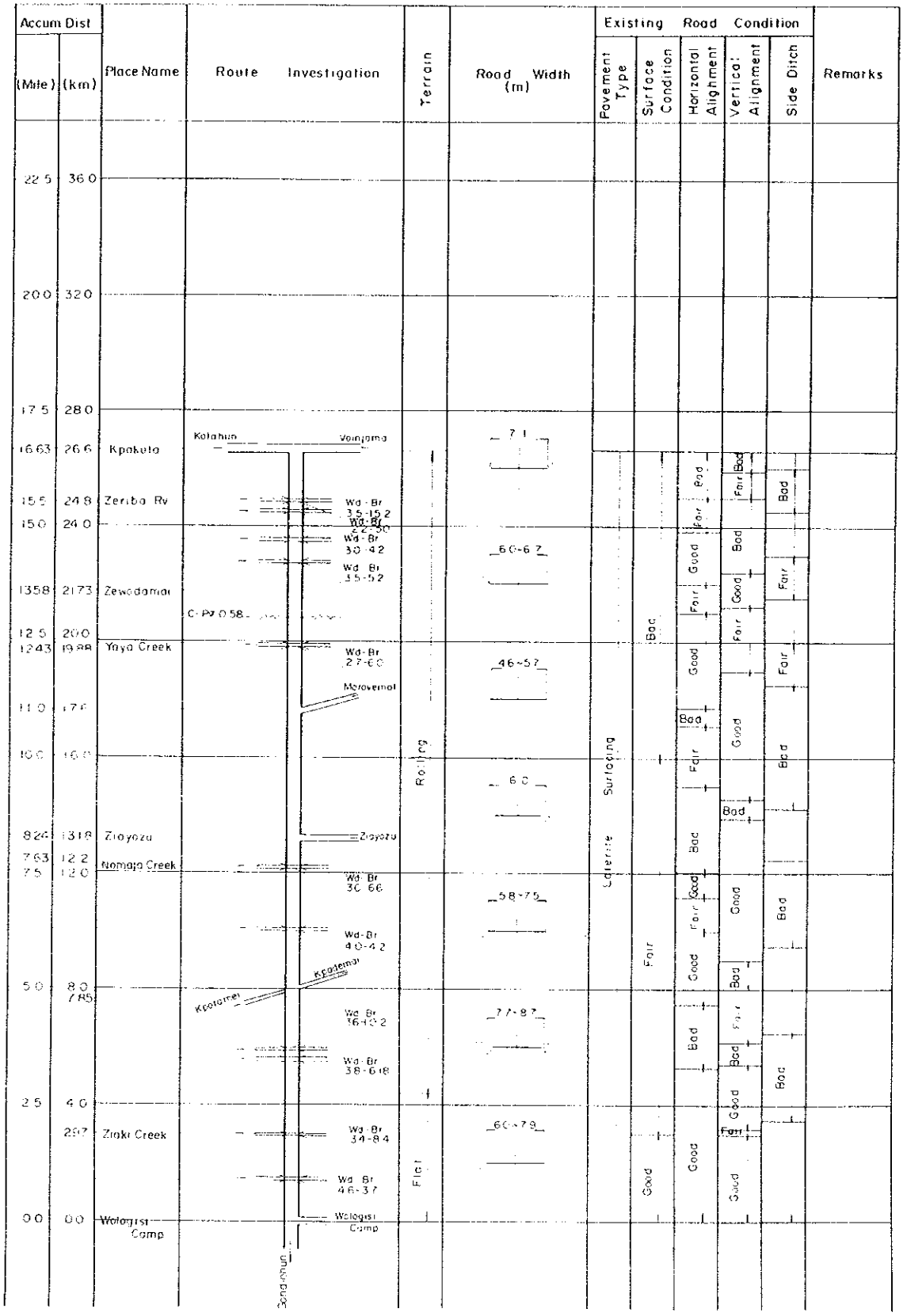
Work Item	Unit of Q'ty	Q'ty	Unit Price	Total Costs
1) Site Clearance:				
- Clearing & Grubbing	ha		4,000	726,400
2) Earth Works:				
- Common Excavation	m^3	1,506,200	2.50	3,765,500
- Borrow Excavation	m^3	600,000	4.60	2,760,000
- Side Drain Excavation	m^3	90,500	3.00	271,500
3) Pavement Works:				
- Surface Treatment	m^3	254,200	5.80	1,474,400
- Prime Coat 85 - 100	kg	978,800	1.06	1,037,500
4) Drainage:				
- Cross Ditch (0.80 x 0.80)	ℓ.m	1,020	415.00	423,300
- Cross Ditch (1.00 x 1.00)	ℓ.m	290	482.00	139,800
- Corrugated Steel Pipe ø1.0 M	ℓ.m	190	265.00	50,400
- Inlet Outlet for Pipe ø1.0 M	each	28	2,224.00	62,300
- Corrugated Steel Pipe ø1.5 M	ℓ.m	967	480.00	464,200
- Inlet & Outlet for Pipe ø1.5 M	each	184	3,115.00	573,200
- Corrugated Steel Pipe 2 x ø1.5M	ℓ.m	179	960.00	171,800
- Inlet & Outlet for Pipe 2 x ø1.5M	each	36	4,785.00	172,300
- Barrel of Box Culvert (3.0 x 3.0)		101	2,365.00	237,800
- Headwall "	each	22	8,761.00	192,700
- Barrel of Box Culvert (4.0 x 4.0)	ℓ.m	74	3,731.00	276,100
- Headwall "	each	18	11,820.00	212,800
- Barrel of Box Culvert 2 x (4.0-4.0)	ℓ.m	24	6,491.00	155,800
- Headwall	each	6	20,410.00	122,500
- Demolition of Wooden Culvert	ℓ.m	90	60.00	5,400
5) Bridges:				
- Abutment H=4m	each	16	17,890.00	286,200
- 10 m R.C. Clab	each	7	39,120.00	273,800
- 20 m R.C. T-Beam	each	4	92,930.00	371,700
- 25 m R.C. T-Beam	each	5	134,020.00	670,100
- 30 m Box - Girder	each	4	172,730.00	690,900
- Piers	each	3	97,510.00	292,500
- Abutment H=6m	each	18	30,380.00	546,800
- Rip Rap	m^3	1,099	38.00	41,800
- Demolition of Wooden Bridges	ℓ.m	373	75.00	28,000
6) Miscellaneous:				
- Traffic Signs, Roadmarking, km Post Guardrail, etc.	ℓ.m	181,600	3.17	575,700
Sub-Total				17,073,200
Engineering/Supervision				2,220,000
Physical Contingency (12 %)				2,316,000
Price Contingency (21 %)				4,051,000
Total Estimated Cost				25,660,000

