Annex III-3 Crop Production by District

District	Products (t)	
	1978/1979	1988/1989
Gbarnga		
Rice	5,800	11,640
Coffee	40	440
Cocoa	100	900
Oil Palm	500	1,200
Zorzor		
Rice	9,990	14,920
Coffee	660	1,400
Cocoa	530	1,120
Oil Palm	1,360	5,940
Voinjama		
Rice	8,060	12,710
Coffee	540	1,200
Cocoa	430	950
Oil Palm	1,100	5,060
Kolahun		
Rice	8,380	12,580
Coffee	560	1,180
Cocoa	440	950
Oil Palm	1,140	5,000

Annex IV - 1

Traffic Counts July 1979

Sta. No.: 1

BOTH DIRECTION

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	53	32	183	47	315
10 (Tue)	39	35	143	28	245
11 (Wed)	37	12	208	29	286
12 (Thu)	37	22	128	67	254
13 (Fri)	38	26	190	35	289
14 (Sat)	50	27	172	22	271
15 (Sun)	42	31	111	23	207
T o t a l	296	185	1,135	251	1,867
Average	42	26	162	36	267

DIRECTION Gbarnga-Mendikoma

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	23	20	92	26	161
10 (Tue)	19	17	76	16	128
11 (Wed)	25	5	108	17	155
12 (Thu)	18	17	58	30	123
13 (Fri)	22	13	100	22	157
14 (Sat)	28	17	94	12	151
15 (Sun)	20	18	54	9	101
T o t a l	155	107	582	132	976

DIRECTION Mendikoma - Gbarnga

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	30	12	91	21	134
10 (Tue)	20	18	67	12	117
11 (Wed)	12	7	100	12	131
12 (Thu)	19	5	70	37	131
13 (Fri)	16	13	90	13	132
14 (Sat)	22	10	78	10	120
15 (Sun)	22	13	57	14	106
T o t a l	141	78	553	119	891

Sta. No.: 2

BOTH DIRECTION

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	35	21	73	25	154
10 (Tue)	30	11	80	21	142
11 (Wed)	31	12	86	20	149
12 (Thu)	19	12	89	19	139
13 (Fri)	36	18	95	21	170
14 (Sat)	35	12	95	14	156
15 (Sun)	36	10	54	14	114
T o t a l	222	96	572	134	1,024
Average	32	14	82	19	146

DIRECTION Gbarnga-Mendikoma

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	14	12	30	13	69
10 (Tue)	14	5	42	11	72
11 (Wed)	10	5	39	10	64
12 (Thu)	9	8	44	12	73
13 (Fri)	20	9	45	9	83
14 (Sat)	19	6	49	5	79
15 (Sun)	21	8	22	3	54
T o t a l	107	53	271	63	494

DIRECTION Mendikoma - Gbarnga

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	21	9	43	12	85
10 (Tue)	16	6	38	10	70
11 (Wed)	21	7	47	10	85
12 (Thu)	10	4	45	7	66
13 (Fri)	16	9	50	12	87
14 (Sat)	16	6	46	9	77
15 (Sun)	15	2	32	11	60
T o t a l	115	43	301	71	530

Sta. No.: 3

BOTH DIRECTION

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	31	27	110	17	185
10 (Tue)	18	17	107	21	163
11 (Wed)	33	23	112	31	199
12 (Thu)	28	18	101	65	212
13 (Fri)	30	22	99	41	192
14 (Sat)	20	25	80	21	146
15 (Sun)	26	26	68	17	137
T o t a l	186	158	677	213	1,234
Average	27	23	97	30	177

DIRECTION Gbarnga-Mendikoma

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	8	16	41	8	73
10 (Tue)	6	8	53	10	77
11 (Wed)	18	11	54	16	99
12 (Thu)	14	14	47	29	104
13 (Fri)	15	9	41	17	82
14 (Sat)	12	13	39	9	73
15 (Sun)	11	17	33	8	69
T o t a l	84	88	308	97	577

DIRECTION Mendikoma - Gbarnga

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	23	11	69	9	112
10 (Tue)	12	9	54	11	86
11 (Wed)	15	12	58	15	100
12 (Thu)	14	4	54	36	108
13 (Fri)	15	13	58	24	110
14 (Sat)	8	12	41	12	73
15 (Sun)	15	9	35	9	68
T o t a l	102	70	369	116	657

Annex IV - 1(continued 4)

Sta. No.: 4

BOTH DIRECTION

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	49	54	230	68	401
10 (Tue)	68	63	283	111	525
11 (Wed)	60	68	243	75	446
12 (Thu)	68	19	205	66	358
13 (Fri)	65	96	272	40	473
14 (Sat)	48	76	222	67	413
15 (Sun)	55	165	273	131	624
T o t a l	413	541	1,728	558	3,240
Average	59	77	247	80	463

DIRECTION Gbarnga-Mendikoma

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	27	38	111	43	219
10 (Tue)	33	21	136	48	238
11 (Wed)	27	15	97	20	159
12 (Thu)	35	16	107	29	187
13 (Fri)	36	36	123	18	213
14 (Sat)	22	28	96	24	170
15 (Sun)	24	109	113	74	320
T o t a l	204	263	783	256	1,506

DIRECTION Mendikoma - Gbarnga

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	22	16	119	25	182
10 (Tue)	35	42	147	63	287
11 (Wed)	33	53	146	55	287
12 (Thu)	33	3	98	37	171
13 (Fri)	29	60	149	22	260
14 (Sat)	26	48	126	43	243
15 (Sun)	31	56	160	57	304
T o t a l	209	278	945	302	1,734

Annex IV - 1(continued 5)

Sta. No.: 5

BOTH DIRECTION

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	72	20	209	34	335
10 (Tue)	87	37	190	51	365
11 (Wed)	87	24	204	58	373
12 (Thu)	79	38	213	43	373
13 (Fri)	98	28	309	60	495
14 (Sat)	55	32	208	63	348
15 (Sun)	55	25	127	22	229
T o t a l	533	204	1,460	321	2,518
Average	76	29	209	46	360

DIRECTION Gbarnga-Mendikoma

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	31	10	97	12	150
10 (Tue)	41	21	98	23	183
11 (Wed)	43	12	99	32	186
12 (Thu)	38	20	104	17	179
13 (Fri)	45	12	152	27	236
14 (Sat)	26	16	105	26	173
15 (Sun)	34	14	68	12	128
T o t a l	258	105	723	149	1,235

DIRECTION Mendikoma - Gbarnga

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	41	10	112	22	185
10 (Tue)	46	16	92	28	182
11 (Wed)	44	12	105	26	187
12 (Thu)	41	18	109	26	194
13 (Fri)	53	16	157	33	259
14 (Sat)	29	16	103	27	175
15 (Sun)	21	11	59	10	101
T o t a l	275	99	737	172	1,283

Sta. No.: 6

BOTH DIRECTION

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	41	53	235	21	350
10 (Tue)	40	50	214	34	228
11 (Wed)	47	46	184	38	315
12 (Thu)	42	31	226	49	348
13 (Fri)	50	53	216	45	364
14 (Sat)	53	83	246	66	448
15 (Sun)	58	100	274	49	481
T o t a l	331	416	1,595	302	2,644
Average	47	59	228	43	377

DIRECTION Gbarnga-Mendikoma

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	20	25	114	12	171
10 (Tue)	19	28	117	21	185
11 (Wed)	28	23	98	26	175
12 (Thu)	23	15	117	24	179
13 (Fri)	28	35	115	33	211
14 (Sat)	31	45	123	46	245
15 (Sun)	26	42	108	19	195
T o t a l	175	213	792	181	1,361

DIRECTION Mendikoma - Gbarnga

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	21	28	121	9	179
10 (Tue)	21	22	97	13	153
11 (Wed)	19	23	86	12	140
12 (Thu)	19	16	109	25	169
13 (Fri)	22	18	101	12	153
14 (Sat)	22	38	123	20	203
15 (Sun)	32	58	166	30	286
T o t a l	156	203	803	121	1,283

Annex IV - 1 (continued 7)

Sta. No.: 7

BOTH DIRECTION

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	27	36	227	13	303
10 (Tue)	33	34	201	12	280
11 (Wed)	18	38	214	27	297
12 (Thu)	37	41	202	31	311
13 (Fri)	38	54	255	35	382
14 (Sat)	44	60	287	33	424
15 (Sun)	31	36	177	24	268
T o t a l	228	299	1,563	175	2,265
Average	33	43	223	25	324

DIRECTION Gbarnga-Mendikoma

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	11	19	97	5	132
10 (Tue)	16	16	89	4	125
11 (Wed)	8	17	96	15	136
12 (Thu)	21	24	112	18	175
13 (Fri)	15	24	117	18	174
14 (Sat)	19	37	143	27	226
15 (Sun)	12	13	93	17	135
T o t a l	102	150	747	104	1,103

DIRECTION Mendikoma - Gbarnga

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	16	17	130	8	171
10 (Tue)	17	18	112	8	155
11 (Wed)	10	21	118	12	161
12 (Thu)	16	17	90	13	136
13 (Fri)	23	30	138	17	208
14 (Sat)	25	23	144	6	298
15 (Sun)	19	23	84	7	133
T o t a l	126	149	816	71	1,162

Sta. No.: 8

BOTH DIRECTION

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	12	30	62	11	115
10 (Tue)	13	53	67	29	162
11 (Wed)	12	20	66	10	108
12 (Thu)	5	53	81	18	157
13 (Fri)	9	15	93	2	119
14 (Sat)	9	34	163	33	239
15 (Sun)	38	59	264	17	378
T o t a l	98	264	796	120	1,278
Average	14	38	114	17	183

DIRECTION Gbarnga-Mendikoma

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	6	14	33	6	59
10 (Tue)	5	29	32	19	85
11 (Wed)	3	11	39	3	56
12 (Thu)	2	27	38	10	77
13 (Fri)	4	6	41	0	51
14 (Sat)	5	19	72	12	108
15 (Sun)	7	20	109	6	142
T o t a l	32	126	364	56	578

DIRECTION Mendikoma - Gbarnga

DAY	CAR	TAXI	PICK-UP	TRUCK	TOTAL
July 9 (Mon)	6	16	29	5	56
10 (Tue)	8	24	35	10	77
11 (Wed)	9	9	27	7	52
12 (Thu)	3	26	43	8	80
13 (Fri)	5	9	52	2	68
14 (Sat)	4	15	91	21	131
15 (Sun)	31	39	155	11	236
T o t a l	66	138	432	64	700

Annex IV -2

Car

Origin-Destination Matrix (1979)

(unit: vehicle/day)

Zone No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total	Zone No.
		15		1		13		3											32	1
			5									1			1				22	2
																			5	3
						16		3	1						1				22	4
						21													21	5
							63	5	9			3		8	10				148	6
								21						5					89	7
									29						1				62	8
										11					1	5			56	9
																			11	10
																			0	11
																			4	12
																			0	13
															1				14	14
																1			16	15
																			6	16
																			0	17
																			0	18
																			508	

Annex IV -2 (continued 2)

Taxi

Origin-Destination Matrix (1979)

(unit: vehicle/day)

Zone No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total	Zone No.
		8		2	1	6			1										18	1
												1							9	2
				6															6	3
						44						1			5				58	4
						37									1				39	5
							5	13	14						2				121	6
								42											47	7
									30	1						4			90	8
										14					1	26			86	9
																			15	10
																			0	11
																			2	12
																			0	13
																			0	14
																			9	15
																			30	16
																			0	17
																			0	18
																			530	

Annex IV-2 (continued 3)

Origin-Destination Matrix (1979)

(unit: vehicle/day)

Zone No. (Pick-up)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total	Zone No.
1		71	1	2	2	11		4	1	1						1			94	1
2												28							99	2
3				20															21	3
4						86		6				1			2				117	4
5						123						1			1				127	5
6							119	58	34		1	4			33				469	6
7								132	12										263	7
8									138	46					18	27			429	8
9										21		1			11	43			261	9
10																			68	10
11																			1	11
12																			35	12
13																			0	13
14																			0	14
15																1			66	15
16																			72	16
17																			0	17
18																			0	18
Total																			2,122	

Annex IV -2 (continued 4)

Truck

Origin-Destination Matrix (1979)

(unit: vehicle/day)

Zone No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total	Zone No.
					3	3			1										7	1
												1			3				4	2
				1															1	3
						20	1	1							4				27	4
						45					1				3				52	5
							9	11	9		3				7	1			108	6
								5											15	7
															8	1			26	8
										7		1			9	4			31	9
															7				14	10
																			4	11
																			2	12
																			0	13
																			0	14
																3			44	15
																			9	16
																			0	17
																			0	18
																			344	

Annex IV -2 (continued 5)

Origin-Destination Matrix (1979)

(unit: vehicle/day)

Zone No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total	Zone No.
1		94	1	5	6	33		7	3	1						1			151	1
2			3									31			4				134	2
3				27															33	3
4						166	1	10	1			2			12				224	4
5						220					1	1			5				239	5
6							196	87	66		4	7		8	52	1			846	6
7								200	12					5					414	7
8									197	47					27	32			607	8
9										53		2			22	78			434	9
10															7				108	10
11																			5	11
12																			43	12
13																			0	13
14															1				14	14
15																5			135	15
16																			117	16
17																			0	17
18																			0	18
Total																			3,504	

Annex IV - 3

Traffic Characteristics

1. Type of Fuel

Vehicle Type	Fuel	Station						
		1	3	4	6	8	Total	%
Car	Regular	4	2	9	10	3	28	24.8
	Super	9	-	49	22	1	81	71.7
	Diesel	1	-	3	-	-	4	3.5
Taxi	Regular	1	-	10	12	5	28	23.9
	Super	10	4	10	16	48	88	75.2
	Diesel	-	-	1	-	-	1	0.9
Pick-up Bus	Regular	20	15	34	58	28	155	28.7
	Super	40	9	125	153	52	379	70.0
	Diesel	-	-	7	-	-	7	1.3
Truck	Regular	-	-	8	-	-	8	7.0
	Super	-	-	4	3	1	8	7.0
	Diesel	14	9	27	32	17	99	86.0

2. Ownership

Vehicle Type	Ownership	Station						
		1	3	4	6	8	Total	%
Car	Private	13	2	46	10	4	75	65.8
	Government	1	-	16	22	-	39	34.2
Taxi	Private	12	4	19	28	51	114	100.0
	Government	-	-	-	-	-		
Pick-up Bus	Private	53	23	156	177	77	486	92.6
	Government	6	-	7	26	-	39	7.4
Truck	Private	10	6	24	28	15	83	82.2
	Government	4	1	7	6	-	18	17.8

3. Purpose of Trip

Vehicle Type	Purpose	Station						
		1	3	4	6	8	Total	%
Car	Go to and come back from agricaltural activity	-	-	5	-	2	7	8.2
	Business	11	1	34	13	-	59	69.5
	Shopping	-	-	10	2	-	12	14.1
	Social/Religious	-	1	4	-	2	7	8.2
	Recreation	-	-	-	-	-	-	-
	O.A.U. /1	-	-	-	-	-	-	-
	Others	-	-	-	-	-	-	-
Taxi	Go to and come back from agricaltural activity	-	3	-	-	-	3	3.8
	Business	11	1	13	12	24	61	76.1
	Shopping	-	-	3	3	6	12	15.0
	Social/Religious	-	-	1	-	2	3	3.8
	Recreation	-	-	-	-	-	-	-
	O.A.U. /1	-	-	-	-	-	-	-
	Others	-	-	1	-	-	1	1.3
Pick-up Bus	Go to and come back from agricaltural activity	1	10	14	10	2	37	10.2
	Business	48	13	104	73	43	281	77.2
	Shopping	1	-	16	8	6	31	8.5
	Social/Religious	-	1	1	-	5	7	1.9
	Recreation	-	-	-	-	-	-	-
	O.A.U. /1	-	-	-	-	1	1	0.3
	Others	1	-	5	-	1	7	1.9
Truck	Go to and come back from agricaltural activity	-	3	9	2	-	14	16.5
	Business	3	6	25	16	14	64	75.3
	Shopping	-	-	-	4	-	4	4.7
	Social/Religious	-	-	-	-	-	-	-
	Recreation	-	-	-	-	-	-	-
	O.A.U. /1	-	-	-	-	-	-	-
	Others	-	-	3	-	-	3	3.5

/1 Organization for African Unity

4. Number of Passengers Carried (including driver)

Vehicle Type	Number	Station					
		1	3	4	6	8	Total
Car	Person	37	8	204	50	7	306
	Vehicle	11	2	48	17	3	81
	Person/ Vehicle	3.4	4.0	4.3	2.9	2.3	3.8
Taxi	Person	75	23	88	92	186	464
	Vehicle	12	4	17	15	32	80
	Person/ Vehicle	6.3	5.8	5.2	6.1	5.8	5.8
Pick-up Bus	Person	678	226	1,534	914	668	4,020
	Vehicle	58	22	130	102	58	370
	Person/ Vehicle	11.9	10.3	11.8	9.0	11.5	10.9
Truck	Person	17	12	37	14	34	114
	Vehicle	6	4	13	5	13	41
	Person/ Vehicle	2.8	3.0	2.8	2.8	2.6	2.8

5. Type of Goods Carried by Truck

Goods	Station						
	1	3	4	6	8	Total	%
Empty	2	5	4	19	9	30	35.3
Fuel	2	3	3	-	-	8	9.4
Logs	-	-	2	-	-	2	2.4
Sawn timer	-	1	1	-	-	2	2.3
Rubber	1	-	-	-	-	1	1.2
Agricultural crop product	-	-	12	2	7	21	24.7
Consumer goods	6	-	2	4	2	14	16.5
Construction materials	2	-	3	-	-	5	5.9
Mix	1	-	1	-	-	2	2.3
Total	14	9	28	16	18	85	100.0

6. Average Load carried by Truck

Goods	Station						
	1	3	4	6	8	Total	%
Empty	2	5	4	14	9	34	8.2
1/4			1		1	2	2.2
1/2	1		5	1		7	7.9
3/4			9	2	1	12	13.5
Full	11	4	9	3	7	34	38.2
Total	14	9	28	20	18	89	100.0

7. Frequency of Trip

Station	Frequency	Vehicle type					
		Car	Taxi	Pick-up	Truck	Total	%
1	-1/week	4	6	9	8	27	27.9
	2-6/week	4	4	15	3	26	26.8
	1/day	1	1	18	1	21	21.6
	2/day	4	1	11		16	16.5
	3/day			7		7	7.2
3	-1/week		1	2	1	4	10.8
	2-6/week	2	1	12	4	19	51.4
	1/day			2		2	5.4
	2/day			3		3	8.1
	3/day		2	5	2	9	24.3
4	-1/week	5	1	12	7	25	10.3
	2-6/week	13	3	22	10	48	19.8
	1/day	15	6	31	13	15	26.9
	2/day	14	4	39	5	62	25.6
	3/day	7	4	30	1	42	17.4
6	-1/week	3	0	5	3	11	7.2
	2-6/week	3	3	7	10	23	15.0
	1/day	2	2	18	2	24	15.7
	2/day	5	8	40	2	55	36.0
	3/day	4	2	30	4	40	26.1
8	-1/week		1	7	2	10	8.8
	2-6/week	4	22	31	16	73	64.7
	1/day		4	6		10	8.8
	2/day			8		8	7.1
	3/day		6	6		12	10.6
Total	-1/week	12(13.3)	8 (9.9)	35 (9.3)	21(22.4)	76	11.8
	2-6/week	26(28.9)	33(40.8)	87(23.1)	43(45.8)	189	29.5
	1/day	18(20.0)	13(16.0)	75(20.0)	16(17.0)	122	19.0
	2/day	23(25.6)	13(16.0)	101(26.9)	7 (7.4)	144	22.5
	3/day	11(12.2)	14(17.3)	78(20.7)	7 (7.4)	110	19.2
	Total	90	81	376	94	641	100.0

Annex V-1

Car Origin-Destination Matrix (1984) (unit: vehicle/day)

Zone No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total	Zone No.
		24		1		16		4											45	1
			6									1			1				32	2
																			6	3
						23		4	1						1				30	4
						29													29	5
							107		11			4		9	19				218	6
								37						9					153	7
									45						1				91	8
										15					1	7			80	9
																			15	10
																			0	11
																			5	12
																			0	13
															1				19	14
																1			25	15
																			8	16
																			0	17
																			0	18
																			756	

Annex V-1 (continued 2)

Taxi — Origin-Destination Matrix (1984) — (unit: vehicle/day)

Zone No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total	Zone No.
		12		2	1	8			1										24	1
												1							13	2
				7															7	3
						65						1			9				84	4
						54									1				56	5
							8	15	22						3				175	6
								74											82	7
									41										130	8
										19					1	40			124	9
																			19	10
																			0	11
																			2	12
																			0	13
																			0	14
																			14	15
																			40	16
																			0	17
																			0	18
																			770	

Annex V-1 (continued 3)

Pick-up Origin-Destination Matrix (1984) (unit: vehicle/day)

Zone No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total	Zone No.
		105	1	2	2	15		5	1	1						1			133	1
												40							145	2
				27															28	3
						129		8				1			3				170	4
						177						1			1				181	5
							203	61	43			5			54				687	6
								236	22										461	7
									199	60					28	31			628	8
										30		1			20	64			380	9
																			91	10
																			0	11
																			48	12
																			0	13
																			0	14
																1			107	15
																			97	16
																			0	17
																			0	18
																			3,156	

Annex V-2

Car

Origin-Destination Matrix (1994)

(unit: vehicle/day)

Zone No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total	Zone No.
		48		2		33		7											90	1
			10									2			2				62	2
																			10	3
						47		8	2						3				62	4
						57													57	5
							209	2	25			8		11	42				434	6
								70						22					301	7
									91						3				181	8
										26					4	11			159	9
																			26	10
																			0	11
																			10	12
																			0	13
															3				36	14
																3			60	15
																			14	16
																			0	17
																			0	18
																			1,502	

Annex V-2 (continued 2)

Taxi Origin-Destination Matrix (1994) (unit: vehicle/day)

Zone No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total	Zone No.
		23		5	2	18			3										51	1
												2							25	2
				12															12	3
						128									20				167	4
						103									3				108	5
							17	27	49						7				349	6
								144											161	7
									88							2			261	8
										35					4	69			248	9
																			35	10
																			0	11
																			4	12
																			0	13
																			0	14
																			34	15
																			71	16
																			0	17
																			0	18
																			1,526	

Annex V-2 (continued 3)

Origin-Destination Matrix (1994)

(unit: vehicle/day)

Zone No. (Pick-up)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total	Zone No.
1		205	1	6	5	31		11	3	2						2			266	1
2												76							281	2
3				46															47	3
4						261		17				2			7				339	4
5						343						2			3				353	5
6							389	125	88		1	10			120				1,368	6
7								467	47										903	7
8									403	105					68	56			1,252	8
9										54		2			50	111			758	9
10																			161	10
11																			1	11
12																			92	12
13																			0	13
14																			0	14
15																3			251	15
16																			172	16
17																			0	17
18																			0	18
																			6,244	

Annex V-3

Car

Origin-Destination Matrix (2004)

(unit: vehicle/day)

Zone No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total	Zone No.
		82		5		61		13											161	1
			17									4			7				110	2
																			17	3
						80		14	5						7				111	4
						102													102	5
							359	10	46			13		24	77				772	6
								119						33					511	7
									160						7				323	8
										45					8	20			284	9
																			45	10
																			0	11
																			17	12
																			0	13
															6				63	14
																5			117	15
																			25	16
																			0	17
																			0	18
																			2,658	

Annex V-3 (continued 2)

Taxi

Origin-Destination Matrix (2004)

(unit: vehicle/day)

Zone No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total	Zone No.
		40		10	4	32			5										91	1
												4							44	2
				21															21	3
						225						4			38				298	4
						181									7				192	5
							31	51	88						15				623	6
								242											273	7
									165							6			464	8
										61					7	116			442	9
																			61	10
																			0	11
																			8	12
																			0	13
																			0	14
																			67	15
																			122	16
																			0	17
																			0	18
																			2,706	

Annex V-3 (continued 3)

Pick-up

Origin-Destination Matrix (2004)

(unit: vehicle/day)

Zone No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total	Zone No.
		367	1	10	10	58		20	5	4						4			479	1
												128							495	2
				75															76	3
						466		32				4			16				603	4
						604						4			7				625	5
							655	235	160		3	17			233				2,431	6
								792	79										1,526	7
									725	180					137	99			2,220	8
										92		4			95	186			1,346	9
																			276	10
																			3	11
																			157	12
																			0	13
																			0	14
																5			493	15
																			284	16
																			0	17
																			0	18
																			11,024	

Annex V-4

Present and Future Normal Truck Traffic
by Commodity and by Link

Link	Commodity Type	1979	1984	1994	2004
1	Agricultural Crops	8	14	35	76
	Rubber	1	1	2	5
	Logs and Sawn Timber	10	13	21	36
	Fuel	6	9	17	31
	Consumer Goods	9	13	24	39
	Construction Materials	4	6	11	17
	Mix	1	1	3	4
	Empty	18	26	46	77
	Total	57	83	159	285
2	Agricultural Crops	7	12	31	66
	Rubber	1	1	2	5
	Logs and Sawn Timber	10	13	21	36
	Fuel	5	7	14	26
	Consumer Goods	9	13	24	39
	Construction Materials	3	4	8	13
	Mix	1	1	3	4
	Empty	17	24	45	73
	Total	53	75	148	262
3	Agricultural Crops	8	14	35	76
	Rubber	1	1	2	5
	Logs and Sawn Timber	10	13	21	36
	Fuel	5	7	14	26
	Consumer Goods	9	13	24	39
	Construction Materials	3	4	8	13
	Mix	1	1	3	4
	Empty	17	24	45	73
	Total	54	77	152	272
4	Agricultural Crops	10	17	44	95
	Rubber	0	0	0	0
	Logs and Sawn Timber	14	18	30	51
	Fuel	7	10	20	36
	Consumer Goods	11	16	29	47
	Construction Materials	4	6	11	17
	Mix	1	1	3	4
	Empty	24	34	63	103
	Total	71	102	200	353

Link	Commodity Type	1979	1984	1994	2004
5	Agricultural Crops	15	26	66	142
	Rubber	0	0	0	0
	Logs and Sawn Timber	21	27	44	76
	Fuel	11	16	32	57
	Consumer Goods	17	24	45	73
	Construction Materials	7	10	19	30
	Mix	2	3	5	9
	Empty	36	52	95	155
	Total	109	158	306	342
6	Agricultural Crops	11	19	49	104
	Rubber	0	0	0	0
	logs and Sawn Timber	0	0	0	0
	Fuel	8	12	23	41
	Consumer Goods	12	17	32	52
	Construction Materials	4	6	11	17
	Mix	1	1	3	4
	Empty	25	36	66	107
	Total	61	91	184	325
7	Agricultural Crops	10	17	44	95
	Rubber	0	0	0	0
	Logs and Sawn Timber	0	0	0	0
	Fuel	7	10	20	36
	Consumber Goods	11	16	29	47
	Construction Materials	4	6	11	17
	Mix	1	1	3	4
	Empty	23	33	61	99
	Total	56	83	168	298
8	Agricultural Crops	6	10	26	57
	Rubber	0	0	0	0
	Logs and Sawn Timber	0	0	0	0
	Fuel	4	6	12	21
	Consumer Goods	6	9	16	26
	Construction Materials	2	3	5	9
	Mix	1	1	3	4
	Empty	13	19	34	56
	Total	32	48	93	173
9	Agricultural Crops	4	7	18	38
	Rubber	0	0	0	0
	Logs and Sawn Timber	0	0	0	0
	Fuel	3	4	9	13
	Consumer Goods	5	7	13	21
	Construction Materials	1	1	3	4
	Mix	1	1	3	4
	Empty	9	13	24	39
	Total	23	33	70	119

Annex V-5 Composition of Generated Traffic

Link	Type of Vehicle	1984	2004
1	Passenger Car	68 (0.80)	228 (0.80)
	Cargo	17 (0.20)	57 (0.20)
	Agricultural Crops	3	15
	Rubber	0	1
	Log and Sawn Timber	3	7
	Others	6	18
	Empty	5	16
2	Passenger Car	33 (0.69)	110 (0.69)
	Cargo	15 (0.31)	50 (0.31)
	Agricultural Crops	2	12
	Rubber	0	1
	Log and Sawn Timber	3	7
	Others	5	16
	Empty	5	14
3	Passenger Car	39 (0.71)	131 (0.71)
	Cargo	16 (0.29)	54 (0.29)
	Agricultural Crops	3	15
	Rubber	0	1
	Log and Sawn Timber	3	7
	Others	5	16
	Empty	5	15
4	Passenger Car	73 (0.76)	246 (0.76)
	Cargo	23 (0.24)	77 (0.24)
	Agricultural Crops	4	21
	Rubber	0	0
	Log and Sawn Timber	4	11
	Others	7	23
	Empty	8	22
5	Passenger Car	124 (0.76)	417 (0.76)
	Cargo	40 (0.24)	134 (0.24)
	Agricultural Crops	7	56
	Rubber	0	0
	Log and Sawn Timber	7	30
	Others	13	67
	Empty	13	61

Link	Type of Vehicle	1984	2004
6	Passenger Car	116 (0.80)	390 (0.80)
	Cargo	29 (0.20)	98 (0.20)
	Agricultural Crops	7	31
	Rubber	0	0
	Log and Sawn Timber	0	0
	Others	11	34
	Empty	11	33
7	Passenger Car	128 (0.83)	428 (0.82)
	Cargo	27 (0.17)	91 (0.18)
	Agricultural Crops	6	29
	Rubber	0	0
	Log and Sawn Timber	0	0
	Others	10	32
	Empty	11	30
8	Passenger Car	98 (0.87)	329 (0.87)
	Cargo	14 (0.13)	47 (0.13)
	Agricultural Crops	3	14
	Rubber	0	0
	Log and Sawn Timber	0	0
	Others	5	18
	Empty	6	15
9	Passenger Car	53 (0.84)	178 (0.84)
	Cargo	10 (0.16)	34 (0.16)
	Agricultural Carops	2	11
	Rubber	0	0
	Log and Sawn Timber	0	0
	Others	4	12
	Empty	4	11

Annex VI - 1

VOC Calculation, Modified TRRL Method

The calculation of VOC was made using the following formula.

1. Vehicle Speeds

Vehicle speeds on paved roads (km/h)

1) Passenger cars

$V = 102.6-0.372RS-0.076F-0.111C-0.0049A$

2) Light goods vehicles

$V = 86.9-0.418RS-0.050F-0.074C-0.0028A$

3) Medium and heavy goods vehicles

$V = 48.0-0.519RS+0.030F-0.058C-0.0042A+1.114PW$

V = speed (km/h), RS = Rise (m/km), F = Fall (m/km), C = Curvature (degrees/km), A = Altitude (meters), PW = Power/Weight Ratio (BHP/t)

Vehicle speeds on unpaved roads

1) Passenger cars

$V = 84.2-0.210RS-0.070F-0.118C-0.00089R-0.13M-0.19RD$

2) Light goods vehicles

$V = 81.2-0.317RS-0.059F-0.097C-0.00095R-0.29M-0.20RD$

3) Medium and heavy goods vehicles

$V = 49.2-0.433RS+0.004F-0.061C-0.00060R-0.22M-0.27RD$
$+1.114PW$

M = Moisture (%), RD = Rut Depth (mm)

2. Fuel Consumption

Fuel consumption on paved roads (litres/1,000 km)

1) Passenger cars

$$FL = (53.4+\frac{499}{V}+0.0058V^2+1.594RS-0.854F)\times 1.08$$

2) Light goods vehicles

$$FL = (74.7+\frac{1151}{V}+0.013V^2+2.906RS-1.277F)\times 1.08$$

3) Medium goods vehicles

$$FL = (105.4+\frac{903}{V}+0.0143V^2+4.362RS-1.834F-2.40PW)\times 1.13$$

4) Heavy goods vehicles

$$FL = (-48.6+69.2\sqrt{GVW}+\frac{903}{V}+0.0143V^2+4.362RS-1.834F-2.40PW)\times 1.13$$

GVW = Gross Vehicle Weight (t)

Fuel consumption on unpaved roads

1) Passenger cars

$$FL = (46.9+\frac{614}{V}+0.0079V^2+1.723RS-1.066F+0.00113R+0.82L)\times 1.08$$

2) Light goods vehicles

$$FL = (72.8+\frac{844}{V}+0.0137V^2+2.828RS-1.306F+0.00110R+1.76L)\times 1.08$$

3) Medium goods vehicles

$$FL = (122.0+\frac{796}{V}+0.0150V^2+4.176RS-2.216F+0.00145R+1.97L-2.62PW)\times 1.13$$

4) Heavy goods vehicles

$$FL = (-32.0+69.2\sqrt{GVW}+\frac{796}{V}+0.0150V^2+4.176RS-2.216F+0.00145R+1.97L-2.62PW)\times 1.13$$

FL = Fuel Consumption (litres/1000 km)

L = Looseness (mm), R = Roughness (mm/km)

3. Lubricating Oil Consumption

Average figures for total oil consumption were as follows:

(litres/1000km)

	Paved roads	Gravel and earth roads
1) Passenger cars	1.2	2.4
2) Light goods vehicles	1.8	3.6
3) Medium & heavy goods vehicles	4.0	8.0

4. Vehicle Maintenance

Parts consumption

1) Passenger cars and light goods vehicles

$PC = (-2.03+0.0018R) \times K \times 10^{-11} \times VP$; $K \geq 10000$

$= 0$ $K < 10000$

2) Medium and heavy goods vehicles

$PC = (0.48+0.0037R) \times K \times 10^{-11} \times VP$; $K \geq 20000$

$= 0$ $K < 20000$

where PC is the cost of parts per kilometre
VP is the cost of an equivalent new vehicle
K is the cumulative kilometres run by the vehicle to date.