ANNEX-I

INVENTORY OF EXISTING ROADS

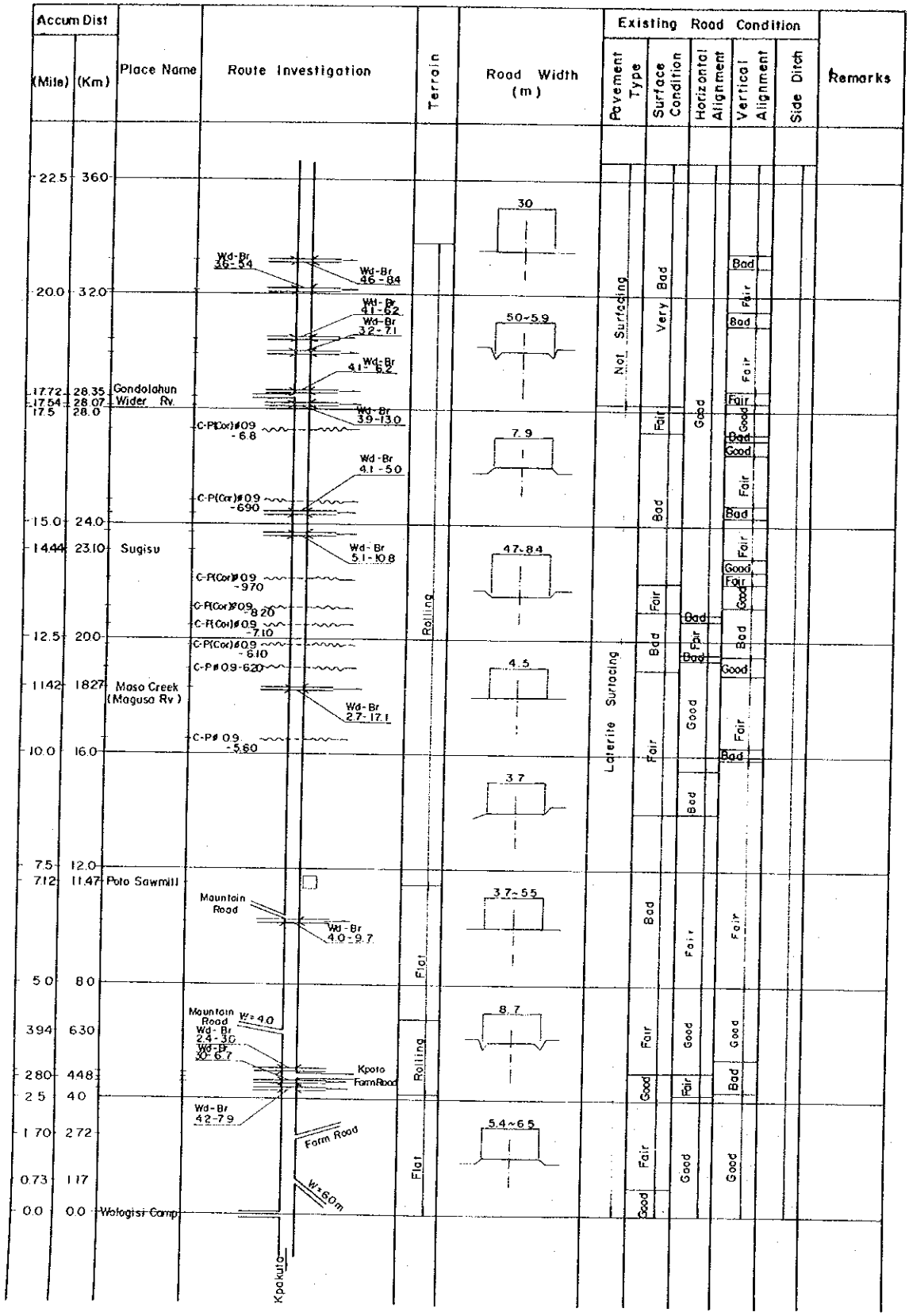
ROAD INVENTORY - FEEDER ROAD

Wologisi Camp ~ Kpakuta



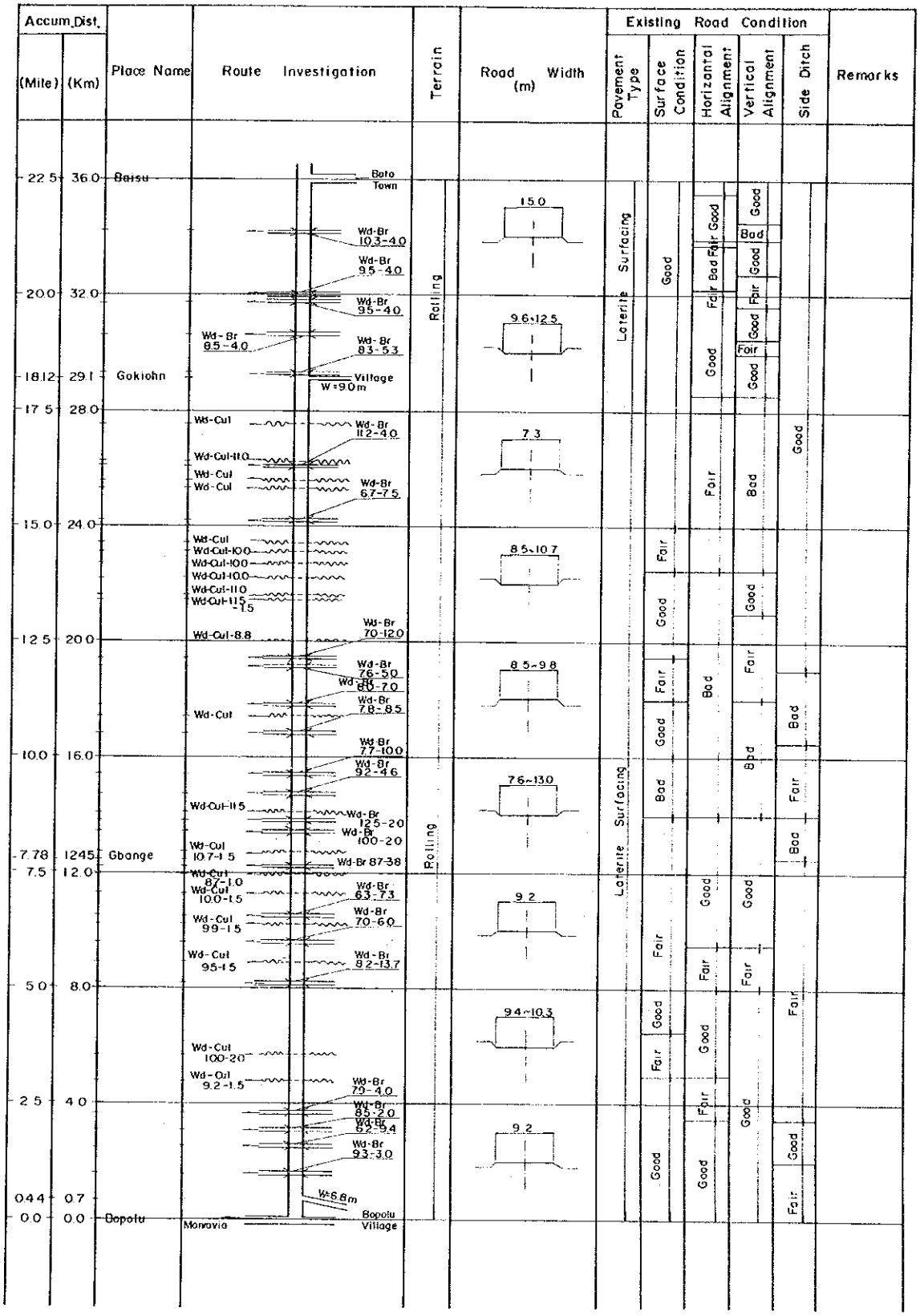
ROAD INVENTORY - FEEDER ROAD

Wologisi Camp ~ Gondolahun ~ Yaselehun



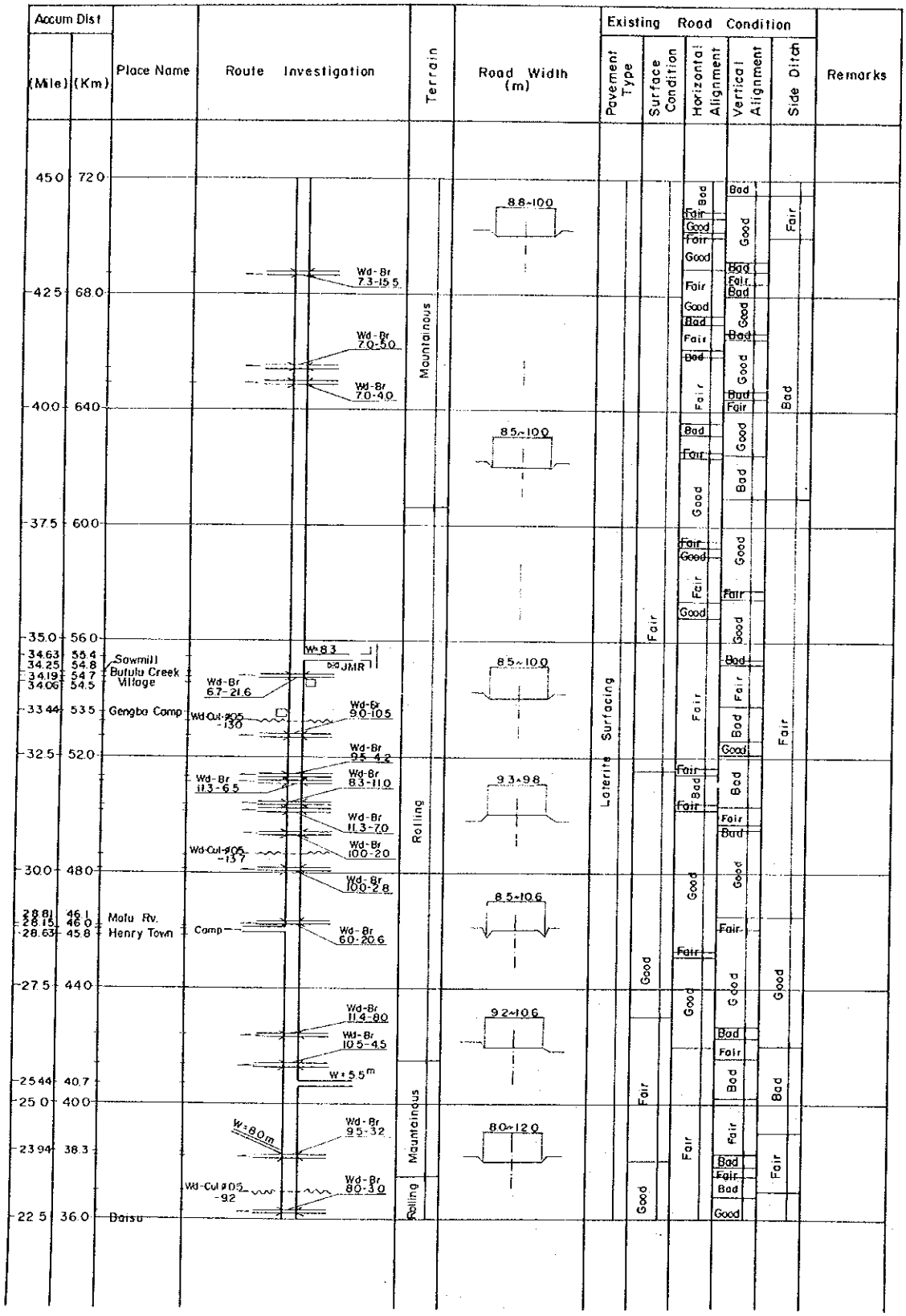
ROAD INVENTORY-PRIVATE ROAD

Bopolu ~ T.F.C ~ Kpelle National Forest (1)