Maintenance labour hours

1) Passenger cars and light goods vehicles

$LH = (851-0.078R) PC/VP$; $R \leq 6000$

$= 383 \times PC/VP$ $R > 6000$

2) Medium and heavy goods vehicles

$LH = (2975-0.078R) PC/VP$; $R \leq 6000$

$= 2507 \times PC/VP$ $R > 6000$

5. Tyre Consumption

1) Passenger cars and light goods vehicles

$TC = (-83+0.058R) \times 10^{-6}$ $\quad R \geq 2000$

$= 3.0 \times 10^{-5}$ $\quad R < 2000$

2) Medium and heavy goods vehicles

$TC = (83+0.0112R) \times L \times 10^{-7}$ $\quad R \geq 1500$

$= 1.0 \times L \times 10^{-5}$ $\quad R < 1500$

where TC is the number of tyres per kilometre
L is the total weight of the vehicle plus its load.

6. Depreciation

$$DC = \frac{VP}{U \times K_A}$$

where DC = Depreciation Cost ($/km)
U = useful life of Vehicles (years)
K_A = Annual Average Milage (km)

The estimated depreciation costs were distributed to the running cost portion and the fixed cost portion according to the following ratio.

For passenger car and taxi
70% for running cost, 30% for fixed cost
For pick-up and truck
65% for running cost, 35% for fixed cost

7. Wage

$$= \frac{\text{Annual Income (\$)}}{\text{Annual Average Milage (km)}}$$

8. Insurance

$$= \frac{\text{Annual Insurance Cost (\$)}}{\text{Annual Average Milage (km)}}$$

Annex VI-2

Vehicle Operating Costs (Paved Road)

(US¢/km)

Type of Vehicle	Passenger Cars			Taxis			Pick-Ups			M-Trucks			H-Trucks		
Road Condition	G	F	P	G	F	P	G	F	P	G	F	P	G	F	P
Wages	-	-	-	2.31	2.31	2.31	4.50	4.50	4.50	5.82	5.82	5.82	7.50	7.50	7.50
Insurance	2.20	2.20	2.20	1.35	1.35	1.35	1.80	1.80	1.80	4.16	4.16	4.16	11.67	11.67	11.67
Depreciation Related KM	3.33	3.81	4.70	1.42	1.68	2.23	2.35	2.78	3.69	4.61	5.41	7.55	11.05	12.64	15.60
Depreciation Related Time	1.63	1.63	1.63	0.72	0.72	0.72	1.50	1.50	1.50	2.91	2.91	2.91	6.80	6.80	6.80
Interest	0.41	0.41	0.41	0.18	0.18	0.18	0.32	0.32	0.32	0.62	0.62	0.62	1.46	1.46	1.46
Tyres	0.34	0.74	1.29	0.22	0.47	0.83	0.42	0.91	1.58	3.96	4.45	5.17	8.20	9.24	10.68
Lubricants	0.13	0.13	0.13	0.13	0.13	0.13	0.20	0.20	0.20	0.44	0.44	0.44	0.44	0.44	0.44
Repair and Maint.	1.48	2.71	4.26	0.69	1.25	1.95	1.70	3.11	4.84	6.12	8.01	10.56	14.61	19.29	25.74
Fuel R=F=10	4.28	4.28	4.28	4.28	4.28	4.28	6.93	6.93	6.93	7.28	7.28	7.28	10.31	10.31	10.31
Fuel R=F=50	4.81	4.81	4.81	4.81	4.81	4.81	8.32	8.32	8.32	11.41	11.41	11.41	13.13	13.13	13.13
Fuel R=F=70	5.13	5.13	5.13	5.13	5.13	5.13	9.19	9.19	9.19	14.06	14.06	14.06	14.92	14.92	14.92
Operating Cost R=F=10	13.80	15.91	18.90	11.30	12.38	13.98	19.92	22.05	25.36	35.92	39.10	44.51	72.04	79.35	90.20
Operating Cost R=F=50	14.33	16.44	19.43	11.83	12.91	14.51	21.11	23.44	26.75	40.05	43.23	48.64	74.86	82.17	93.02
Operating Cost R=F=70	14.65	16.76	19.75	12.15	13.23	14.83	21.98	24.31	27.62	42.70	45.88	51.29	76.65	83.96	94.81

G = Good (R = 2500 mm/km) F = Fair (R = 3750 mm/km) P = Poor (R = 5500 mm/km)

Source : Ministry of Public Works

Annex VI-2 (continued 2)

Vehicle Operating Costs (Unpaved Road)

(US¢/km)

Type of Vehicle	Passenger Cars			Taxis			Pick-Ups			M-Trucks			H-Trucks		
Road Condition	G	F	P	G	F	P	G	F	P	G	F	P	G	F	P
Wages	-	-	-	2.31	2.31	2.31	4.50	4.50	4.50	5.82	5.82	5.82	7.50	7.50	7.50
Insurance	2.75	2.75	2.75	1.69	1.69	1.69	2.25	2.25	2.25	5.20	5.20	5.20	14.58	14.58	14.58
Depre- Related KM	4.70	5.71	8.00	2.23	2.95	5.17	3.69	4.87	8.55	7.01	9.02	14.55	15.60	18.95	26.51
ciation Related Time	2.44	2.44	2.44	1.26	1.26	1.26	2.63	2.63	2.63	4.86	4.86	4.86	10.21	10.21	10.21
Interest	0.92	0.92	0.92	0.47	0.47	0.47	0.84	0.84	0.84	1.56	1.56	1.56	3.28	3.28	3.28
Tyres	0.98	1.62	2.42	0.62	1.03	1.54	1.19	1.97	2.95	4.76	5.56	6.56	9.86	11.52	13.58
Lubricants	0.26	0.26	0.26	0.26	0.26	0.26	0.40	0.40	0.40	0.88	0.88	0.88	0.88	0.88	0.88
Repair and Maint.	3.40	5.15	7.54	1.57	2.34	3.43	3.88	5.83	8.54	9.12	12.04	15.90	22.07	29.44	38.88
R=F=10	4.69	4.72	4.77	4.69	4.72	4.77	7.61	7.59	7.58	7.94	8.00	8.09	11.32	11.43	11.56
Fuel R=F=50	5.33	5.39	5.46	5.33	5.39	5.46	9.14	9.26	9.31	10.59	10.70	10.88	14.14	14.27	14.45
R=F=70	5.70	5.77	5.85	5.70	5.77	5.85	10.21	10.25	10.33	12.35	12.55	12.84	15.81	15.99	16.25
Operating Cost R=F=10	20.14	23.57	29.10	15.10	17.03	23.63	26.99	30.88	38.24	47.15	52.94	63.42	95.30	107.79	126.98
Operating Cost R=F=50	20.78	24.27	29.79	16.44	17.70	24.32	28.52	32.55	39.97	49.80	55.64	66.21	98.12	110.67	129.87
Operating Cost R=F=70	21.15	24.62	30.18	16.11	18.08	24.71	29.59	33.54	40.99	51.56	57.49	68.17	99.79	112.35	131.67

G = Good (R = 4500 mm/km) F = Fair (R = 6500 mm/km) P = Poor (R = 9000 mm/km)

Source : Ministry of Public Works

ROAD INVENTORY- PRIMARY ROAD

FIGURE 1

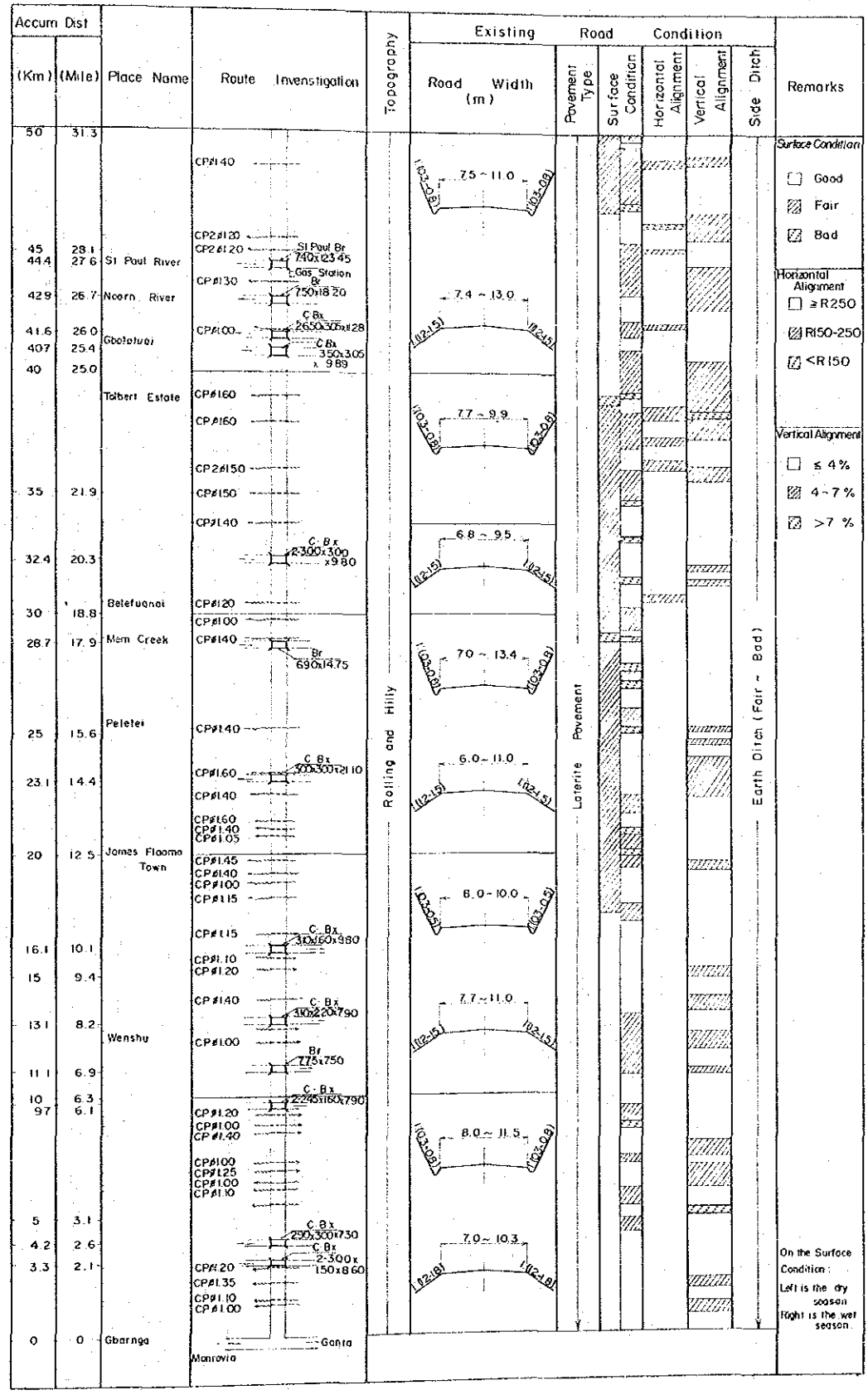
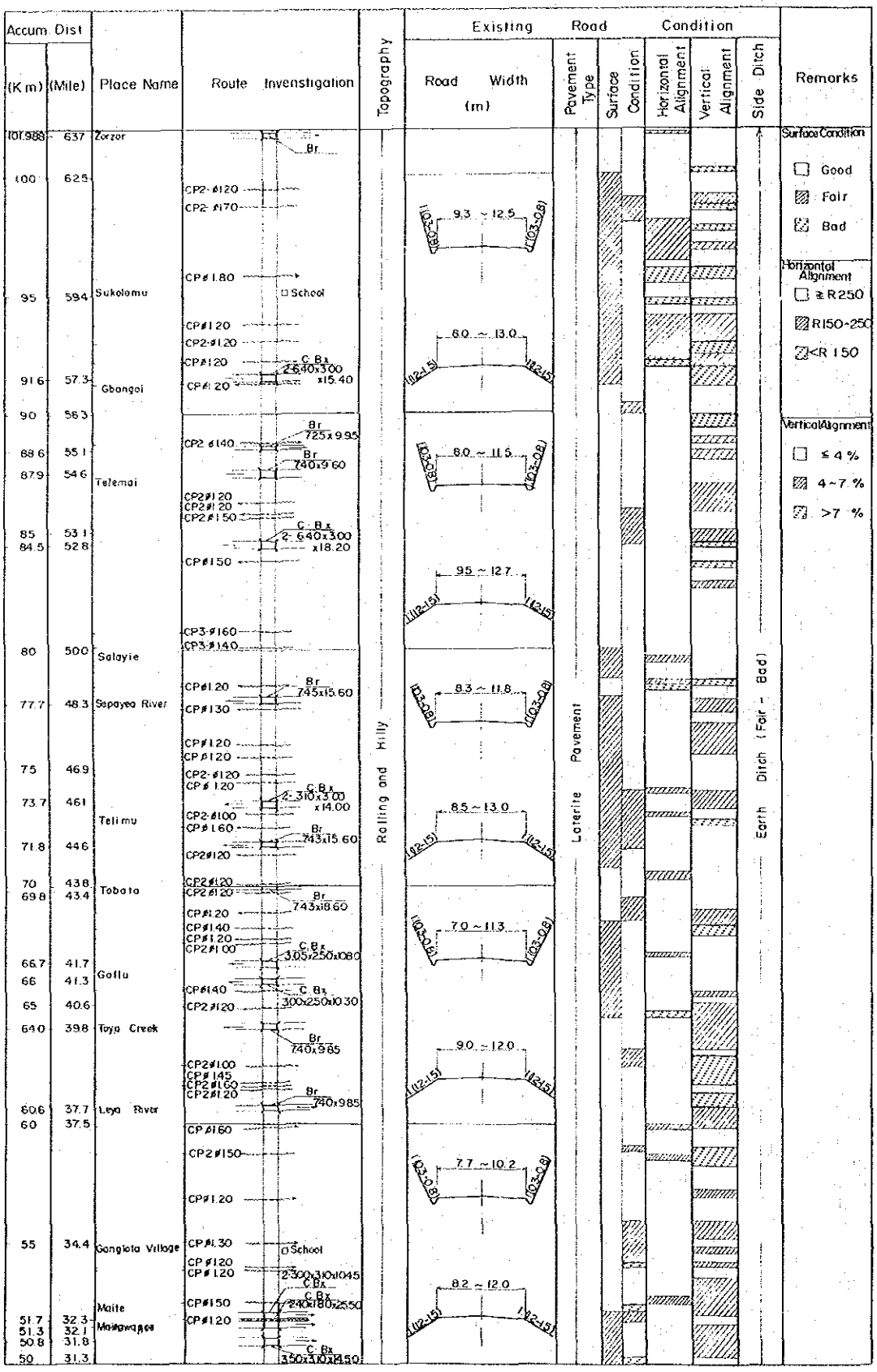


FIGURE 2

ROAD INVENTORY-PRIMARY ROAD



ROAD INVENTORY- PRIMARY ROAD

FIGURE 3

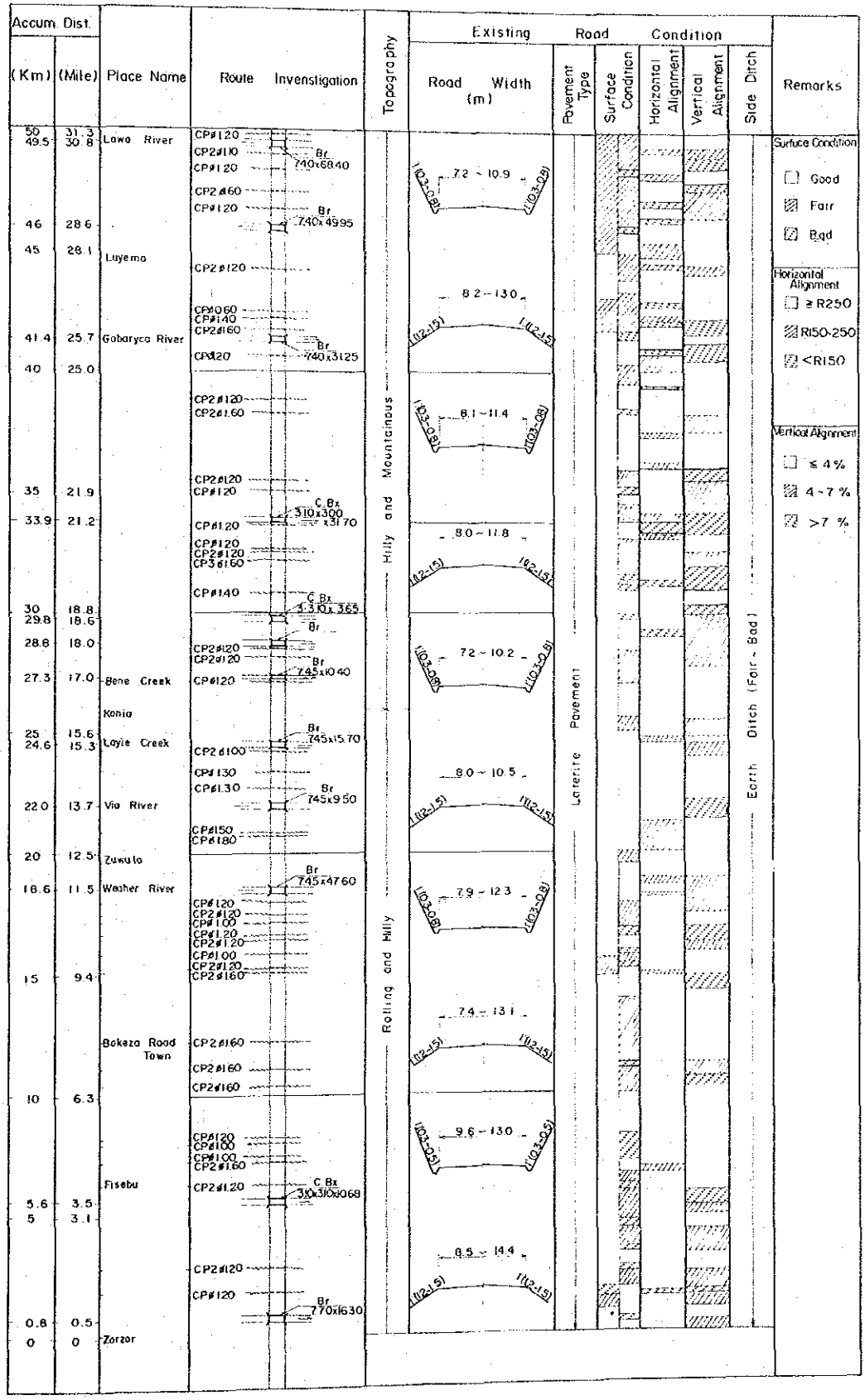
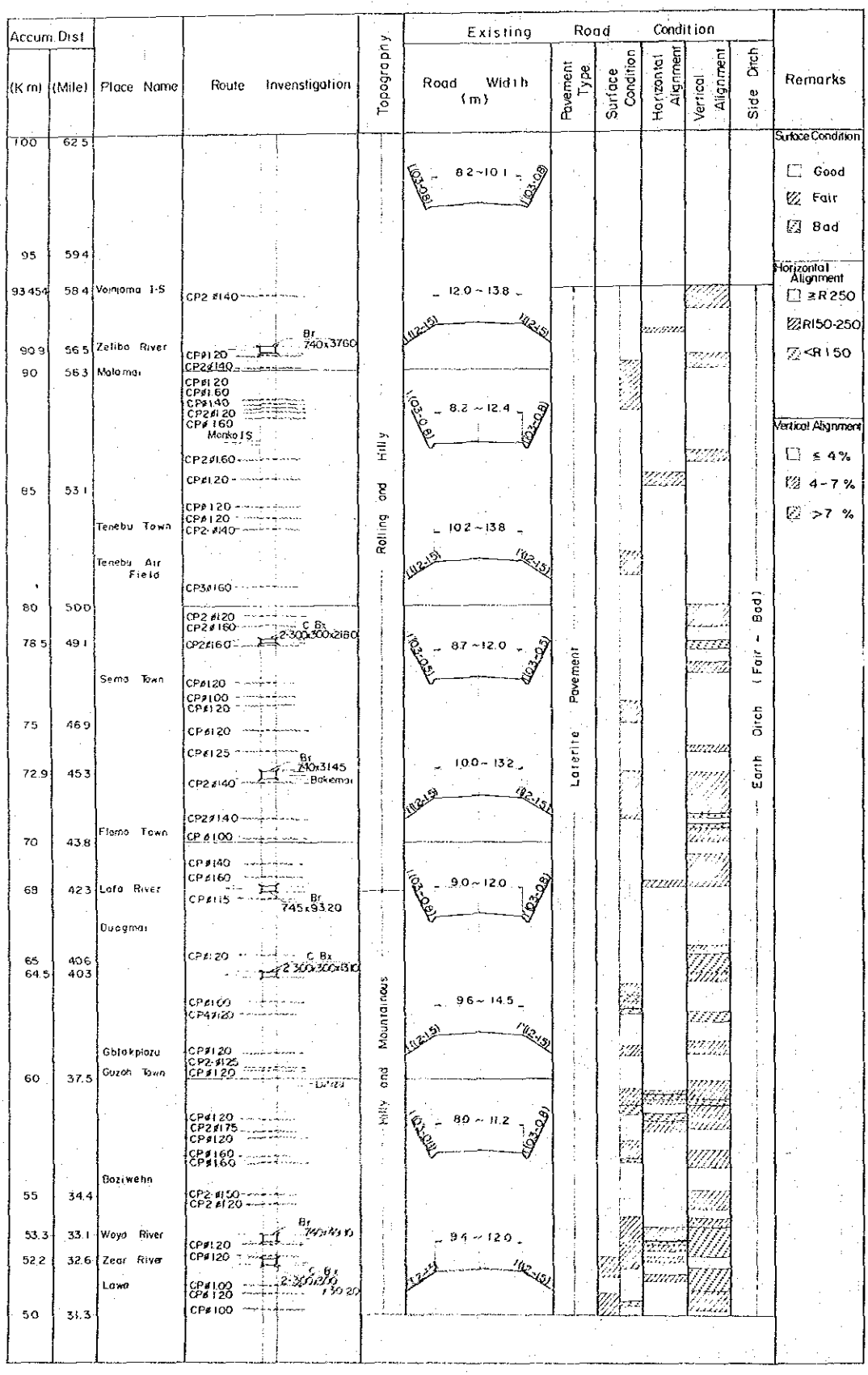


FIGURE 4

ROAD INVENTORY-PRIMARY ROAD



ROAD INVENTORY- PRIMARY ROAD

FIGURE 5

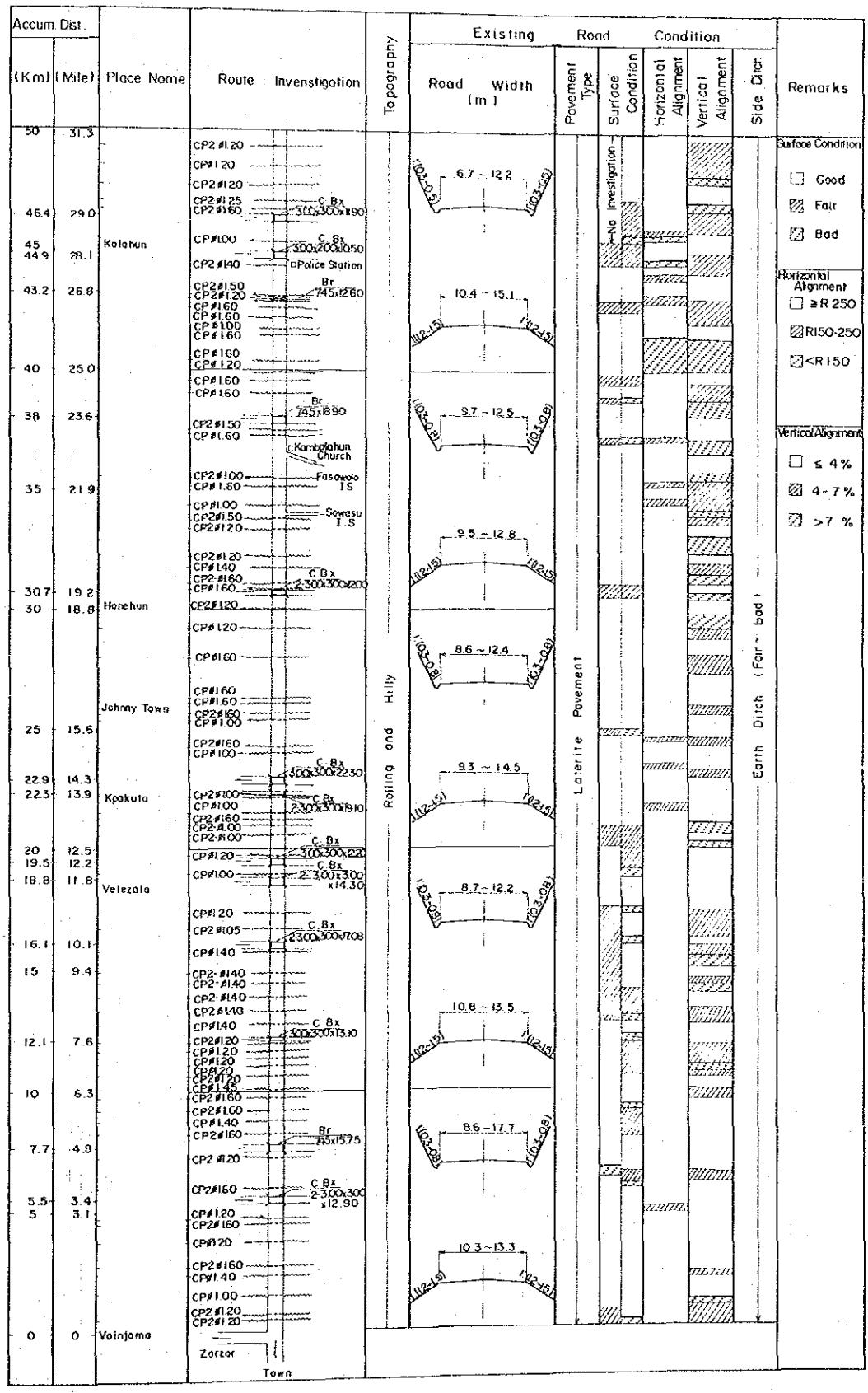
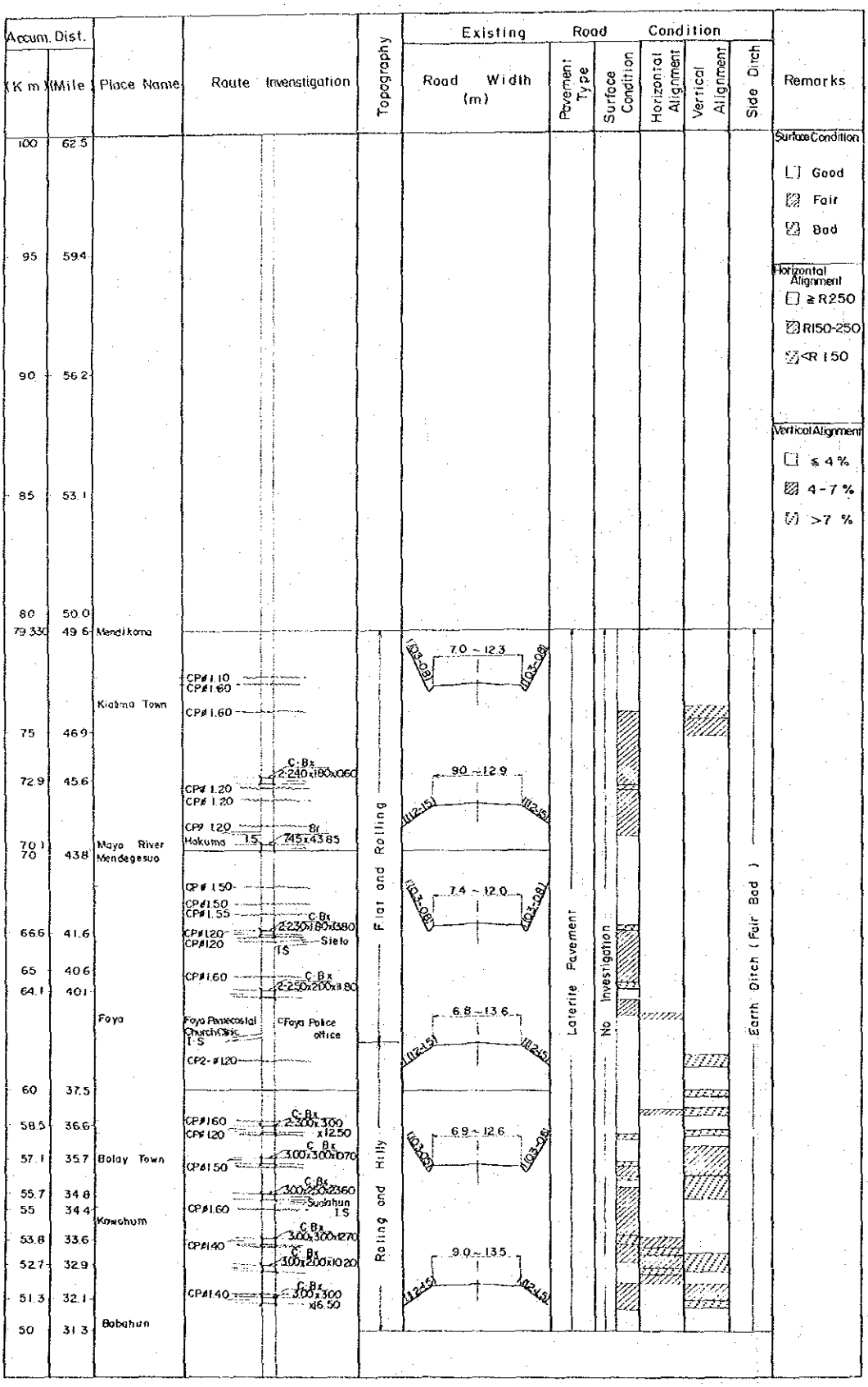


FIGURE 6

ROAD INVENTORY-PRIMARY ROAD



Annex VII-2

Bridge Inventory: Gbarnga-Mendikoma (1)

Bridge No.	Accum. (mile)	Dist (Km)	River Name	Br. Length (m)	Span Composition (m)	Effective Width (m)	Type of Br.	Condition	Remarks
(Gbarnga)	0	0							
1	17.9	28.7	Mem Creek	15.15	14.75	6.90	Steel Girder	Good	
2	26.7	42.9	Noorn River	18.20	17.80	7.50	Concrete T-beam	"	
3	27.6	44.4	St. Paul River	123.45	@14.80+12.20 +15.25+49.60	7.40	Concrete T-beam (5) Steel truss (1)	"	
4	37.7	60.6		9.85	9.45	7.40	Concrete Slab	"	
5	39.8	64.0	Leya River	9.85	9.45	7.40	Concrete Slab	"	
6	43.4	69.2		18.60	18.20	7.43	Concrete T-beam	"	
7	44.6	71.8		15.60	15.20	7.43	"	"	
8	48.3	77.7	Sepayea River	15.60	15.20	7.45	"	"	
9	54.6	87.9		9.60	9.20	7.40	Concrete Slab	"	
10	55.1	88.7		9.95	9.55	7.25	"	"	
11	63.2	101.7		10.25	9.85	7.45	"	"	
(Zorzor)	63.39	102.0							

(continued 2)

Bridge Inventory: Gbarnga-Mendikoma (2)