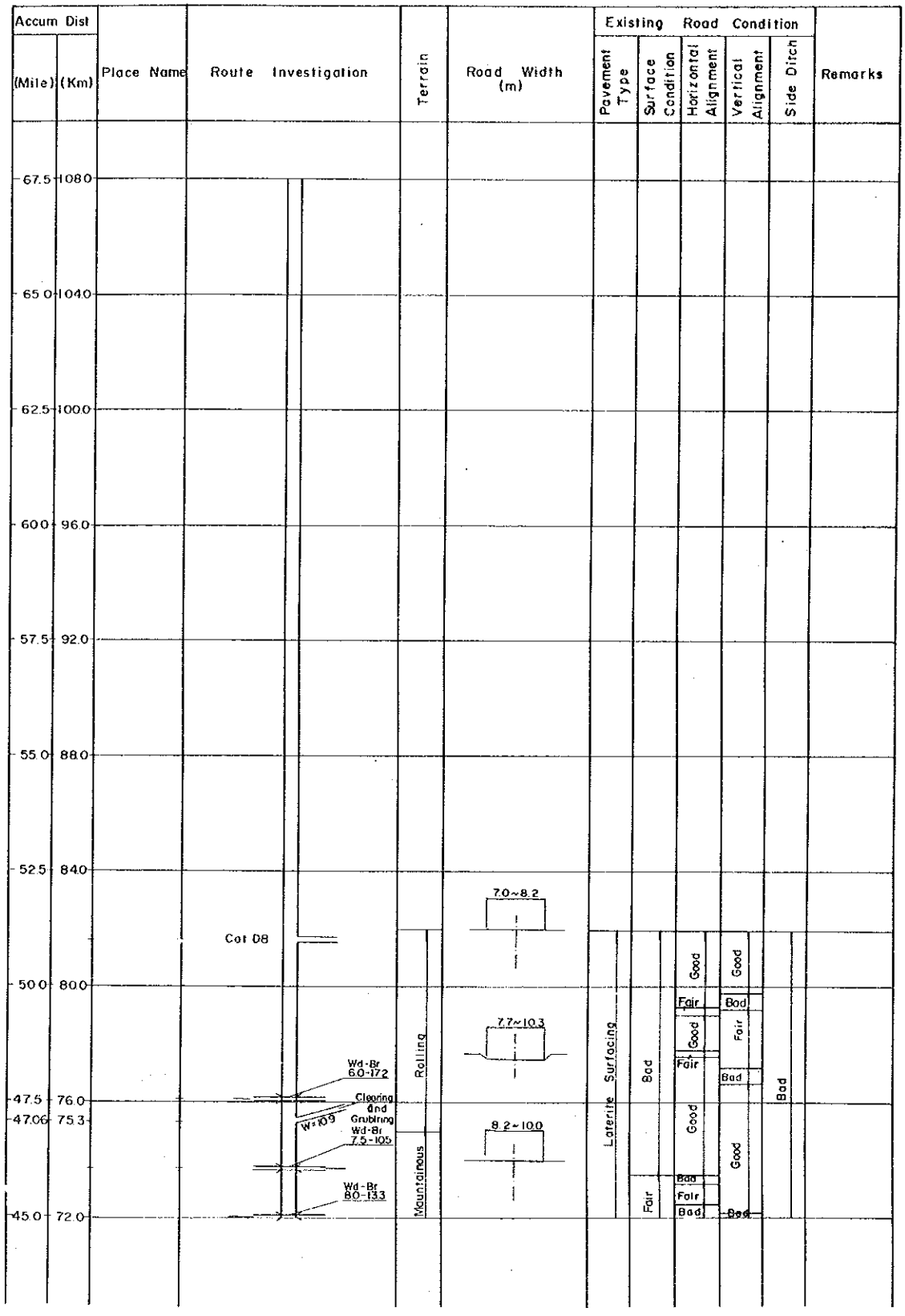
ROAD INVENTORY – PRIVATE ROAD

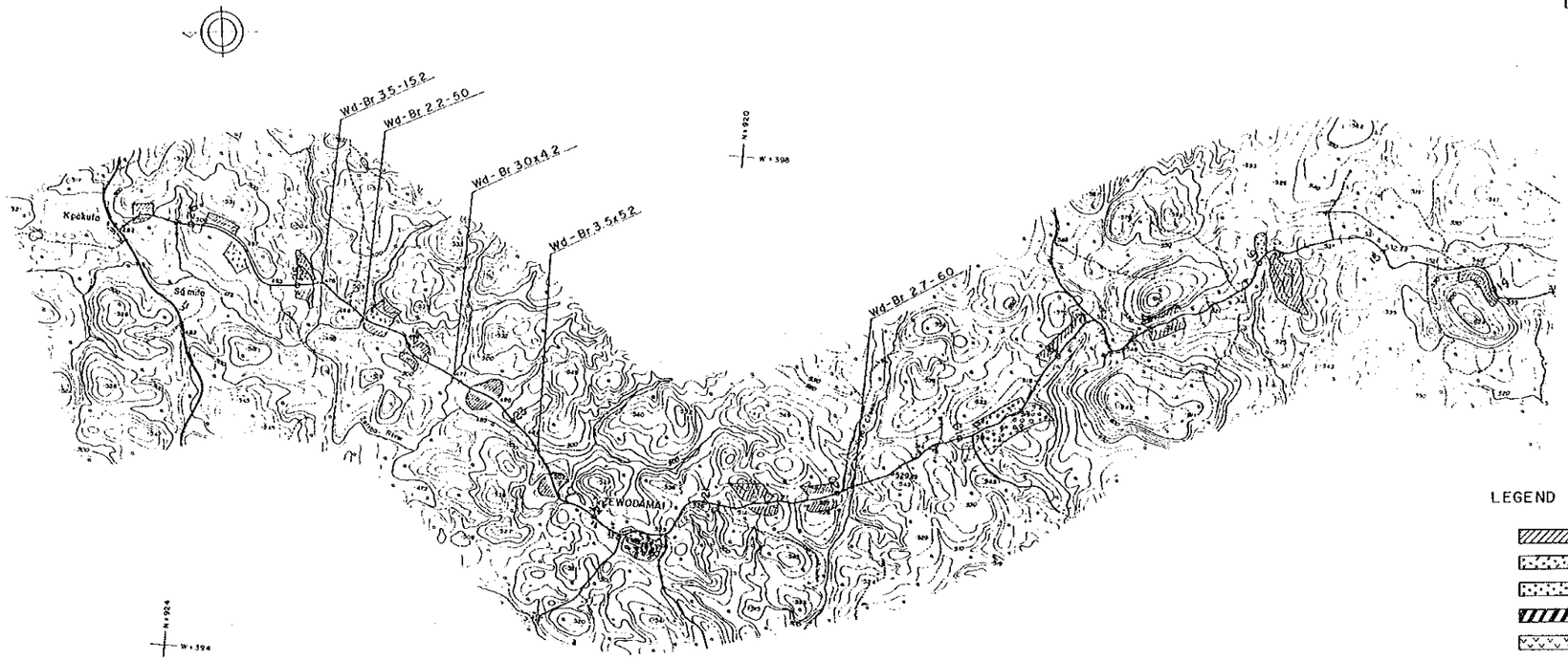
Bopolu ~ T.F.C ~ Kpelle National Forest (2)



ROAD INVENTORY – PRIVATE ROAD

Bopolu ~ T. F. C ~ Kpelle National Forest (3)





WOLOGISI IRON MINING PROJECT
: ACCESS ROAD
ROAD INVENTORY

SHEET NO.
DWG – 1

SECTION; KPAKUTA ~ WOLOGISI CAMP

0 500 1000 2,000 meters

LEGEND OF SOIL

▨ LATERITE CLAYISH
░ LATERITE SANDY
░ LATERITE GRAVEL
▨ WEATHERED ROCK (GRANTIC,BASALT)
▒ FRESH POCK (GRANTIC,BASALT)