Bridge No.	Accum. (mile)	Dist (Km)	River Name	Br. Length (m)	Span Composition (m)	Effective Width (m)	Type of Br.	Condition	Remarks
(Zorzor)	0	0							
1	0.5	0.8		16.30	15.90	7.70	Concrete T-beam	Good	
2	11.5	18.6	Weaher River	10.50	10.00	7.45	Concrete Slab		
3	12.5	20.1	Via River	47.60	10.10+18.15 +18.15	7.45	Concrete Slab (1) Concrete T-beam (2)	"	
4	14.1	22.7		9.50	9.10	7.45	Concrete Slab	"	
5	15.3	24.6	Layia Creek	15.70	15.30	7.45	Concrete T-beam	"	
6	17.0	27.3	Beney River	10.40	10.00	7.45	Concrete Slab	"	
7	17.9	28.8		16.50	16.10	7.45	Concrete T-beam	"	
8	25.7	41.4	Gabaryca River	31.25	15.30+15.15	7.40	Concrete T-beam	"	
9	28/6	46.0	Lueah River	49.95	24.65+24.50	7.40	Concrete Box girder	"	
10	30.8	49.5	Lawa River	68.40	14.80+19.20+ 18.00+14.80	7.40	Concrete T-beam	"	
11	33.1	53.3	Zear River	49.10	17.40+18.30 +12.20	7.40	Concrete T-beam	"	
12	42.3	68.0	Lofa River	93.20	30.40+30.75 +30.85	7.45	Concrete Box girder	"	
13	45.3	72.9		31.45	12.10+18.55	7.40	Concrete T-beam	"	
14	56.5	90.9	Zeliba River	37.60	18.30+18.50	7.40	Concrete T-beam	"	
(Voinjama)	58.1	93.5							

(continued 3)

Bridge Inventory: Gbarnga-Mendikoma (3)

Bridge No.	Accum. (mile)	Dist (Km)	River Name	Br. Length (m)	Span Composition (m)	Effective Width (m)	Type of Br.	Condition	Remarks
(Voinjama)	0	0							
1	4.8	7.7		15.75		7.45	Concrete T-beam	Good	
2	23.6	38.0		18.90	18.90	7.45	"	"	
3	26.8	43.2		12.60		7.45	"	"	
4	43.6	70.1	Maiya River	43.85	12.75+18.45 +12.65	7.45	"	"	
(Mendikoma)	49.3	79.3							

Soil Sampling and Tests

(1) Soil Samples and Labolatory Test

		A	B	C	D	E	F	G	H	I
Gbarnga-Zorzor	1	T	NT	T	T	–	–	–	T	–
	2	T	T	NT	NT	T	NT	NT	T	5.6
	3	T	T	T	T	–	N*	–	T	"
	4	T	T	T	T	T	–	–	T	"
	5	T	T	T	T	–	–	–	T	"
	6	T	T	T	T	T	–	T	T	"
	7	T	T	T	T	–	–	–	T	"
	8	T	T	T	T	T	–	–	T	"
	9	T	T	T	T	–	–	–	T	"
	10	T	T	T	T	T	NT	NT	T	"
	11	T	T	T	T	–	–	–	T	"
Zorzor-Voinjama	1	T	T	T	T	T	NT	NT	T	–
	2	T	T	T	T	–	–	–	T	5.8
	3	T	T	T	T	T	NT	T	T	"
	4	T	T	NT	NT	–	–	–	T	"
	5	T	T	T	T	T	–	–	T	"
	6	T	T	T	T	–	–	–	T	"
	7	T	T	T	T	T	–	NT	T	"
	8	T	T	T	T	–	NT	–	T	"
	9	T	T	T	T	T	–	–	T	"
	10	T	NT	T	T	T	NT	T	T	"
Voinjama-Mendikoma	1	T	T	T	T	–	NT	–	T	–
	2	T	T	T	T	T	–	T	T	5.4
	3	T	NT	T	T	–	–	–	T	"
	4	T	T	T	T	–	–	–	T	"
	5	T	T	T	T	T	–	NT	T	"
	6	T	T	T	T	–	NT	–	T	"
	7	T	T	T	T	T	–	–	T	"
	8	T	T	T	T	T	–	NT	T	"
	9	T	T	T	T	–	NT*	–	T	"

LEGEND

A : Moisture Centent

B : Grainsize Analysis

C : Liquid Limit

D : Plastic Limit

E : C.B.R. Test for Subgrade Material

F : C.B.R. Test for Basecaurse Material

G : Compaction

H : Natural Density

I : Interval (miles)

T : Tested

N.T : Not Tested

* : Mixed and tested or one material

(2) Summary of Soil Laboratory Test

LOCATION	SECTION	SAMPLE NO.	SAMPLE DEPTH (m)	GRAVEL %	SAND %	SILT & CLAY %	MAX DIAMETER (mm)	LIQUID LIMIT LL (%)	PLASTIC LIMIT PL (%)	PLASTIC INDEX PI	NATURAL MOISTURE CONTENT Wn (%)	WET DENSITY γ_t (g/cm^3)	DRY DENSITY γ_d (g/cm^3)	TEST (AASHTO) CONDITION T-180	OPTIMUM MOISTURE CONTENT w_{opt} (%)	MAXIMUM DRY DENSITY γ_{dmax} (g/cm^3)	TEST FOR SUBGRADE MATERIAL (%)	TEST FOR BASE MATERIAL %
			GRADATION					CONSISTENCY			NATURAL STATE			COMPACTION			CBR TEST	
IOINJAMA-MENDEKOMA ZORZOR-VOINJAMA GBARNGA-ZORZOR	I	G-1	0.5	-	-	-	-	43.7	35.8	7.9	24.3	1,778	1.4	-	-	-	-	-
		G-2	1.0	65.1	19.8	15.1	25.4	-	-	-	13.9	1,825	1.6	-	-	-	9.1	-
		G-3	1.0	26.8	35.8	37.4	25.4	49.3	33.4	15.9	19.0	2,129	1.8	-	-	-	-	-
		G-4	0.5	4.6	37.5	57.9	9.5	26.8	24.2	2.6	19.5	2,015	1.7	-	-	-	8.1	-
		G-5	0.5	18.5	39.9	41.6	19.1	54.0	22.8	31.2	22.3	1,915	1.6	-	-	-	-	-
	II	G-6	1.0	37.3	23.6	39.1	19.1	36.4	23.6	12.8	25.1	1,884	1.5	C	13.8	1.92	19.0	-
		G-7	1.5	38.1	34.6	27.3	19.1	37.8	22.3	15.5	13.2	2,050	1.8	-	-	-	-	-
		G-8	2.0	34.9	38.9	26.2	25.4	42.2	18.1	24.1	13.3	1,897	1.7	-	-	-	20.7	-
		G-9	4.0	1.1	59.9	39.0	4.76	35.6	21.8	13.8	27.7	1,836	1.4	-	-	-	-	-
		G-10	1.0	1.4	59.9	38.7	4.76	32.5	20.8	11.7	20.5	1,859	1.5	-	-	-	6.6	-
		G-11	2.0	22.5	45.7	31.2	19.1	37.5	26.9	10.6	24.8	1,694	1.4	-	-	-	-	-
	III	Z-1	2.0	24.6	32.2	43.2	19.1	51.1	34.5	16.6	22.7	1,983	1.6	-	-	-	17.4	-
		Z-2	3.5	19.2	36.8	44.0	12.7	46.4	27.1	19.3	20.2	2,000	1.7	-	-	-	-	-
		Z-3	0.5	3.4	60.3	36.3	9.5	26.8	16.4	10.4	12.9	2,019	1.8	C	10.6	2.00	15.7	-
		Z-4	3.0	17.0	36.8	46.2	12.7	-	-	-	20.8	2,015	1.7	-	-	-	-	-
		Z-5	0.5	8.4	41.4	50.2	4.76	47.1	31.0	16.1	21.6	2,004	1.7	-	-	-	6.6	-
		Z-6	0.6	21.6	44.0	34.4	25.4	56.6	31.3	25.3	16.7	2,017	1.7	-	-	-	-	-
		Z-7	0.8	13.1	32.2	54.7	25.4	37.2	27.0	10.2	21.9	2,006	1.7	-	-	-	8.3	-
		Z-8	1.5	4.9	73.3	21.9	9.5	55.4	30.8	24.6	26.7	1,848	1.5	-	-	-	-	-
	IV	Z-9	1.0	16.5	35.1	48.4	19.1	38.4	24.1	14.3	17.8	2,057	1.8	-	-	-	8.3	-
		Z-10	2.0	-	-	-	-	-	-	-	21.9	1,955	1.6	-	-	-	6.6	-
		V-1	0	57.0	19.6	23.4	25.4	52.8	23.5	29.3	14.9	2,095	1.8	-	-	-	-	-
		V-2	1.0	0.4	58.1	41.5	4.76	3.8	21.9	16.9	17.5	1,933	1.7	C	14.0	1.86	5.8	-
		V-3	3.0	-	-	-	-	-	-	-	26.1	1,752	1.4	-	-	-	-	-
		V-4	0.5	16.3	40.9	42.9	9.5	42.4	28.2	14.2	20.0	1,891	1.6	-	-	-	-	-
		V-5	2.0	2.9	67.7	29.4	9.5	38.6	22.0	16.6	24.2	1,926	1.6	-	-	-	6.6	-
		V-6	0	41.9	28.2	29.9	19.1	56.2	29.2	27.0	17.7	2,014	1.7	-	-	-	-	-
		V-7	2.0	2.4	34.5	63.1	4.76	51.6	44.5	7.1	33.5	1,848	1.4	-	-	-	4.6	-
	V	V-8	1.2	13.0	55.3	31.7	19.1	38.9	25.5	13.4	16.1	2,103	1.8	-	-	-	13.2	-
		V-9	0	52.1	16.6	31.5	25.4	36.8	27.7	10.1	22.6	2,211	1.8	-	-	-	-	-
		V-9'	0.5	-	-	-	-	-	-	-	35.2	1,870	1.4	-	-	-	-	-
		G-3 & V-9	-	47.5	25.4	27.1	19.1	42.1	29.7	12.4	-	-	-	-	16.2	1.89	-	63/49

(3) Summary of Road Surface Test (in the field)

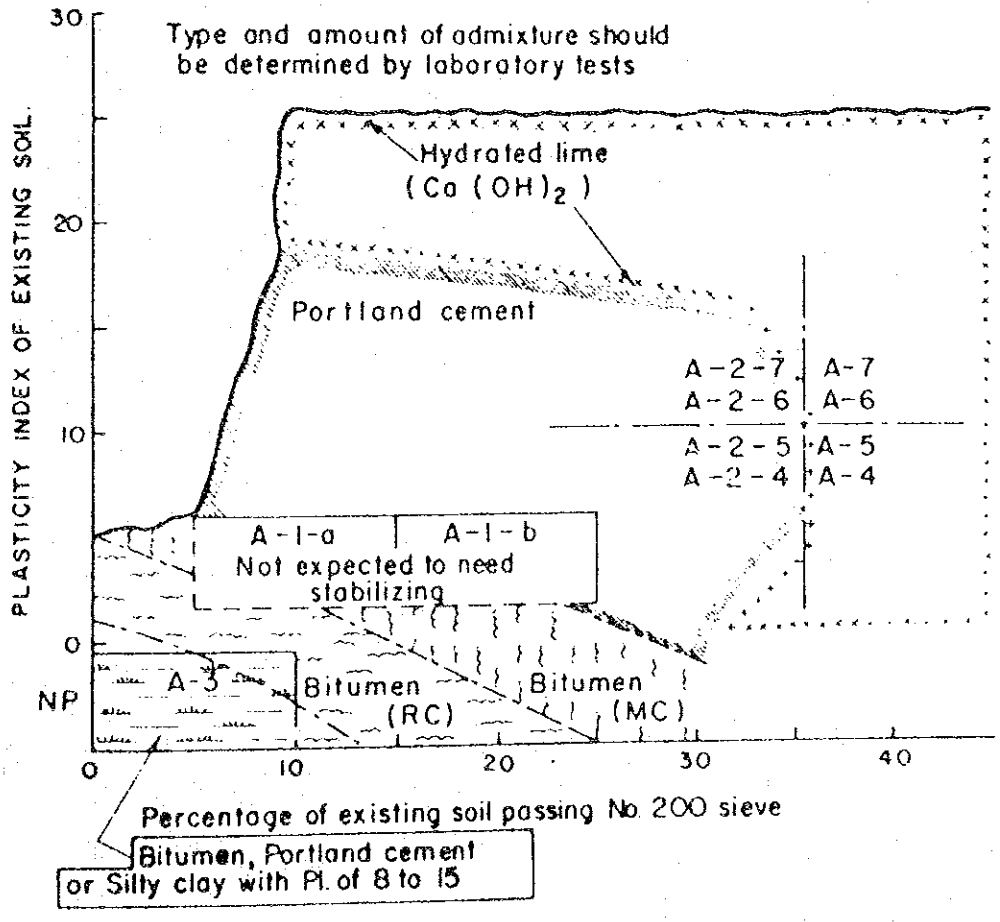
TEST ITEMS \ LOCATION			Gbarnga-Zorzor										Zorzor-Voinjama												Voinjama-Mendekoma									
Sample No.			No.51		No.148		No.266		No.389		No.516		No.08		No.129		No.260		No.398		No.549		No.594		No.95		No.300		No.397		No.464		No.505	
Sample Depth (m)			0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0	
C.B.R. Test	Natural Moisture Content (%)		10.7		15.0		10.6		6.1		8.9		8.9		3.3		6.2		11.1		10.1		9.4		8.0		8.3		18.0		8.4		11.8	
	Field C.B.R. (%)		46.4		30.7		46.7		42.4		38.0		74.6		94.9		108.0		42.3		34.3		16.1		38.9		39.4		15.4		35.8		49.6	
Benkelman Bean Test	Initial Dial Reading (mm)		2.3	2.5	2.2	2.0	1.0	1.4	0.7	0.2	3.1	2.5	2.4	2.3	1.7	0.8	2.2	2.5	3.7	2.5	1.1	1.7	0.6	1.0	3.5	3.6	2.4	4.2	3.8	4.3	3.8	3.4	2.6	2.3
	Final Dial Reading (mm)		0.6	0.9	1.2	1.0	0.7	1.4	0.7	0.2	2.6	1.8	2.4	2.0	1.3	0.8	1.5	2.4	2.2	1.0	0.6	0.7	0.2	1.0	3.1	2.7	2.4	4.2	1.6	2.3	2.2	2.1	1.8	1.7
	Total Rebound Deflection (mm)		0.7	1.6	1.0	1.0	0.3	0	0	0	0.5	1.4	0	0.3	0.2	0	0.7	0.1	1.5	1.5	0.5	1.0	0.4	0.1	0.4	0.9	0	0	2.2	2.0	1.6	1.4	0.8	0.6
Sounding Test	N-Value per 10 CM Depth from Surface	Lane	150		104		58		58		75		167	125	98		136		125		-		250		208		139		91		127		91	
		Shoulder	36		25		17		29		30		12		23		125		29		28		-		-		-		-		78		45	

Annex VII-4

Consideration of the Chemical Treatment

Referring to the estimated figure regarding the stabilization of laterite soils presented hereunder, 40% of the soil samples taken from the Project area, or 12 samples are classified into A-2 group, which can be considered as suitable soils for cement stabilization.

Stabilization of Laterite Soils



Source: Laterite Soil Engineering, M.D. Gidigasu

However, Judging from the typical grading standard for cement treated base course defined in AASHTO Interim Guide for Design of pavement structures, less than 10 soil samples are classified into C, D and E group which are considered to be suitable materials for cement treated base. This indicates that the laterite soil is to be treated with some mechanical stabilization before cement treatment.

Annex VII-5

Comparative Study by Different Design Speeds on the Stretch from Konia to Lofa River

The result of comparative study by the two design speeds of 60 km/h and 80 km/h are shown below.

Comparative study on the stretch Konia/Lofa River

		60 km/h	80 km/h
Improved curvatures		14 points	35 points
Road length (km)		40.60	40.13
Earth Works	cut	660,000	1,030,000
	bank (m^3)	340,000	540,000
Economic construction cost hotmix (10 year) (US$1,000)		11,120	13,700
Annual economic benefit (US$1,000)		2,774	3,247
EIRR /1	(%)	14.3	13.9

/1 : Economic benefits after the 10 years after opening include saving of road user's cost, saving of road maintenance cost and dust stopping cost.

Study on the Pavement Design

1. Estimation of the Average Equivalent 18-KIP (8.2 ton) Single Axle Loads from Traffic Survey

According to the traffic survey, 72 percent are 10-ton trucks, the remaining are mostly 20-ton trucks, and trailer trucks are quite few. The loading ratio of trucks was surveyed as follows:

Cargo Loading Ratio	Percent
Full	38
3/4	14
1/2	8
1/4	2
Empty	38

From the above data, average equivalent factor is calculated as follows:

Average truck weight data are obtained from automobile guide book as given below;

10-ton truck	self W. 4.7 ton	gross W. 11.5 ton
20-ton truck	self W 9.0 ton	gross W. 20.0 ton

10-ton truck (72%)

	Axle load(t)	Frequency (%)		Equivalent factor		Actual factor
(Full load)	9.2	38	x	1.60	=	0.61
(3/4 load)	7.8	14	x	0.84	=	0.12
(1/2 load)	6.5	8	x	0.39	=	0.03
						0.76

20-ton truck (28%)

	Axle load(t)	Frequency(%)		Equivalent factor		Actual factor
(Full load)	8.0	72	x	0.99	=	0.71
(3/4 load)	6.9	28	x	0.51	=	0.14
(1/2 load)	6.0	16	x	0.20	=	0.03
(1/4 load)	4.0	38	x	0.05	=	0.02
						0.90

Axle loads less than 3.5 ton were disregarded.

The average equivalent factor far one truck is as given below:

$$0.76 \times 72\% + 0.90 \times 28\% = 0.80$$

Calculation of Structural Number (SN)

Before deciding the thickness of flexible pavement, the Structural Number (SN) of asphalt pavement for each alternative plans was calculated by AASHTO Interim Guide Design Chart for Flexible Pavements (Pt=2.0).

Main factors for the above design chart method are:

a) Soil support value,

b) Total equivalent 18-KIP (8.2 ton) single axle-load applications and

c) Regional factor

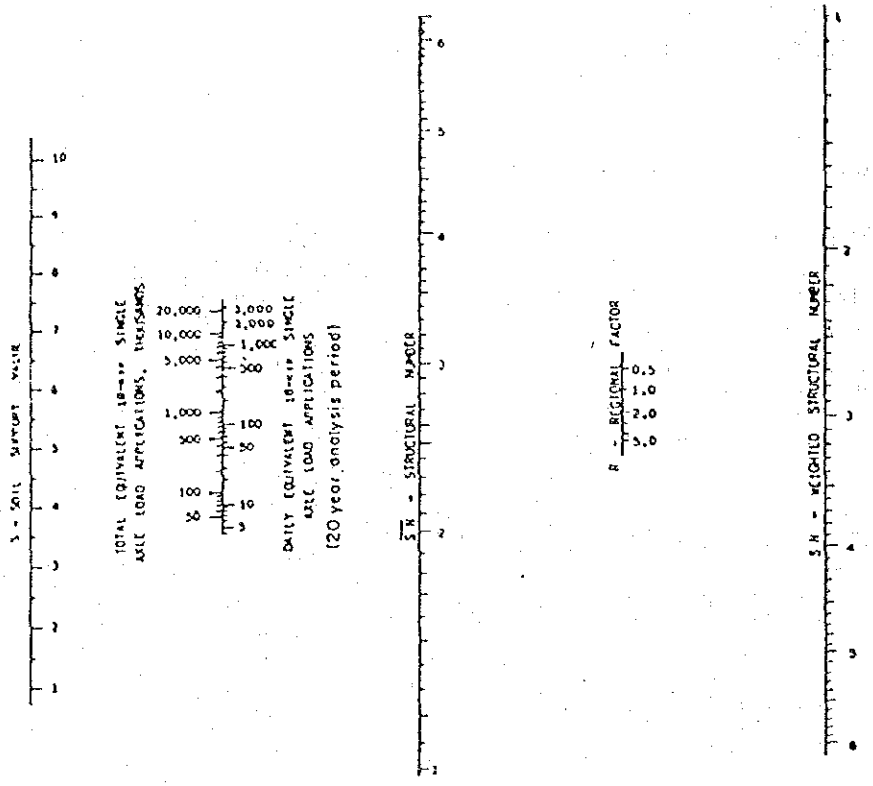
The calculation methods of the above values are as shown in the following examples:

Soil Support Value (S)

One the basis of the result of the CBR test carried out by the Soil Laboratory of the Ministry of Public Works, the CBR values are calculated as follows:

The design CBR values are converted to soil support values using Fig. VII.1 and VII.2.

Fig.VII.1 Design Chart of Pavement



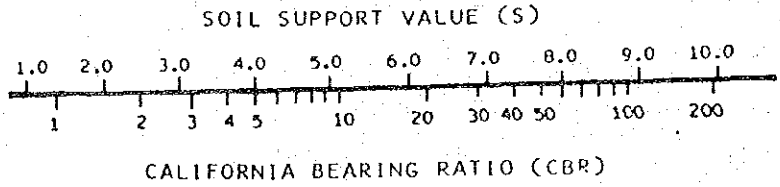
where:

a_1, a_2, a_3 = layer coefficient for surface, base and subbase course materials, respectively

D_1, D_2, D_3 = thickness of surface, base and subbase courses, respectively, in inches

SN = structural number for the total pavement structure

Fig.VII.2 Correlation between Soil Support Value and CBR



Source: AASHTO Interim Guide

Example: Section III (soil test data: $Z_1 - Z_8$)

$$CBR = \frac{1}{4}(17.4+15.7+6.6+8.3) + \frac{1}{2.24}(17.4-6.6)$$

$$= 7$$

Soil support value = 4.5

With the same method, design CBR for each section was calculated as below using the data from Table 7.5.

Design CBR and Soil Support Values

Section	Data	No. of Sample	Design CBR	Soil Support Value S
I	$G_1 - G_5$	2	8	4.8
II	$G_6 - G_{11}$	3	8	4.8
III	$Z_1 - Z_8$	4	7	4.5
IV	$Z_9 - V_7$	5	5	4.0
V	$V_8 - V_9$	1	11	5.2

Total equivalent 18-KIP single axle load application

Example: Section IV (see Table 5.8)

Number of truck in 1984: 121 (vehicle/day)
in 2004: 412 (vehicle/day)

Average number of truck in 20 years:

$$\frac{1}{2}(121+412) = 266.5 \text{ (vehicle/day)}$$

Number of truck for design lane:

$$266.5 \times 0.5 = 133.3 \text{ vehicle/day)}$$

Average equivalent volume:

$$133.3 \times 0.8 = 106.6 \text{ (vehicle/day)}$$

Total axle load for 20 years:

$$106.6 \times 20 \times 365 = 778 \times 10^3 \text{ (vehicle/day)}$$

Regional factor (R)

The value of Regional factor is estimated to be 1.0.

The SN value, thus, calculated, and are given in Table VII.1.

2. Calculation of Pavement Structure

Example of the procedure of pavement structure design are shown as follow:

Hotmix asphalt concrete surface

Sec. I (20 years design period) SN = 2.6

$2.6 = 0.44(2) + 0.20(6) + 0.11(D_3)$

$D_3 = \frac{1}{0.11}(2.6 - 0.88 - 1.2) = 4.7$ inch

$D_3 = 12$ cm

Therefore, the pavement composition for Section I will be as follows:

Surfacing : 5 cm of hotmix asphalt concrete
Base course : 15 cm of cement treated laterite
Subbase course: 12 cm of laterite

Roadmix asphalt treatment surface

Sec. V (20 years design period) SN = 2.28

$2.28 = 0.20(0.6) + 0.20(6) + 0.11(D_3)$

$D_3 = \frac{1}{0.11}(2.28 - 0.12 - 1.2) = 8.7$ inch

$D_3 = 22$ cm

Therefore, for this section the pavement composition is as follows:

Surfacing : 1.5 cm DBST roadmix asphalt treatment
Base course : 15 cm of cement treated laterite
Subbase course: 22 cm of laterite

Table VII.1 Structure Number of Flexible Pavement

Road Section	Design factor	20 years	15 years	10 years	5 years
I	S	4.8	4.8	4.8	4.8
	Axle load (10^3)	467.2	292.4	156.2	63.1
	$\bar{S}N$	2.60	2.38	2.18	1.85
	R	1	1	1	1
	SN for initial part	2.60	2.38	2.18	1.85
	SN for overlay	-	0.22	0.41	0.75
II	S	4.8	4.8	4.8	4.8
	Axle load (10^3)	443.8	278.1	148.2	59.6
	$\bar{S}N$	2.58	2.37	2.15	1.82
	R	1	1	1	1
	SN for initial part	2.58	2.37	2.15	1.82
	SN for overlay	-	0.21	0.43	0.77
III	S	4.5	4.5	4.5	4.5
	Axle load (10^3)	738.8	463.2	248.2	99.0
	$\bar{S}N$	2.95	2.73	2.48	2.12
	R	1	1	1	1
	SN for initial part	2.95	2.73	2.48	2.12
	SN for overlay	-	0.22	0.47	0.83
IV	S	4.0	4.0	4.0	4.0
	Axle load (10^3)	778.2	490.6	265.0	106.0
	$\bar{S}N$	3.18	2.95	2.66	2.33
	R	1	1	1	1
	SN for initial part	3.18	2.95	2.66	2.33
	SN for overlay	-	0.23	0.52	1.37
V	S	5.2	5.2	5.2	5.2
	Axle load (10^3)	286.2	180.7	97.8	37.7
	$\bar{S}N$	2.28	2.10	1.92	1.65
	R	1	1	1	1
	SN for initial part	2.28	2.10	1.92	1.65
	SN for overlay	-	0.18	0.36	0.63

3. Thickness of surface cource

In the calculation of surface & wearing course thickness for various types of pavement; asphalt surface treatment; asphalt penetration macadam and asphalt concrete, are considered.

In the preliminary design, however, pavement types are classified into following two groups:

Hotmix asphalt concrete, and
Roadmix asphalt treatment group.

Single Bituminous Surface Treatment (SBST), Double Bituminous Surface Treatment (DBST) and Asphalt penetration macadam are included in the group of Roadmix asphalt treatment. Hotmix asphalt concrete means plant asphalt pavement.

Alternative thickness of pavements are designed from a viewpoint of field practice as follows:

Hotmix types:	10.0 cm	
	7.5 cm	
	6.0 cm	(asphalt concrete)
	5.0 cm	
	4.0 cm	
	3.0 cm	
Roadmix types	3.0 cm	(penetration macadam 3 or 5 layers)
	1.5 cm	(DBST)
	0.7 cm	(seal coat)

Annex VII-7

Proposed Pavement Structure

AC: Asphale concrete surface course
RAC: Roadmix asphalt concrete surface course
CSB: Crushed stone base course
BB: Bitumen base course
CLB: Cement treated gravelly laterite base course
MLB: Cement mechanically treated gravelly laterite base course
GLSB: Gravelly laterite sub-base course

Alternative A

Section	Required SN	Composition	Thickness (Inches)
I	2.60	AC CSB CSB	2.0 6.0 6.4
II	2.58	AC CSB CSB	2.0 6.0 6.4
III	2.95	AC CSB CSB	2.0 6.0 8.8
IV	3.18	AC BB CSB	2.0 3.0 9.2
V	2.28	AC CSB CSB	2.0 4.0 6.0

Alternative B

Section	Required SN	Composition	Thickness (Inches)
II	2.18/1	AC CLB GLSB	1.2 4.8 8.0
	0.42/2	RAC	1.2
II	2.15/1	AC CLB GLSB	1.2 4.8 8.0
	0.43/2	RAC	1.2
III	2.48/1	AC CLB GLSB	1.2 4.8 11.2
	0.47/2	RAC	1.2
IV	2.66/1	AC CLB GLSB	1.2 6.0 11.2
	0.52/2	RAC	1.2
V	1.92/1	AC CLB GLSB	1.2 4.8 6.4
	0.36/2	RAC	0.6

/1: SN value for 10 years design period.

/2: SN value after 10 years overlayed.

Alternative C

Section	Required SN	Composition	Thickness (Inches)
I	2.18/1	RAC MLB GLSB	0.6 6.0 14.0
	0.42/2	RAC	1.2
II	2.15/1	RAC CLB GLSB	0.6 4.8 12.0
	0.43/2	RAC	1.2
III	2.48/1	RAC CLB GLSB	1.2 6.0 12.0
	0.47/2	RAC	1.2
IV	2.66/1	RAC CLB GLSB	1.2 6.0 13.0
	0.52/2	RAC	1.2
V	1.92/1	RAC MLB GLSB	0.6 6.0 12.6
	0.36	RAC	0.3

/1: SN value for 10 years design period.

/2: SN value after 10 years overlayed.

Alternative D

Section	Required SN	Composition	Thickness (Inches)
I	1.85/1	RAC	0.3
		MLB	6.0
		GLSB	12.0
	0.33/2	RAC	0.3
	0.20/3	RAC	1.2
	0.22/4	RAC	1.2
II	1.82/1	RAC	0.3
		MLB	6.0
		GLSB	12.0
	0.33/2	RAC	0.3
	0.22/3	RAC	1.2
	0.21/4	RAC	1.2
III	2.12/1	RAC	0.3
		CLB	6.0
		GLSB	13.2
	0.36/2	RAC	1.2
	0.25/3	RAC	1.2
	0.22/4	RAC	1.2
IV	2.33/1	RAC	0.6
		CLB	6.0
		GLSB	10.4
	0.33/2	RAC	1.2
	0.29/3	RAC	1.2
	0.23/4	RAC	1.2
V	1.65/1	RAC	0.3
		MLB	6.0
		GLSB	10.0
	0.27/2	RAC	1.2
	0.18/3	RAC	0.6
	0.18/4	RAC	0.3

/1: SN value for 5 years design period.
/2: SN value after 5 years overlayed.
/3: SN value after 5 years overlayed.
/4: SN value after 5 years overlayed.

Annex VII-8

Cost Comparison of Alternative Pavement

For selecting the optimum pavement structure, cost comparison was made for each section. The costs to be compared include cost of the pavement structures, annual maintenance cost and vehicle operating cost, which were estimated for each alternative pavement as presented in Table VII.2.

Since the economic benefits can be assumed as equal for each alternative after excluding the savings of vehicle operating cost, the alternative with the least cost in terms of net present cost discounted at 12% is the most optimum plan to be selected.

The result of the calculation indicates that the Alternative B is the most optimum pavement structure as presented in the following table.