Improvement Plan: Short Cut | Realignment | Widening | Short Cut | Widening | Realignment

Alignment – Vertical: Bad | Fair | Bad | Good | Fair | Good | Bad | Good
Alignment – Horizontal: Bad | Fair | Good | Fair | Good | Bad | Fair | Bad
Road Surface – Condition: Bad | Fair
Road Surface – Type: Laterite Surfacing

Cross Section

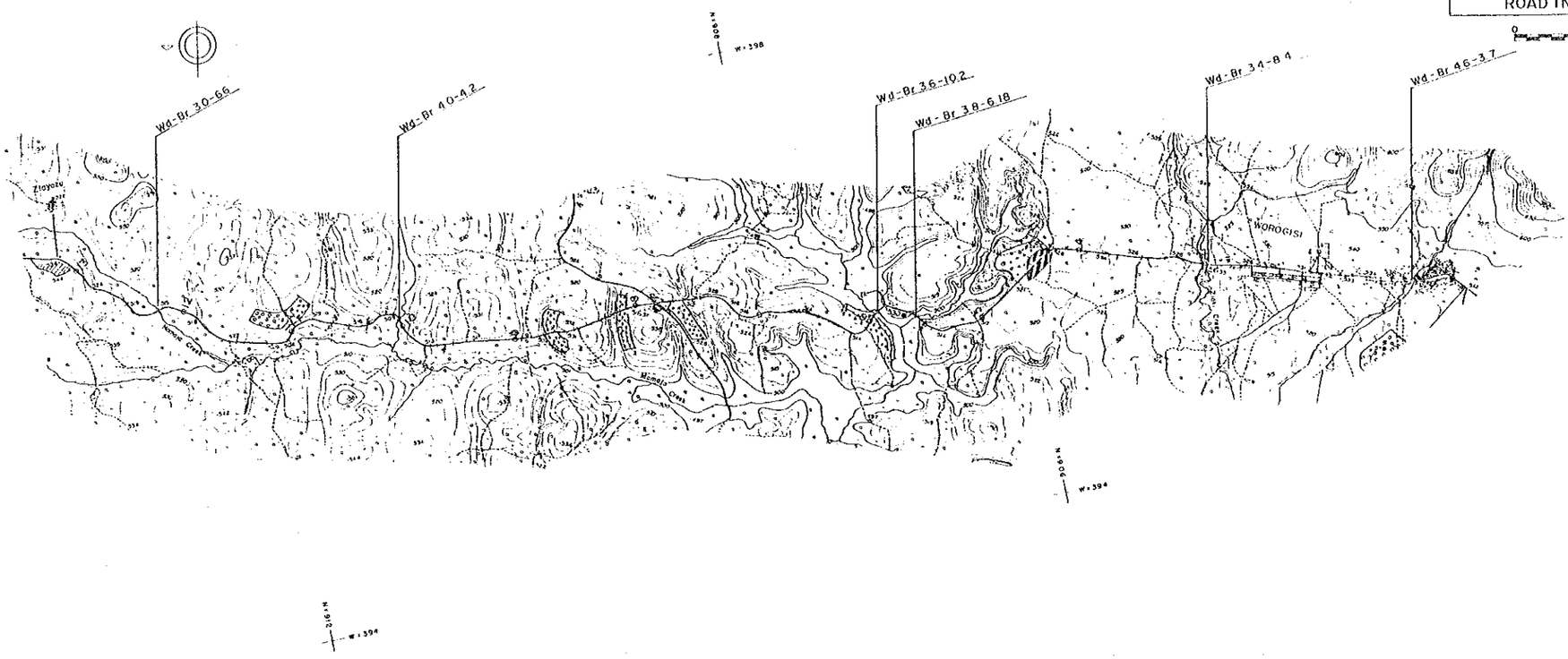
Terrain

Distance From LISCO CAMP (km): 26.6 | 26.0 | 25.0 | 24.0 | 23.0 | 22.0 | 21.0 | 20.0 | 19.0 | 18.0 | 17.0 | 16.0 | 15.0 | 14.0

WOLOGISI IRON MINING PROJECT : ACCESS ROAD	SHEET NO.
ROAD INVENTORY	DWG -- 2

0 500 1000 2000 meters

SECTION; KPAKUTA ~ WOLOGISI CAMP



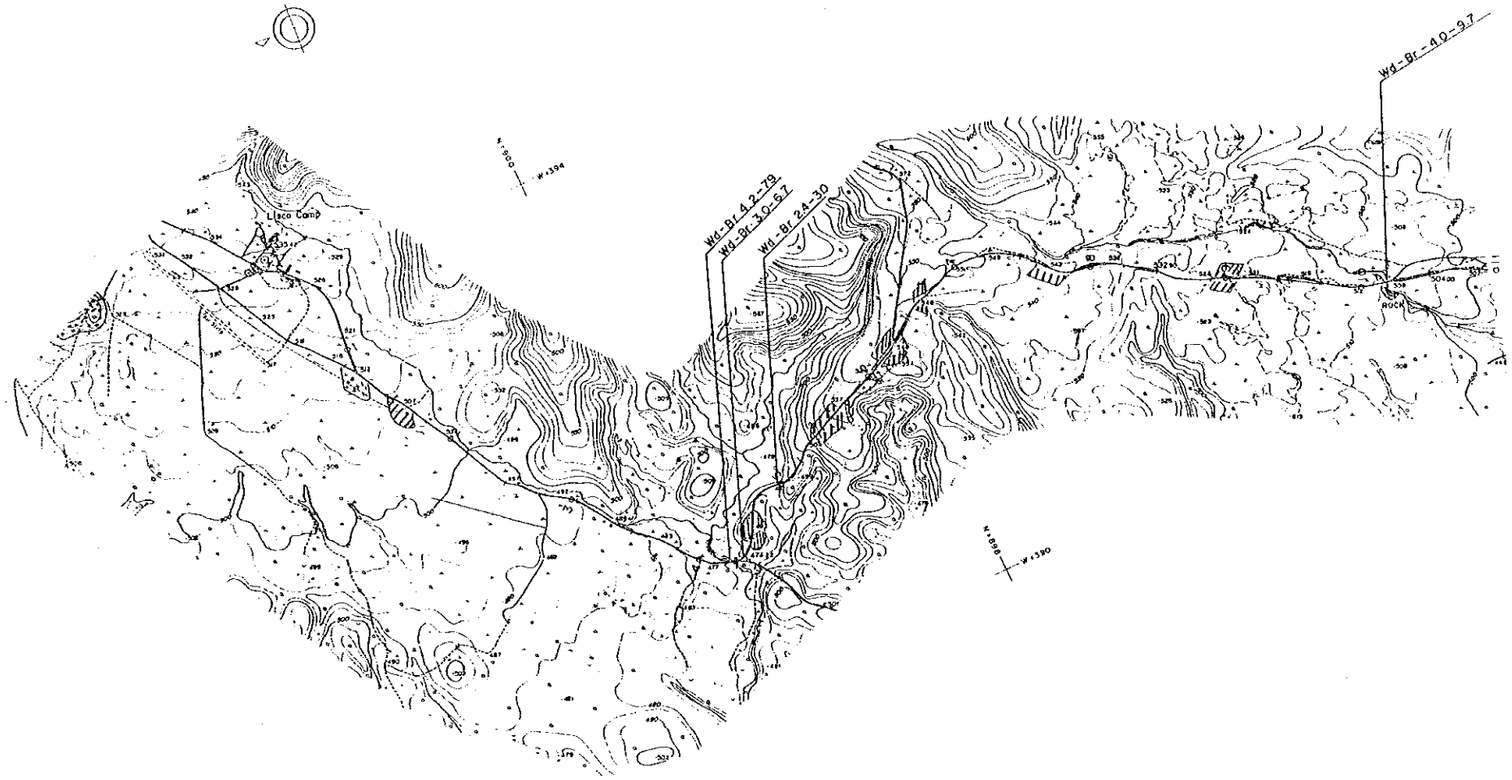
Improvement Plan		Realignment		Pavement Only		Realignment		Short Cut	Pavement Only				Short Cut
Alignment	Vertical	Good				Bad	Fair	Bad	Good		Fair	Good	
	Horizontal	Bad	Good	Fair		Good	Bad			Good			
Road Surface	Condition	Fair				Fair						Good	
	Type	Laterite Surfacing											
Cross Section		6.6		7.5		9.9	6.0		7.7	8.7		7.9	7.5
Terrain													
Distance From LISCO CAMP (km)		13.0	12.0	11.0	10.0	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0

ELEVATION IN METERS: 580, 560, 540, 520, 500, 480, 460, 440, 420, 400

WOLOGISI IRON MINING PROJECT : ACCESS ROAD	SHEET NO.
ROAD INVENTORY	DWG – 3

0 500 1000 2000 meters

SECTION; WOLOGISI CAMP ~ GONDOLAHUN



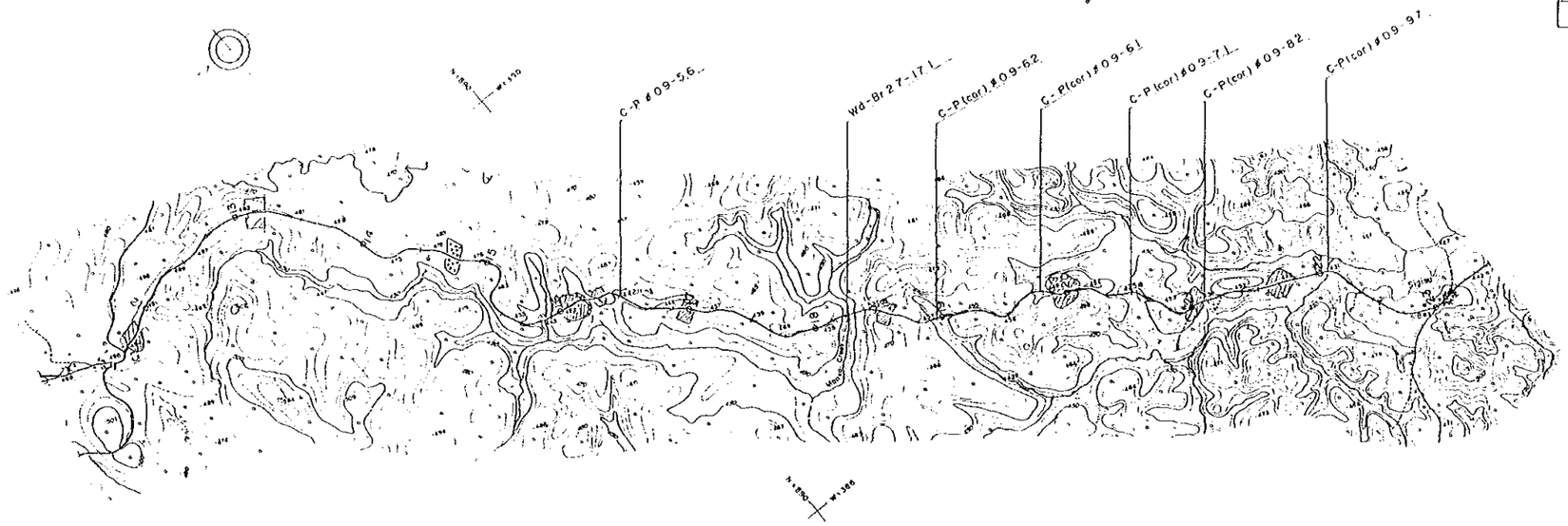
Improvement Plan		Short Cut	Widening	Short Cut	Widening	Short Cut
Alignment	Vertical	Good	Bad	Good	Fair	
	Horizontal	Good	Fair	Good	Fair	
Road Surface	Condition	Good / Fair	Good	Fair	Bad	
	Type	Laterite Surfacing				
Cross Section		8.7	5.5	6.0	5.4	5.5	4.75	4.4	4.1
Terrain						
Distance From LISCO CAMP (km)		0.0 – 1.0 – 2.0 – 3.0 – 4.0 – 5.0 – 6.0 – 7.0 – 8.0 – 9.0 – 10.0 – 11.0				

580 / 560 / 540 / 520 / 500 / 480 / 460 / 440 / 420 / 400

WOLOGISI IRON MINING PROJECT : ACCESS ROAD	SHEET NO.
ROAD INVENTORY	DWG – 4

0 500 1000 2000 meters

SECTION ; WOLOGISI CAMP ~ GONDOLAHUN



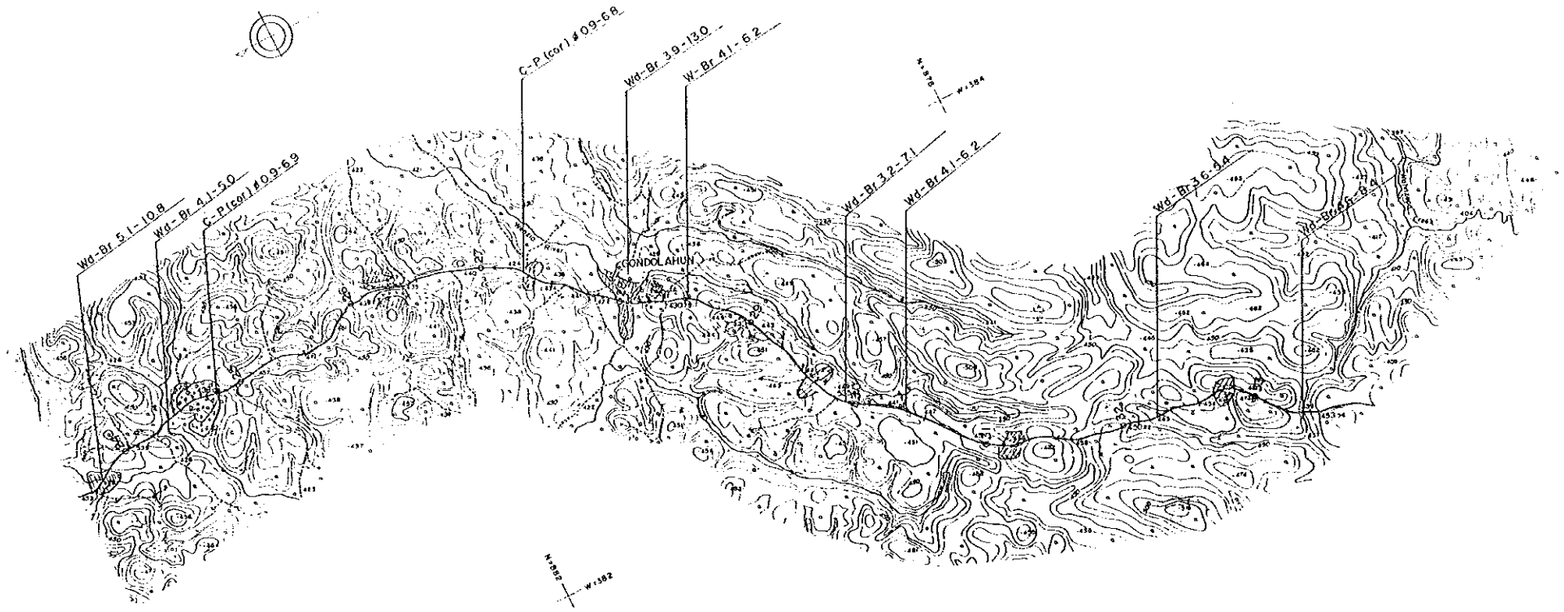
Improvement Plan		Short Cut	Widening	Short Cut	Widening	Short Cut	Realignment	Short Cut	Pavement Only	Widening
Alignment	Vertical	Fair		Bad	Fair	Good	Bad	Good	Fair Good	Fair
	Horizontal	Fair	Bad	Good		Bad	Fair	Bad	Good	
Road Surface	Condition	Fair			Bad			Fair		
	Type	Laterite Surfacing								

ELEVATION IN METERS: 580, 560, 540, 520, 500, 480, 460, 440, 420, 400

Cross Section: 5.5, 9.4, 3.7, 5.0, 4.5, 8.4, 6.6, 4.7

Terrain

Distance From LISCO CAMP (km): 11.0, 12.0, 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, 19.0, 20.0, 21.0, 22.0, 23.0



WOLOGISI IRON MINING PROJECT : ACCESS ROAD	SHEET NO.
ROAD INVENTORY	DWG – 5

0 500 1000 2,000 meters

SECTION; WOLOGISI CAMP~GONDOLAHUN

Improvement Plan: Widening | Pavement Only | Widening | New Construction Road

Alignment – Vertical: Fair | Bad | Fair | Good | Bad | Good | Fair | Fair | Bad | Fair | Bad