Cost Comparison of the Alternative Pavement Structure (Present Value)/1

(US$1,000)

	I	II	III	IV	V
Alternative A	19,639	20,846	40,133	66,832	4,970
Alternative B	16,854	17,514	35,814	57,567	4,199
Alternative C	17,570	17,517	37,419	60,434	4,369
Alternative D	17,641	17,987	38,319	61,825	4,361

/1 : Discounted at 12%

Table VII.2 Cost Comparison of the Alternative Pavement Structure

(US$1,000)

	Section I	Section II	Section III	Section IV	Section V	Total
Alternative-A						
1) Cost for Pavement Structure						
a) Initial Cost	8,174	10,270	13,440	23,126	2,350	57,360
b) Reconstruction Cost	-	-	-	-	-	-
2) Annual Maintenance Cost/1	160	203	284	444	49	1,140
3) Annual VOC/2	3,050	2,912	6,926	11,431	695	25,014
Alternative-B						
1) Cost for Pavement Structure						
a) Initial Cost	3,947	5,253	6,766	9,250	1,218	26,434
b) ReconstructionsCost	1,430	1,803	2,117	2,960	288	8,598
2) Annual Maintenance Cost/1	160	203	284	444	49	1,140
3) Annual VOC/2	3,089	2,948	7,015	11,619	704	25,375
Alternative-C						
1) Cost for Pavement Structure						
a) Initial Cost	4,152	4,684	6,941	9,547	1,344	26,668
b) Reconstruction Cost	1,430	1,803	2,117	2,960	307	8,617
2) Annual Maintanance Cost/I	155	161	304	491	41	1,152
3) Anuual VOC/2	3,252	3,105	7,382	12,231	738	26,708
Alternative-D						
1) Cost for Pavement Structure						
a) Initial Cost	3,568	4,500	6,186	7,333	1,007	22,594
b) Reconstruction Cost	3,287	4,155	6,351	8,880	912	25,585
2) Annual Maintenance Cost/1	155	161	304	491	41	1,152
3) Annual VOC/2	3,307	3,151	7,488	12,629	746	27,321

/1 Maintenance cost at the 10th year after open
/2 VOC at the 10th year after open

Annex VII-9

Detailed Cost Estimate of the Project

Section I (44.5km) (US$)

	Item	Quantity		Unit Cost	Total Cost	Foreign Currency Portion	Local Currency Portion
1.	Site Clearance	38	ha	4,000	152,000	121,600	30,400
2.	Earthworks						
	Common Rd. Excav.	490,000	m^3	5.5	2,695,000	2,058,000	637,000
	Rock Rd. Excav.						
	Barrow Excav.	120,000	m^3	7.6	912,000	708,000	204,000
	Waste Excav.	200,000	m^3	3.2	640,000	500,000	140,000
3.	Pavement						
	Surface	311,000	m^2	6.0	1,866,000	1,523,900	342,100
	Base	311,000	m^2	4.2	1,306,200	1,057,400	248,800
	Sub-base	233,000	m^3	2.8	652,400	535,900	116,500
	Shoulder	47,000	m^3	8.6	404.200	333,700	70,500
4.	Drainage						
	Cor-pipe (ø1.0)	295	l.m	240	70,800	59,000	11,800
	Cor-pipe (ø)1.5)	165	l.m	430	70,950	61,050	9,900
	Cor-pipe (ø1.8)	30	l.m	860	25,800	21,900	3,900
	C-Box (0.8x0.8)	30	l.m	340	10,200	5,700	4,500
	C-Box (3.0x3.0)	50	l.m	2,000	100,000	55,000	45,000
	Side Ditch in Shoulder	21,300	l.m	4.8	102,240	72,420	29,820
5.	Miscel-laneous						
	Traffic Signs	180	No.	500	90,000	81,000	9,000
	Road Marking	44,400	l.m	1.5	66,600	53,280	13,320
	Km Post	44	No.	150	6,600	3,960	2,640
	Guard Rail	4,400	l.m	12.5	55,000	44,000	11,000
6.	Mobili-zation				150,000	142,500	7,500
7.	Right of Way				111,000		111,000
8.	Contin-gency				948,699	743,831	204,868
9.	Engineer-ing				1,138,439	892,597	245,842
	Grand Total				11,574,128	9,074,738	2,499,390

Annex VII-9 (continued 2)

Section II (56.0km) (US$)

	Item	Quantity	Unit Cost	Total Cost	Foreign Currency Portion	Local Currency Portion
1.	Site Clearance	54 ha	4,600	248,400	198,720	49,680
2.	Earthworks					
	Common Rd.	600,000 m3	5.7	3,420,000	2,640,000	780,000
	Excav. Rock Rd.	9,000 m3	8.4	75,600	58,500	17,100
	Excav. Barrow	50,000 m3	7.0	350,000	270,000	80,000
	Excav. Waste Excav.	550,000 m3	3.2	1,760,000	1,375,000	385,000
3.	Pavement					
	Surface	392,000 m2	5.8	2,273,600	1,881,600	392,000
	Base	392,000 m2	4.7	1,842,400	1,528,800	313,600
	Sub-base	294,000 m3	3.2	940,800	764,400	176,400
	Shoulder	59,000 m3	9.8	578,200	472,000	106,200
4.	Drainage					
	Cor-pipe (ø1.0)	170 l.m	240	40,800	34,000	6,800
	Cor-pipe (ø1.5)	200 l.m	430	86,000	74,000	12,000
	Cor-pipe (ø1.8)	25 l.m	860	21,500	18,250	3,250
	C-Box (0.8x0.8)	40 l.m	340	13,600	7,600	6,000
	C-Box (3.0x3.0)	40 l.m	2,000	80,000	44,000	36,000
	Side Ditch in Shoulder	54,300 l.m	4.8	260,640	184,620	76,020
5.	Miscel-laneous					
	Traffic Signs	230 No.	500	115,000	103,500	11,500
	Road Marking	56,000 l.m	1.5	84,000	67,200	16,800
	Km Post	56 No.	150	8,400	5,040	3,360
	Guard Rail	5,100 l.m	12.5	63,570	51,000	12,750
6.	Mobili-zation			190,000	180,500	9,500
7.	Right of Way			142,000		142,000
8.	Contin-gency			1,259,469	995,873	263,596
9.	Engineer-ing			1,511,363	1,195,048	316,315
	Grand Total			15,365,522	12,149,651	3,215,871

Annex VII-9 (continued 3)

Section III (68.7km) (US$)

	Item	Quantity	Unit Cost	Total Cost	Foreign Currency Portion	Local Currency Portion
1.	Site Clearance	72 ha	5,700	410,400	328,320	82,080
2.	Earthworks					
	Common Rd. Excav.	540,000 m3	5.3	2,862,000	2,214,000	648,000
	Rock Rd. Excav.	20,000 m3	8.2	164,000	126,000	38,000
	Barrow Excav.	50,000 m3	7.2	360,000	275,000	85,000
	Waste Excav.	680,000 m3	3.2	2,176,000	1,700,000	476,000
3.	Pavement					
	Surface	461,000 m2	5.8	2,673,800	2,212,800	461,000
	Base	461,000 m2	4.7	2,166,700	1,797,900	368,800
	Sub-base	346,000 m3	4.5	1,557,000	1,280,200	276,800
	Shoulder	97,000 m3	13.8	1,338,600	1,096,100	242,500
4.	Drainage					
	Cor-pipe (ø1.0)	280 l.m	250	70,000	58,800	11,200
	Cor-pipe (ø1.5)	475 l.m	440	209,000	175,750	33,250
	Cor-pipe (ø1.8)	65 l.m	900	58,500	49,725	8,775
	C-Box (0.8x0.8)	60 l.m	360	21,600	12,000	9,600
	C-Box (3.0x3.0)	55 l.m	2,040	112,200	61,600	50,600
	Side Ditch in Shoulder	60,000 l.m	4.9	294,000	204,000	90,000
5.	Miscel-laneous					
	Traffic Signs	460 No.	505	232,300	209,300	23,000
	Road Marking	68,700 l.m	1.6	109,920	89,310	20,610
	Km Post	68 No.	155	10,540	6,324	4,216
	Guard Rail	4,800 l.m	13.0	62,400	51,840	12,960
6.	Mobili-zation			220,000	209,000	11,000
7.	Right of Way			121,000		121,000
8.	Contin-gency			1,522,996	1,215,605	307,391
9.	Engineer-ing			1,827,596	1,458,726	368,870
	Grand Total			18,580,552	14,830,380	3,750,172

Annex VII-9 (continued 4)

Section IV-A (23.5km) (US$)

	Item	Quantity	Unit Cost	Total Cost	Foreign Currency Portion	Local Currency Portion
1.	Site Clearance	22 ha	3,700	81,400	65,120	16,280
2.	Earthworks					
	Common Rd. Excav.	150,000 m^3	5.7	855,000	660,000	195,000
	Rock Rd. Excav.					
	Barrow Excav.					
	Waste Excav.	200,000 m^3	3.2	640,000	500,000	140,000
3.	Pavement					
	Surface	165,000 m2	5.7	940,500	775,500	165,000
	Base	165,000 m2	5.6	924,000	759,000	165,000
	Sub-base	124,000 m3	4.0	496,000	409,200	86,800
	Shoulder	43,000 m3	11.1	477,300	391,300	86,000
4.	Drainage					
	Cor-pipe (ø1.0)	45 l.m	260	11,700	9,900	1,800
	Cor-pipe (ø1.5)	95 l.m	450	42,750	36,100	6,650
	Cor-pipe (ø1.8)	15 l.m	920	13,800	11,700	2,100
	C-Box (0.8x0.8)	15 l.m	380	5,700	3,150	2,550
	C-Box (3.0x3.0)	25 l.m	2,060	51,500	28,250	23,250
	Side Ditch in Shoulder	12,600 l.m	5.2	65,520	45.360	20,160
5.	Miscel-laneous					
	Traffic Signs	100 No.	510	51,000	46,000	5,000
	Road Marking	23,500 l.m	1.7	39,950	32,900	7,050
	Km Post	23 No.	160	3,680	2,300	1,380
	Guard Rail	2,200 l.m	13.5	29,700	23,760	5,940
6.	Mobili-zation			82,770	78,632	4,138
7.	Right of Way			60,609	0	60,609
8.	Contin-gency			487,288	387,817	99,471
9.	Engineer-ing			584,745	465,381	119,364
	Grand Total			5,944,912	4,731,370	1,213,542

Section IV-B (44.6km) (US$)

	Item	Quantity	Unit Cost	Total Cost	Foreign Currency Portion	Local Currency Portion
1.	Site Clearance	42 ha	3,700	155,400	124,320	31,080
2.	Earthworks					
	Common Rd. Excav.	73,000 m^3	5.7	4,161,000	3,212,000	949,000
	Rock Rd. Excav.					
	Barrow Excav.					
	Waste Excav.	100,000 m^3	3.2	320,000	250,000	70,000
3.	Pavement					
	Surface	312,000 m2	5.7	1,778,400	1,466,400	312,000
	Base	312,000 m2	5.6	1,747,200	1,435,200	312,000
	Sub-base	234,000 m3	4.0	936,000	772,200	163,800
	Shoulder	82,000 m3	11.1	910,200	746,200	164,000
4.	Drainage					
	Cor-pipe (ø1.0)	125 l.m	260	32,500	27,500	5,000
	Cor-pipe (ø1.5)	50 l.m	450	22,500	19,000	3,500
	Cor-pipe (ø1.8)	80 l.m	920	73,600	62,400	11,200
	C-Box (0.8x0.8)	20 l.m	380	7,600	4,200	3,400
	C-Box (3.0x3.0)	10 l.m	2,060	20,600	11,300	9,300
	Side Ditch in Shoulder	24,500 l.m	5.2	127,400	88,200	39,200
5.	Miscel-laneous					
	Traffic Signs	180 No.	510	91,800	82,800	9,000
	Road Marking	44,600 l.m	1.7	75,820	62,440	13,380
	Km Post	45 No.	160	7,200	4,500	2,700
	Guard Rail	4,100 l.m	13.5	55,350	44,280	11,070
6.	Mobili-zation			156,860	149,017	7,843
7.	Right of Way			114,862		114,862
8.	Contin-gency			1,079,429	856,196	223,233
9.	Engineer-ing			1,295,315	1,027,435	267,880
	Grand Total			13,169,036	10,445,588	2,723,448

Section IV-C (22.0km) (US$)

	Item	Quantity		Unit Cost	Total Cost	Foreign Currency Portion	Local Currency Portion
1.	Site Clearance	19	ha	3,700	70,300	56,240	14,060
2.	Earthworks						
	Common Rd. Excav.	400,000	m^3	5.7	2,280,000	1,760,000	520,000
	Rock Rd. Excav.						
	Barrow Excav.	130,000	m^3	8.2	1,066,000	819,000	247,000
	Waste Excav.						
3.	Pavement						
	Surface	140,000	m2	5.7	798,000	658,000	140,000
	Base	140,000	m2	5.6	784,000	644,000	140,000
	Sub-base	105,000	m3	4.0	420,000	346,500	73,500
	Shoulder	37,000	m3	11.1	410,700	336,700	74,000
4.	Drainage						
	Cor-pipe (ø1.0)	45	l.m	260	11,700	9,900	1,800
	Cor-pipe (ø1.5)	60	l.m	450	27,000	22,800	4,200
	Cor-pipe (ø1.8)	10	l.m	920	9,200	7,800	1,400
	C-Box (0.8x0.8)	15	l.m	380	5,700	3,150	2,550
	C-Box (3.0x3.0)	5	l.m	2,060	10,300	5,650	4,650
	Side Ditch in Shoulder	11,600	l.m	5.2	60,320	41,760	18,560
5.	Miscel-laneous						
	Traffic Signs	80	No.	510	40,800	36,800	4,000
	Road Marking	20,000	l.m	1.7	34,000	28,000	6,000
	Km Post	20	No.	160	3,200	2,000	1,200
	Guard Rail	1,800	l.m	13.5	24,300	19,440	4,860
6.	Mobili-zation				70,370	66,852	3,518
7.	Right of Way				51,529		51,529
8.	Contin-gency				617,742	486,459	131,283
9.	Engineer-ing				741,290	583,751	157,539
	Grand Total				7,536,451	5,934,802	1,601,649

Section V (13.7km) (US$)

	Item	Quantity	Unit Cost	Total Cost	Foreign Currency Portion	Local Currency Portion
1.	Site Clearance	12 ha	3,400	40,800	32,640	8,160
2.	Earthworks					
	Common Rd. Excav.	100,000 m^3	5.8	580,000	450,000	130,000
	Rock Rd. Excav.					
	Barrow Excav.					
	Waste Excav.	110,000 m^3	3.3	363,000	275,000	88,000
3.	Pavement					
	Surface	96,000 m^2	6.2	595,200	489,600	105,600
	Base	96,000 m^2	4.5	432,000	355,200	76,800
	Sub-base	72,000 m^3	2.3	165,600	136,800	28,800
	Shoulder	13,000 m^3	8.9	115,700	94,900	20,800
4.	Drainage					
	Cor-pipe (ø1.0)	35 l.m	270	9,450	8,050	1,400
	Cor-pipe (ø1.5)	65 l.m	460	29,900	25,350	4,550
	Cor-pipe (ø1.8)					
	C-Box (0.8x0.8)					
	C-Box (3.0x3.0)					
	Side Ditch in Shoulder	8,200 l.m	5.7	46,740	32,800	13,940
5.	Miscel-laneous					
	Traffic Signs	50 No.	520	26,000	23,500	2,500
	Road Marking	13,700 l.m	2.0	27,400	21,920	5,480
	Km Post	14 No.	165	2,310	1,386	924
	Guard Rail	1,100 l.m	14.0	15,400	12,320	3,080
6.	Mobili-zation			50,000	47,500	2,500
7.	Right of Way			34,000		34,000
8.	Contin-gency			253,350	200,697	52,653
9.	Engineer-ing			306,420	242,737	63,683
	Grand Total			3,093,270	2,450,400	642,870

Annex VII-10

Road Maintenance Cost of Lofa Area

Actual maintenance cost for St. Paul river - Mendikoma (226.5 km) was compared with the estimated cost using the established formula as presented below.

1. Actual Disbursed Amount for St. Paul - Mendikoma in 1978

1)	Fuel for seven (7) machinery	$54,261
2)	Fuel for seven (7) vehicles	$36,310
3)	Lubricant for above equipment	$18,346
4)	Parts cost of equipment	$13,688
5)	Tyres & Tubes for equipment	$19,068
6)	Depreciation cost for all machinery	$35,948
7)	Personnel services	$169,009
8)	Miscellaneous	$887
	Total	$347,517

Unit maintenance cost per one kilometer,

$$K_A = \frac{\$347,517}{230.5 \text{ km}} = \underline{\$1,507.7/\text{km}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

2. Cost calculated from Maintenance Cost Formula

1) ADT in 1979 from traffic survey

St. Paul river - Zorzor	56.0 km	224 ADT
Zorzor - Lofa river	68.7 km	404 ADT
Lofa river - Shello	88.1 km	471 ADT
Shello - Mendikoma	13.7 km	225 ADT

Weighted average ADT = 375

2) Basic maintenance cost for laterite surface road was calculated using the following formula:

$$K = Kb \left(1 + \frac{T-Tb}{2xTb}\right)$$

where, Kb = 725.3 $/km[/1]

Tb = 100

T = 375 ADT

$$K_B = 725\ 3 \left(1 + \frac{375-100}{2x100}\right) = \$1,722.6/km \ldots\ldots (2)$$

The results of calculation and analysis show that this formula is applicable, since difference between the actually disbursed cost and the calculated cost using this formula is within a range of error.

3. Analysis of Price Escalation Factor

The disbursed amount in 1978 is to be revised taking into account the price level by applying 1979 price as follows:

1)	Fuel for seven (7) machinery	$111,913
2)	Fuel for seven (7) vehicles	$74,889
3)	Lubricant for above equipment	$31,527
4)	Parts cost of equipment	$13,688
5)	Tyres & Tubes for equipment	$19,068
6)	Dipreciation cost	$35,948
7)	Personnel services	$229,770
8)	Miscellaneous	$887
	Total	$517,690

Maintenance cost K' per kilometer is

$$K' = \frac{\$517,690}{230.5\ km} = \underline{\$2,245.9/km}$$

/1 : Minimum maintenance cost for lateritic roads estimated in the Feasibility Study of Ganta-Saniquellie and Ganta-Tapita Roads.