Alignment – Horizontal: Good

Road Surface – Condition: Bad | Fair | Very Bad

Road Surface – Type: Not Surfacing

Cross Section

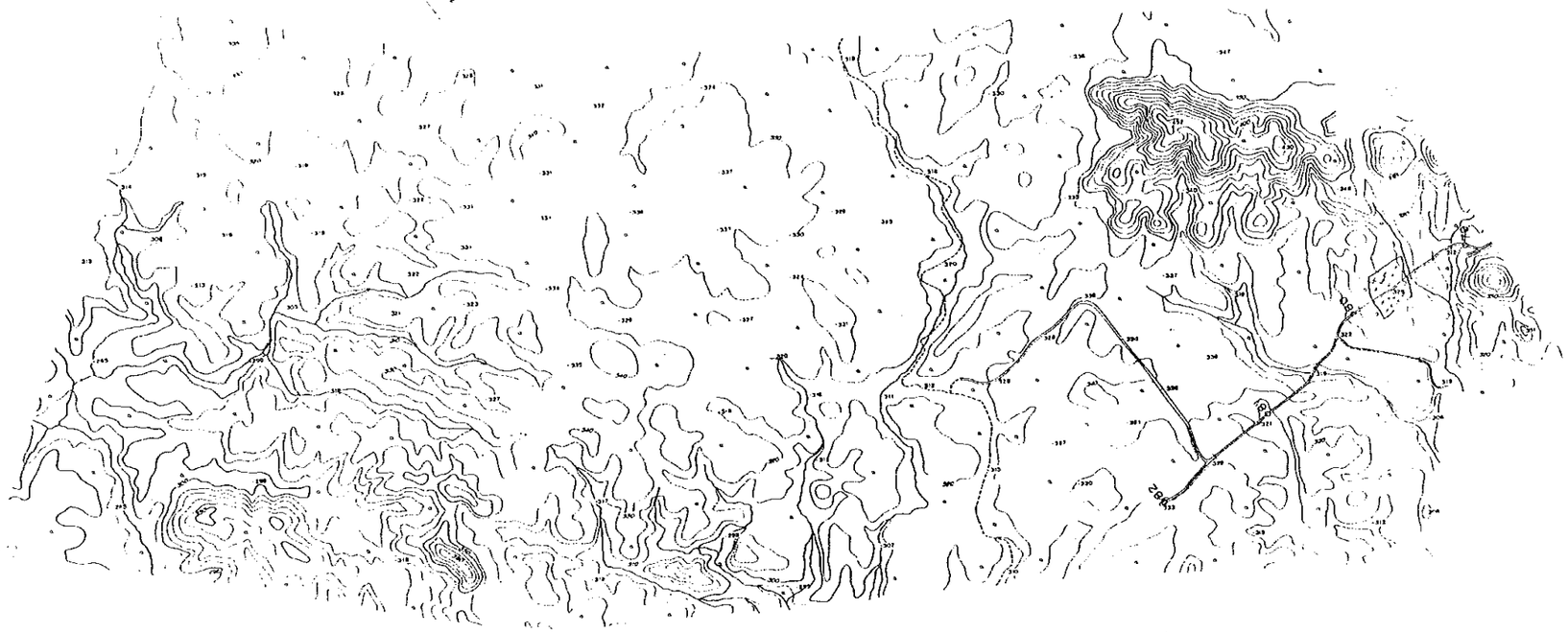
Terrain

Distance From LISCO CAMP (km): 24.0 | 25.0 | 26.0 | 27.0 | 28.0 | 29.0 | 30.0 | 31.0 | 32.0 | 33.0

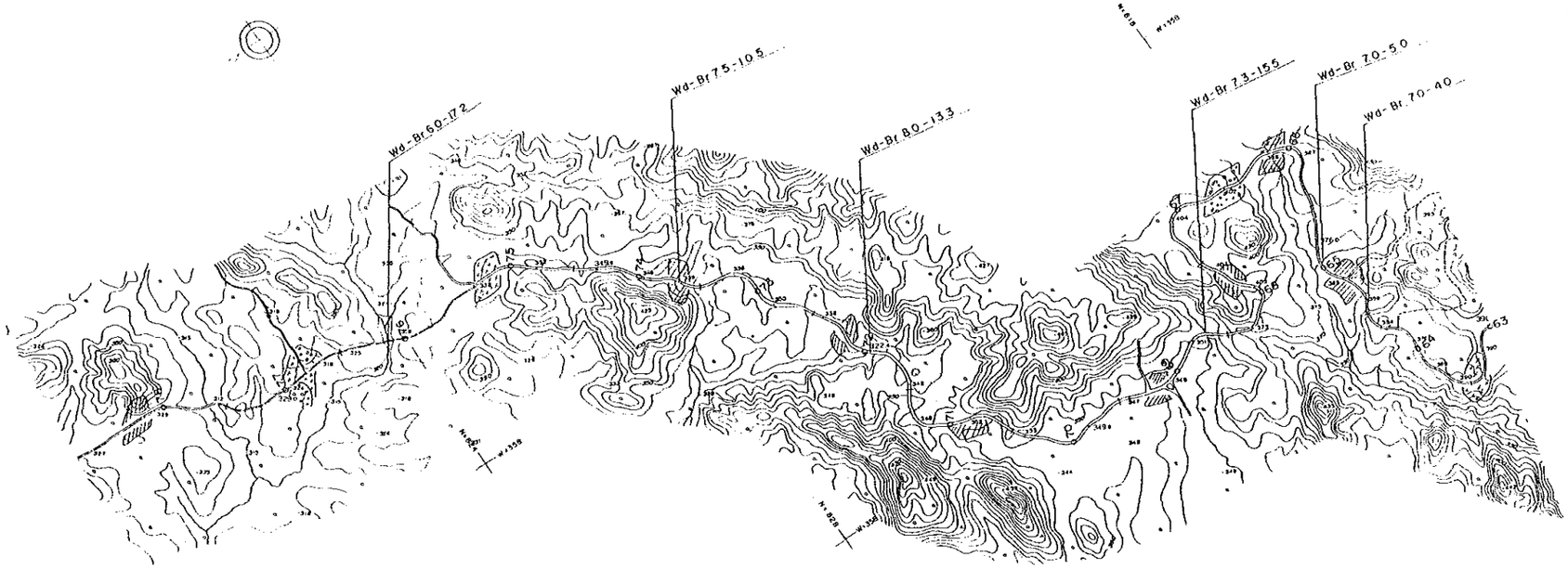
WOLOGISI IRON MINING PROJECT : ACCESS ROAD	SHEET NO.
ROAD INVENTORY	DWG – 6

0 500 1000 2,000 meters

SECTION ; KPELL NATIONAL FOREST – T.F.C – BOPOLU



Improvement Plan			Pavement Only		Short Cut
ELEVATION IN METERS	420 400 380 360 340 320 300 280 260 240 220 200				
Alignment	Vertical		Good	Bad	Fair
	Horizontal		Good	Fair	Good
Road Surface	Condition		Bad		
	Type				
Cross Section			7.0	3.2	
Terrain					
Distance From BOPOLU (km)		82.0	81.0	80.0	79.0



WOLOGISI IRON MINING PROJECT : ACCESS ROAD	SHEET NO.
ROAD INVENTORY	DWG – 7

SECTION; KPELLE NATIONAL FOREST ~ T.F.C ~ BOPOLU

Improvement Plan	Realignment Pavement Only Short Cut Pavement Only Short Cut Realignment Short Cut
Alignment – Vertical	Fair Bad Good Bad Good Bad Fair Bad Good Bad Good Bad
Alignment – Horizontal	Good Fair Good Bad Fair Bad Fair Good Fair Good Fair Fair Bad Fair Bad Fair
Road Surface – Condition	Bad Fair
Road Surface – Type	Laterite Surfacing

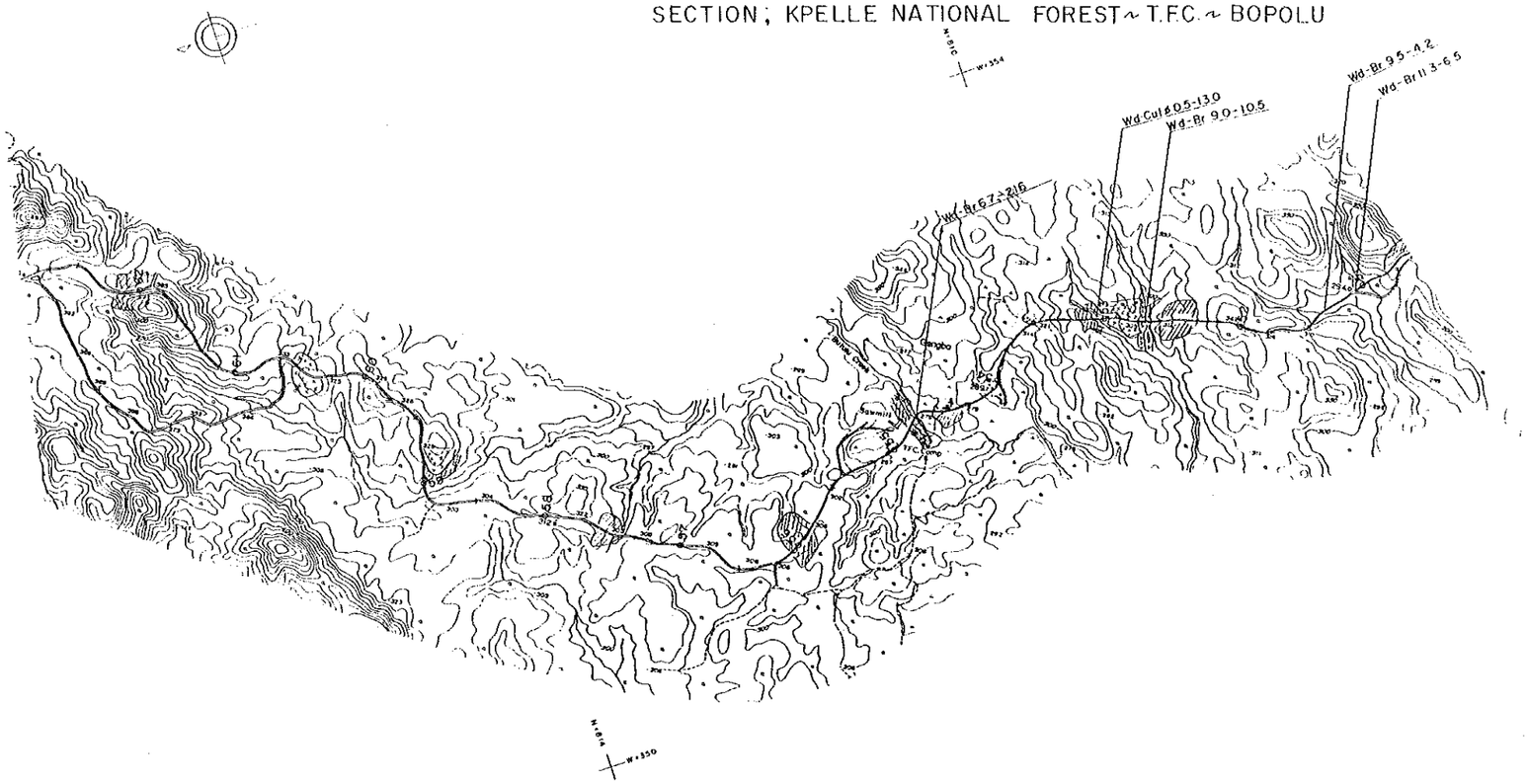
Cross Section

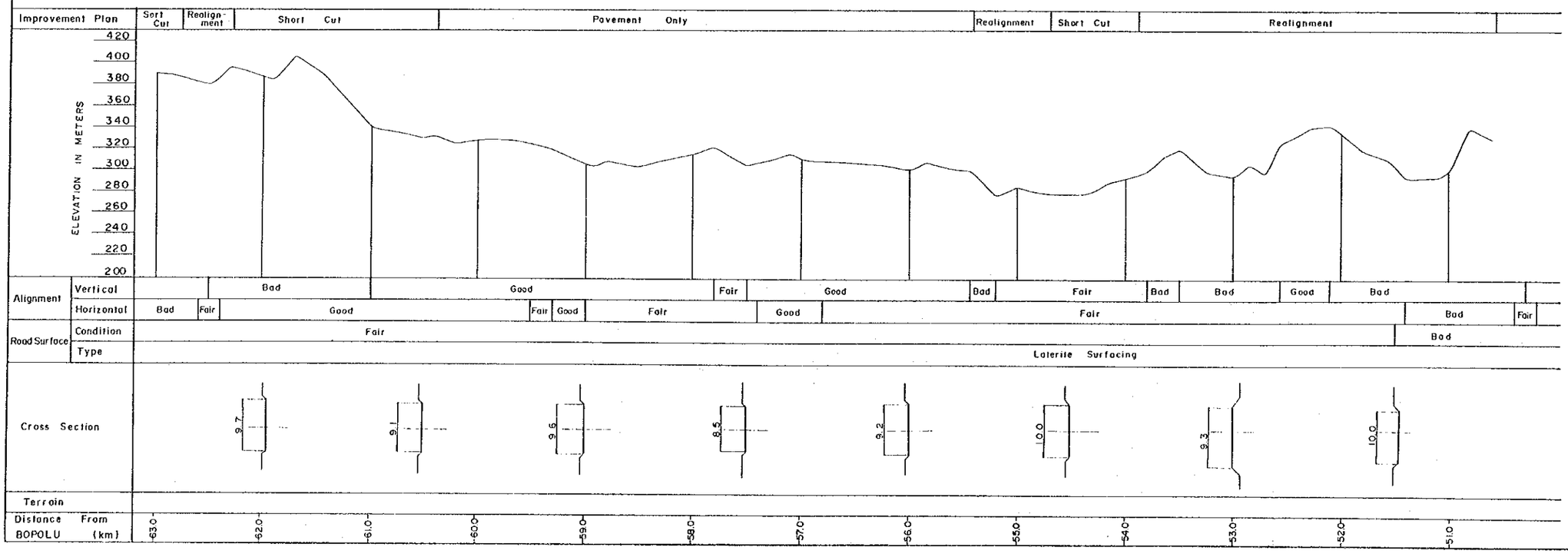
Terrain	
Distance From BOPOLU (km)	78.0 77.0 76.0 75.0 74.0 73.0 72.0 71.0 70.0 69.0 68.0 67.0 66.0 65.0

WOLOGISI IRON MINING PROJECT : ACCESS ROAD	SHEET NO.
ROAD INVENTORY	DWG – 8

0 500 1000 2000 meters

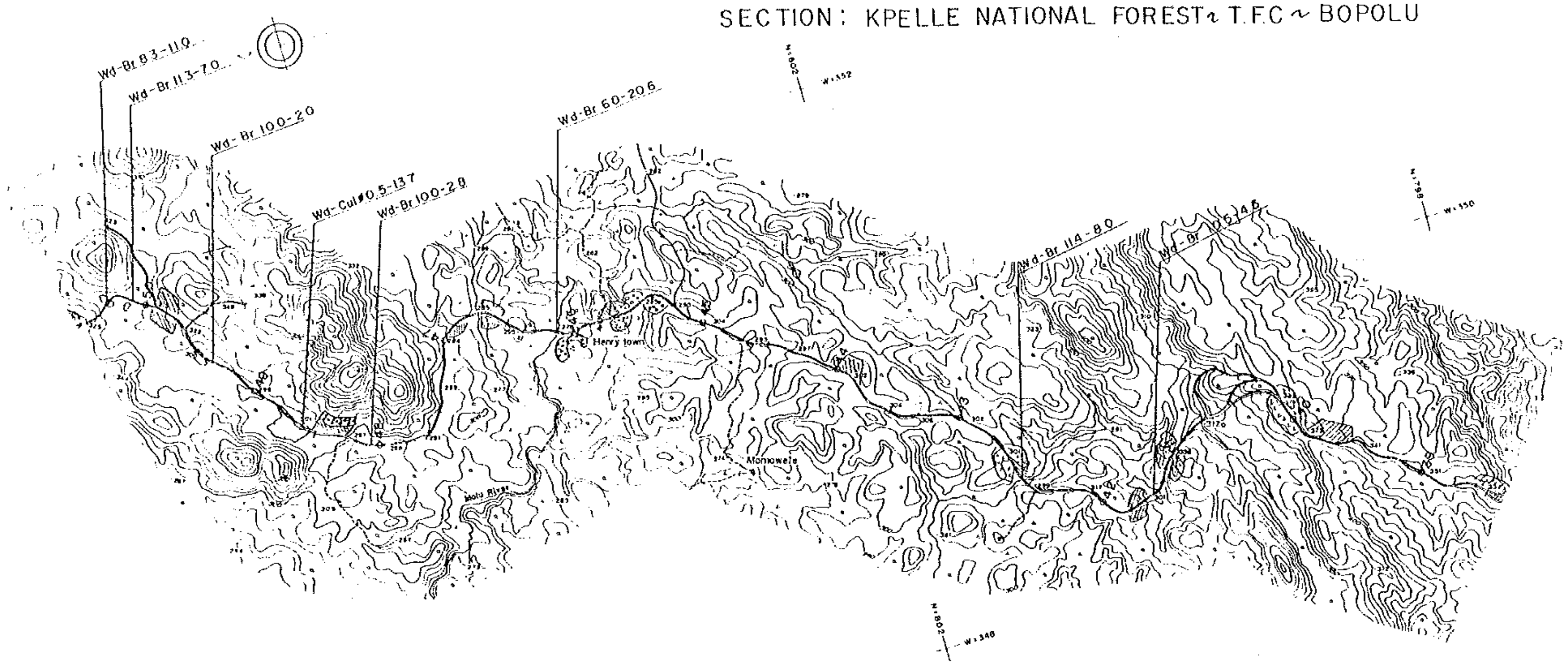
SECTION; KPELLE NATIONAL FOREST ~ T.F.C. ~ BOPOLU