Escalation factor E for basic maintenance cost K_B was calculated at 30% as shown below.

$$E = \frac{K'}{K_B} = \frac{2,245.9}{1,722.6} = \underline{1.30}$$

where,

K_A : maintenance cost per km in 1978

K_B : maintenance cost calculated dry the formula

K' : maintenance cost per km in 1979

E : Escalation factor

Annex VIII-1

Costs and Benefits Statement

Section I (US$1,000)

Year	Costs			Benefits				Discounted at 12%	
	Capital Cost	Maintenance Cost	Total Cost	VOC Saving	Time Saving	Saving of Maintenance Cost	Total Benefit	Costs	Benefits
1981	2,242		2,242					2,002	-
1982	3,362		3,362					2,680	-
1983	4,483		4,483					3,191	-
1984	1,121	120	1,241	1,005	32	71	1,108	789	704
1985		160	160	1,441	47	100	1,588	91	901
1986		160	160	1 549	50	106	1,705	81	864
1987		160	160	1,666	54	113	1,833	72	829
1988		160	160	1,791	58	120	1,969	65	795
1989		160	160	1,926	63	128	2,117	58	763
1990		160	160	2,071	68	136	2,275	52	732
1991		160	160	2,227	73	145	2,445	46	703
1992		160	160	2,395	79	155	2,629	41	675
1993		160	160	2,575	85	164	2,824	37	647
1994		1,591	1,591	2,769	92	176	3,037	326	621
1995		160	160	2 936	97	186	3,219	29	588
1996		160	160	3,113	104	197	3,414	26	557
1997		165	165	3,300	110	208	3,618	24	527
1998		170	170	3,499	117	220	3,836	22	499
1999		176	176	3,710	124	233	4,067	20	472
2000		182	182	3,934	132	246	4,312	19	447
2001		188	188	4,171	141	260	4,572	17	423
2002		194	194	4,422	150	276	4,848	16	401
2003		202	202	4,689	159	292	5,140	15	379
Total	11,208	4,748	15,956	55,189	1,835	3,532	60,556	9,719	12,527

Net Present Value: 2,808 Benefit Cost Ratio: 1.3 EIRR(%): 15.4

Annex VIII-1 (continued-2)

Costs and Benefits Statement

Section II (US$1,000)

Year	Costs			Benefits				Discounted at 12%	
	Capital Cost	Maintenance Cost	Total Cost	VOC Saving	Time Saving	Saving of Maintenance Cost	Total Benefit	Costs	Benefits
1981								-	-
1982								-	-
1983	478		478					340	-
1984	478	91	569	471		91	562	362	357
1985	3,004	96	3,100	512		96	608	1,759	345
1986	4,507	101	4,608	556		101	657	2,335	333
1987	6,009	107	6,116	605		107	712	2,767	322
1988	1,502	182	1,684	1,398	38	114	1,550	680	626
1989		203	203	1,773	54	121	1,948	73	702
1990		203	203	1,910	59	129	2,098	65	675
1991		203	203	2,057	63	137	2,257	58	649
1992		203	203	2,216	69	145	2,430	52	624
1993		203	203	2,388	74	155	2,617	47	600
1994		203	203	2,572	80	165	2,817	42	576
1995		203	203	2,729	85	174	2,988	37	546
1996		203	203	2,896	91	184	3,171	33	517
1997		203	203	3,073	97	195	3,365	30	490
1998		1,967	1,967	3,261	103	206	3,570	256	464
1999		203	203	3,460	110	217	3,787	24	440
2000		203	203	3,672	117	230	4,019	21	417
2001		203	203	3,896	125	243	4,264	19	395
2002		205	205	4,134	133	257	4,524	17	374
2003		212	212	4,387	141	272	4,800	16	354
Total	15,958	5,397	21,355	47,966	1,439	3,339	52,744	9,033	9,806

Net Present Value: 773 Benefit Cost Ratio: 1.1 EIRR(%): 13.5

Annex VIII-1 (continued 3)

Costs and Benefits Statement

Section III (US$1,000)

Year	Costs			Benefits				Discounted at 12%	
	Capital Cost	Maintenance Cost	Total Cost	VOC Saving	Time Saving	Saving of Maintenance Cost	Total Benefit	Costs	Benefits
1981								-	-
1982								-	-
1983	3,599		3,599					2,562	-
1984	5,399		5,399					3,431	-
1985	7,199		7,199					4,085	-
1986	1,800	186	1,986	1,822	81	170	2,073	1,006	1,050
1987		249	249	2,610	116	241	2,967	113	1,342
1988		249	249	2,804	125	257	3,186	101	1,287
1989		249	249	3,012	135	274	3,421	90	1,234
1990		249	249	3,235	145	292	3,672	80	1,182
1991		252	252	3,476	157	313	3,946	72	1,134
1992		262	262	3,734	169	334	4,237	67	1,088
1993		273	273	4,011	182	357	4,550	63	1,043
1994		284	284	4,309	196	382	4,887	58	1,000
1995		294	294	4,556	208	403	5,167	54	944
1996		2,425	2,425	5,535	221	426	6,182	396	1,008
1997		315	315	6,667	234	450	7,351	46	1,071
1998		326	326	7,968	249	476	8,693	42	1,130
1999		338	338	9,460	264	503	10,227	39	1,187
2000		351	351	11,168	280	532	11,980	36	1,242
2001		365	365	13,122	298	563	13,983	34	1,294
2002		379	379	15,354	316	596	16,266	31	1,344
2003		394	394	17,902	336	631	18,869	29	1,392
Total	17,997	7,440	25,437	120,745	3,712	7,200	131,657	12,435	20,972

Net Present Value: 8,537 Benefit Cost Ratio: 1.7 EIRR(%): 18.9

Annex VIII-1 (continued 4)

Costs and Benefits Statement

Section IV (US$1,000)

Year	Costs			Benefits				Discounted at 12%	
	Capital Cost	Maintenance Cost	Total Cost	VOC Saving	Time Saving	Saving of Maintenance Cost	Total Benefit	Costs	Benefits
1981	2,557		2,557					2,283	-
1982	3,836		3,836					3,058	-
1983	7,730		7,730					5,502	-
1984	5,202	124	5,326	1,489	70	129	1,688	3,385	1,073
1985	5,231	166	5,397	2,128	100	183	2,411	3,062	1,368
1986	1,308	288	1,596	4,363	186	338	4,887	809	2,476
1987		359	359	4,793	228	411	5,432	162	2,457
1988		370	370	5,137	245	438	5,820	149	2,351
1989		382	382	5,505	264	468	6,237	138	2,249
1990		393	393	5,899	284	500	6,683	127	2,152
1991		405	405	6,322	305	535	7,162	116	2,059
1992		418	418	6,776	328	572	7,676	107	1,970
1993		431	431	7,261	352	611	8,224	99	1,885
1994		1,942	1,942	7,782	378	654	8,814	397	1,804
1995		460	460	8,514	401	690	9,605	84	1,755
1996		1,941	1,941	10,478	424	727	11,629	317	1,897
1997		495	495	12,755	449	767	13,971	72	2,035
1998		513	513	15,393	475	810	16,687	67	2,169
1999		533	533	18,442	502	854	19,798	62	2,299
2000		554	554	21,963	532	901	23,396	57	2,425
2001		576	576	26,020	563	952	27,535	53	2,549
2002		600	600	30,693	596	1,005	32,294	50	2,669
2003		625	625	36,067	630	1,061	37,758	46	2,786
Total	25,864	11,575	37,439	237,780	7,312	12,606	257,698	20,202	42,428

Net Present Value: 22,226 Benefit Cost Ratio: 2.1 EIRR(%): 21.8

Annex VIII-1 (continued 5)

Costs and Benefits Statement

Section V (US$1,000)

Year	Costs			Benefits				Discounted at 12%	
	Capital Cost	Maintenance Cost	Total Cost	VOC Saving	Time Saving	Saving of Maintenance Cost	Total Benefit	Costs	Benefits
1981								-	-
1982								-	-
1983	115		115					82	-
1984	115	26	141	111		26	137	90	87
1985	115	27	142	119		27	146	81	83
1986	375	29	404	129		29	158	205	80
1987	2,315	30	2,345	139		30	169	1,061	76
1988	289	45	334	261	11	32	304	135	123
1989		49	49	320	16	33	369	18	133
1990		49	49	340	17	35	392	16	126
1991		49	49	362	18	36	416	14	120
1992		49	49	384	20	38	442	13	113
1993		49	49	408	21	40	469	11	107
1994		49	49	434	22	42	498	10	102
1995		49	49	457	23	44	524	9	96
1996		49	49	481	25	46	552	8	90
1997		49	49	506	26	48	580	7	84
1998		337	337	532	27	51	610	44	79
1999		49	49	560	29	53	642	6	75
2000		49	49	589	30	56	675	5	70
2001		49	49	620	32	59	711	5	66
2002		50	50	653	34	62	749	4	62
2003		52	52	687	36	65	788	4	58
Total	3,324	1,184	4,508	8,092	387	852	9,331	1,828	1,830

Net Present Value: 2 Benefit Cost Ratio: 1.0 EIRR(%): 12.1

Annex VIII-1 (continued 6)

Costs and Benefits Statement

Whole Section (US$1,000)

Year	Costs			Benefits				Discounted at 12%	
	Capital Cost	Maintenance Cost	Total Cost	VOC Saving	Time Saving	Saving of Maintenance Cost	Total Benefit	Costs	Benefits
1981	4,799		4,799					4,285	-
1982	7,198		7,198					5,738	-
1983	16,405		16,405					11,677	-
1984	12,315	361	12,676	3,076	102	317	3,495	8,056	2,221
1985	15,549	449	15,998	4,200	147	406	4,753	9,078	2,697
1986	7,990	764	8,754	8,419	317	744	9,480	4,435	4,803
1987	8,324	905	9,229	9,813	398	902	11,113	4,175	5,027
1988	1,791	1,006	2,797	11,391	477	961	12,829	1,130	5,181
1989		1,043	1,043	12,536	532	1,024	14,092	376	5,082
1990		1,054	1,054	13,455	573	1,092	15,120	339	4,868
1991		1 069	1,069	14,444	616	1,166	16,226	307	4,665
1992		1,092	1,092	15,505	665	1,244	17,414	280	4,470
1993		1,116	1,116	16,643	714	1,327	18,684	256	4,282
1994		4,068	4,068	17,866	768	1,419	20,053	832	4,103
1995		1,166	1,166	19,192	814	1,497	21,503	213	3,929
1996		4,778	4,778	22,503	865	1,580	24,948	779	4,070
1997		1,227	1,227	26,301	916	1,668	28,885	179	4,207
1998		3,313	3,313	30,653	971	1,763	33,387	431	4,342
1999		1,299	1,299	35,632	1,029	1,860	38,521	151	4,473
2000		1,339	1,339	41,326	1,091	1,965	44,382	139	4,601
2001		1,381	1,381	47,829	1,159	2,077	51,065	128	4,727
2002		1,428	1,428	55,256	1,229	2,196	58,681	118	4,850
2003		1,485	1,485	63,732	1,302	2,321	67,355	110	4,970
Total	74,371	30,343	104,714	469,772	14,685	27,529	511,986	53,212	87,568

Net Present Value: 34,356 Benefit Cost Ratio: 1.6 EIRR(%): 18.9

Annex VIII-1 (continued 7)

Costs and Benefits Statement

Package I (US$1,000)

Year	Costs			Benefits				Discounted at 12%	
	Capital Cost	Maintenance Cost	Total Cost	VOC Saving	Time Saving	Saving of Maintenance Cost	Total Benefit	Costs	Benefits
1981	4,799		4,799					4,285	
1982	7,198		7,198					5,738	
1983	9,597		9,597					6,831	
1984	2,400	244	2,644	2,494	102	200	2,796	1,680	1,777
1985		326	326	3,569	147	283	3,999	185	2,269
1986		337	337	3,777	158	302	4,237	171	2,147
1987		343	343	4,110	170	323	4,603	155	2,082
1988		349	349	4,411	183	343	4,937	141	1,994
1989		355	355	4,734	198	367	5,299	128	1,911
1990		360	360	5,079	214	391	5,684	116	1,830
1991		367	367	5,451	229	417	6,097	106	1,753
1992		373	373	5,851	246	447	6,544	96	1,680
1993		380	380	6,278	265	476	7,019	87	1,609
1994		3,315	3,315	6,738	285	510	7,533	678	1,541
1995		395	395	7,278	302	538	8,118	72	1,483
1996		403	403	8,457	320	568	9,345	66	1,524
1997		417	417	9,805	339	599	10,743	61	1,565
1998		432	432	11,349	359	633	12,341	56	1,605
1999		448	448	13,115	380	669	14,164	52	1,645
2000		465	465	15,135	403	706	16,244	48	1,684
2001		481	481	17,441	428	746	18,615	45	1,723
2002		500	500	20,075	454	789	21,318	41	1,762
2003		521	521	23,083	480	833	24,396	38	1,800
Total	23,994	10,811	34,805	178,230	5,662	10,140	194,032	20,876	35,384

Net Present Value: 14,508 Benefit Cost Ratio: 1.7 EIRR(%): 18.8

Annex VIII-1 (continued 8)

Costs and Benefits Statement

Package II (US$1,000)

Year	Costs			Benefits				Discounted at 12%	
	Capital Cost	Maintenance Cost	Total Cost	VOC Saving	Time Saving	Saving of Maintenance Cost	Total Benefit	Costs	Benefits
1981									
1982									
1983	6,215		6,215					4,424	
1984	9,322		9,322					5,924	
1985	12,430		12,430					7,053	
1986	3,108	297	3,405	3,957	159	312	4,428	1,725	2,243
1987		425	425	4,959	228	442	5,629	192	2,546
1988		430	430	5,321	245	472	6,038	174	2,439
1989		436	436	5,709	264	503	6,476	157	2,335
1990		442	442	6,126	283	537	6,946	142	2,236
1991		450	450	6,574	306	576	7,456	129	2,143
1992		467	467	7,054	330	614	7,998	120	2,053
1993		484	484	7,569	354	656	8,579	111	1,966
1994		502	502	8,122	381	702	9,205	103	1,884
1995		519	519	8,728	404	741	9,873	95	1,804
1996		4,123	4,123	10,669	429	782	11,880	673	1,938
1997		558	558	12,917	454	826	14,197	81	2,068
1998		577	577	15,511	482	873	16,866	75	2,193
1999		599	599	18,497	510	921	19,928	70	2,314
2000		622	622	21,930	541	973	23,444	64	2,430
2001		648	648	25,872	574	1,029	27,475	60	2,543
2002		673	673	30,394	608	1,088	32,090	56	2,652
2003		700	700	35,575	645	1,151	37,371	52	2,758
Total	31,075	12,952	44,027	235,484	7,197	13,198	255,879	21,480	40,545

Net Present Value: 19,065 Benefit Cost Ratio: 1.9 EIRR(%): 20.6

Annex VIII-1 (continued 9)

Costs and Benefits Statement

Package III (US$1,000)

Year	Costs			Benefits				Discounted at 12%	
	Capital Cost	Maintenance Cost	Total Cost	VOC Saving	Time Saving	Saving of Maintenance Cost	Total Benefit	Costs	Benefits
1981									
1982									
1983	593		593					422	
1984	593	117	710	582		117	699	451	444
1985	3,119	123	3,242	631		123	754	1,840	428
1986	4,882	130	5,012	685		130	815	2,539	413
1987	8,324	137	8,461	744		137	881	3,827	399
1988	1,791	227	2,018	1,659	49	146	1,854	815	749
1989		252	252	2,093	70	154	2,317	91	836
1990		252	252	2,250	76	164	2,490	81	802
1991		252	252	2,419	81	173	2,673	72	768
1992		252	252	2,600	89	183	2,872	65	737
1993		252	252	2,796	95	195	3,086	58	707
1994		252	252	3,006	102	207	3,315	52	678
1995		252	252	3,186	108	218	3,512	46	642
1996		252	252	3,377	116	230	3,723	41	607
1997		252	252	3,579	123	243	3,945	37	575
1998		2,304	2,304	3,793	130	257	4,180	300	544
1999		252	252	4,020	139	270	4,429	29	514
2000		252	252	4,261	147	286	4,694	26	487
2001		252	252	4,516	157	302	4,975	23	460
2002		255	255	4,787	167	319	5,273	21	436
2003		264	264	5,074	177	337	5,588	19	412
Total	19,302	6,581	25,883	56,058	1,826	4,191	62,075	10,855	11,638

Net Present Value: 783 Benefit Cost Ratio: 1.1 EIRR(%): 13.3

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