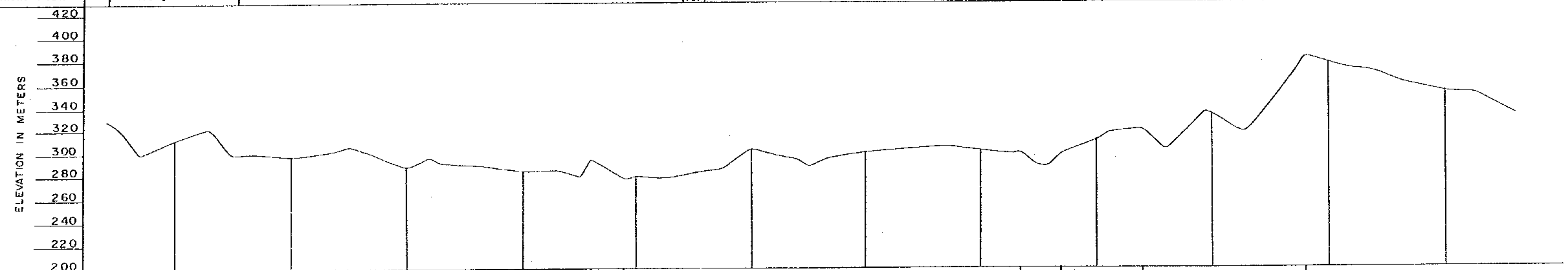


WOLOGISI IRON MINING PROJECT : ACCESS ROAD	SHEET NO.
ROAD INVENTORY	DWG – 9

SECTION : KPELLE NATIONAL FOREST ~ T.F.C ~ BOPOLU



Improvement Plan: Realignment | Pavement Only | Short Cut | Pavement Only | Realignment | Short Cut | Realignment | Short Cut



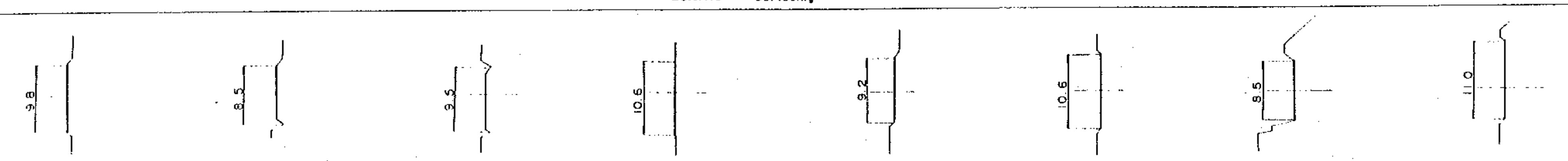
Alignment – Vertical: Bad | Fair | Bad | Good | Fair | Good | Bad | Fair | Bad | Fair

Alignment – Horizontal: Fair | Good | Fair | Good | Fair

Road Surface – Condition: Good | Good | Fair

Road Surface – Type: Laterite Surfacing

Cross Section:

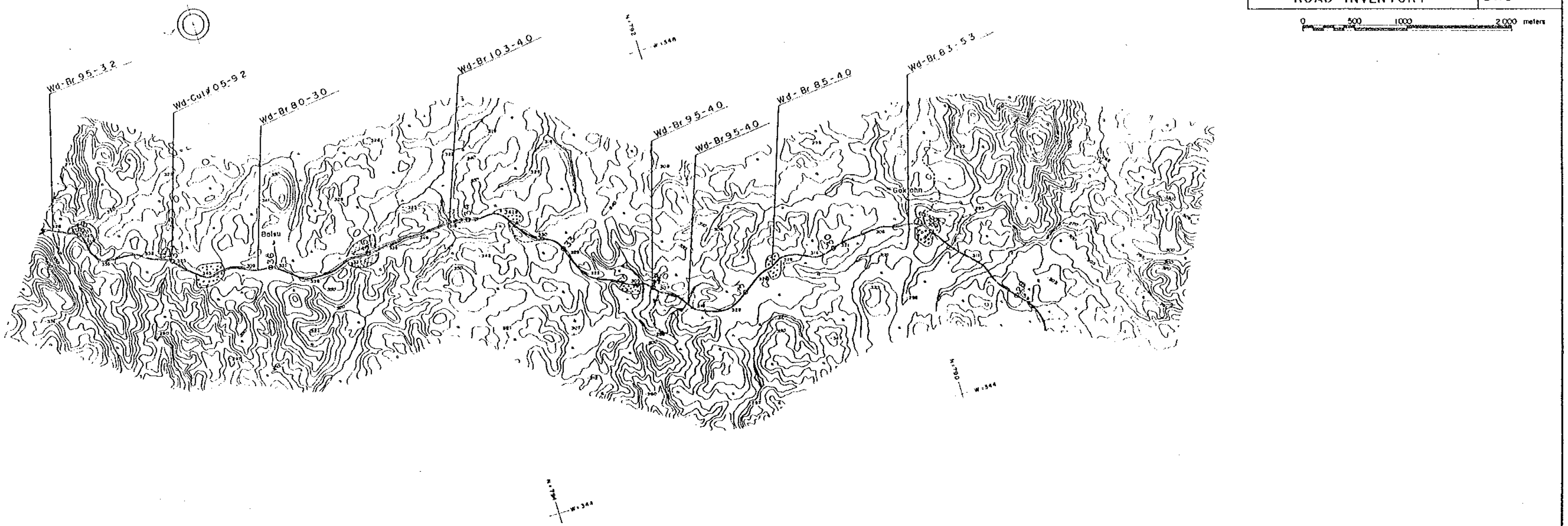


Terrain

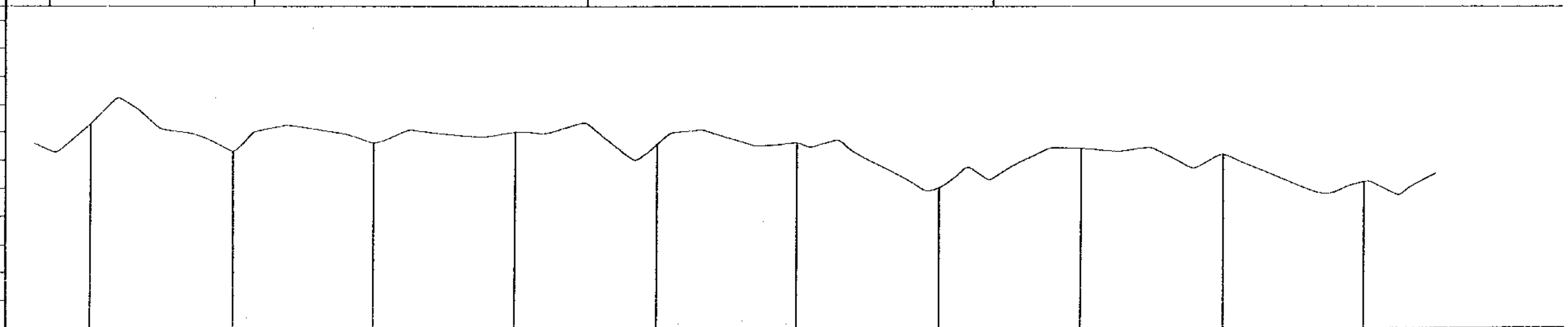
Distance From BOPOLU (km): 50.0 | 49.0 | 48.0 | 47.0 | 46.0 | 45.0 | 44.0 | 43.0 | 42.0 | 41.0 | 40.0 | 39.0

WOLOGISI IRON MINING PROJECT : ACCESS ROAD	SHEET NO.
ROAD INVENTORY	DWG - 10

SECTION; KPELLE NATIONAL FOREST ~ T.F.C ~ BOPOLU

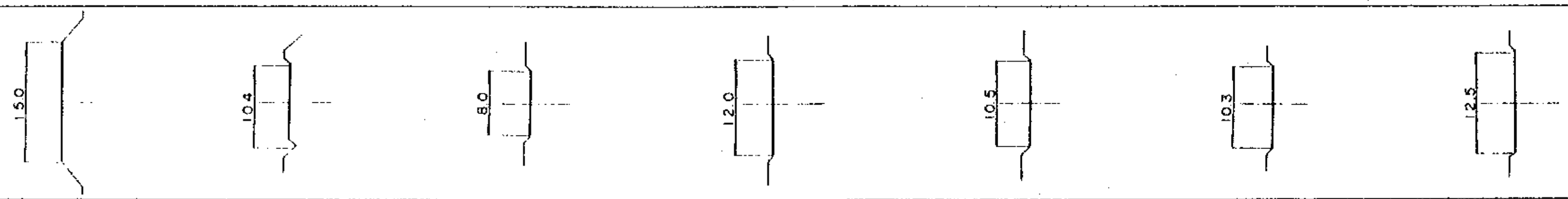


Improvement		Realignment	Pavement Only	Realignment	Pavement Only



Alignment	Vertical	Bad / Fair / Bad / Good / Bad / Good / Fair / Good / Fair / Good
Alignment	Horizontal	Good / Fair / Bad / Fair / Good
Road Surface	Condition	Good
Road Surface	Type	Laterite Surfacing

Cross Section



Terrain	
Distance From BOPOLU (km)	38.0 / 37.0 / 36.0 / 35.0 / 34.0 / 33.0 / 32.0 / 31.0 / 30.0 / 29.0 / 28.0