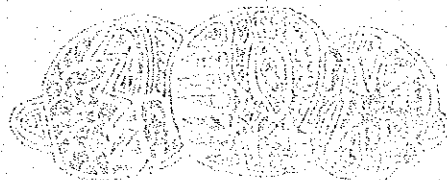


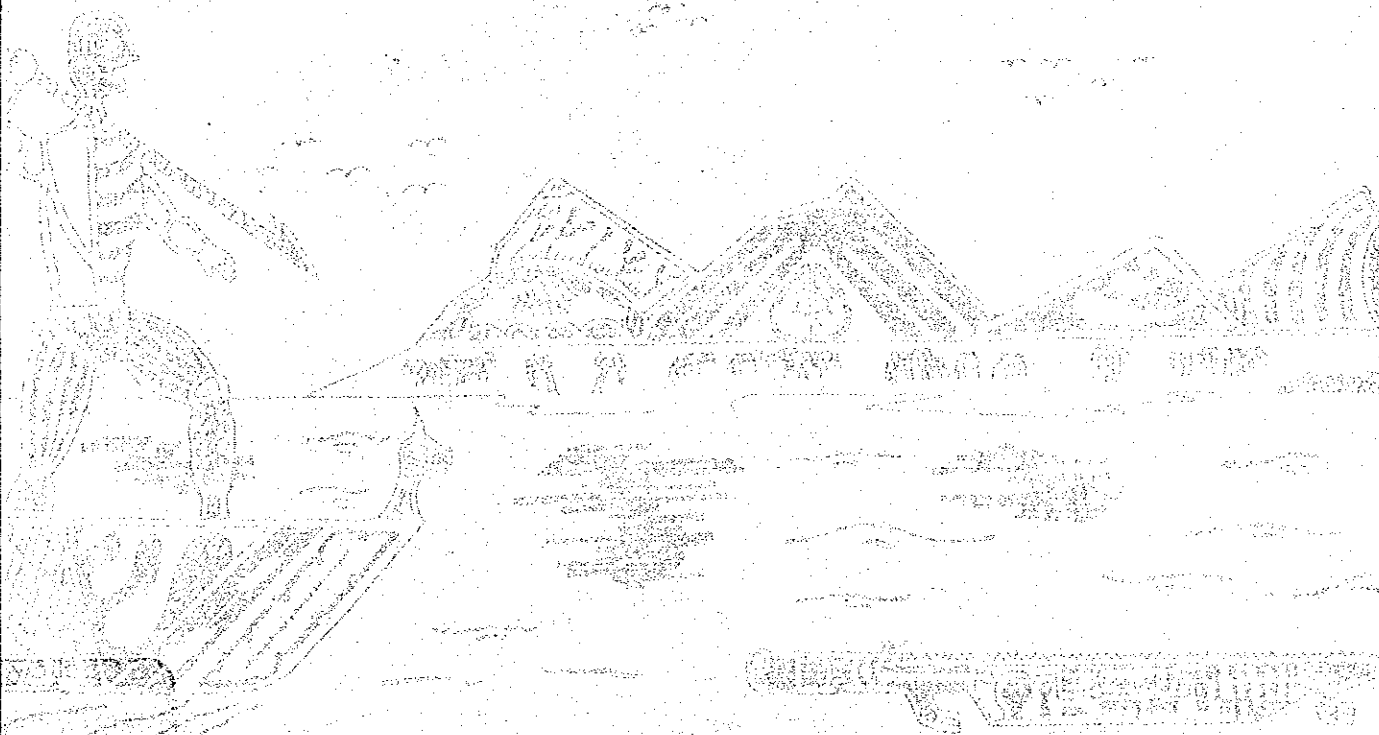
THE GOVERNMENT OF PAPUA NEW GUINEA

CONFIDENTIAL

THE DETAILED DESIGN
ON
ROAD CONSTRUCTION PROJECT
IN
BEREINA-MALALAU



COST ESTIMATES REPORT



JANUARY 1990

JAPAN INTERNATIONAL COOPERATION AGENCY



SSF
SC
90-004

CONFIDENTIAL

THE GOVERNMENT OF PAPUA NEW GUINEA

THE DETAILED DESIGN

ON

ROAD CONSTRUCTION PROJECT

IN

BEREINA - MALALUA

JICA LIBRARY



108116511

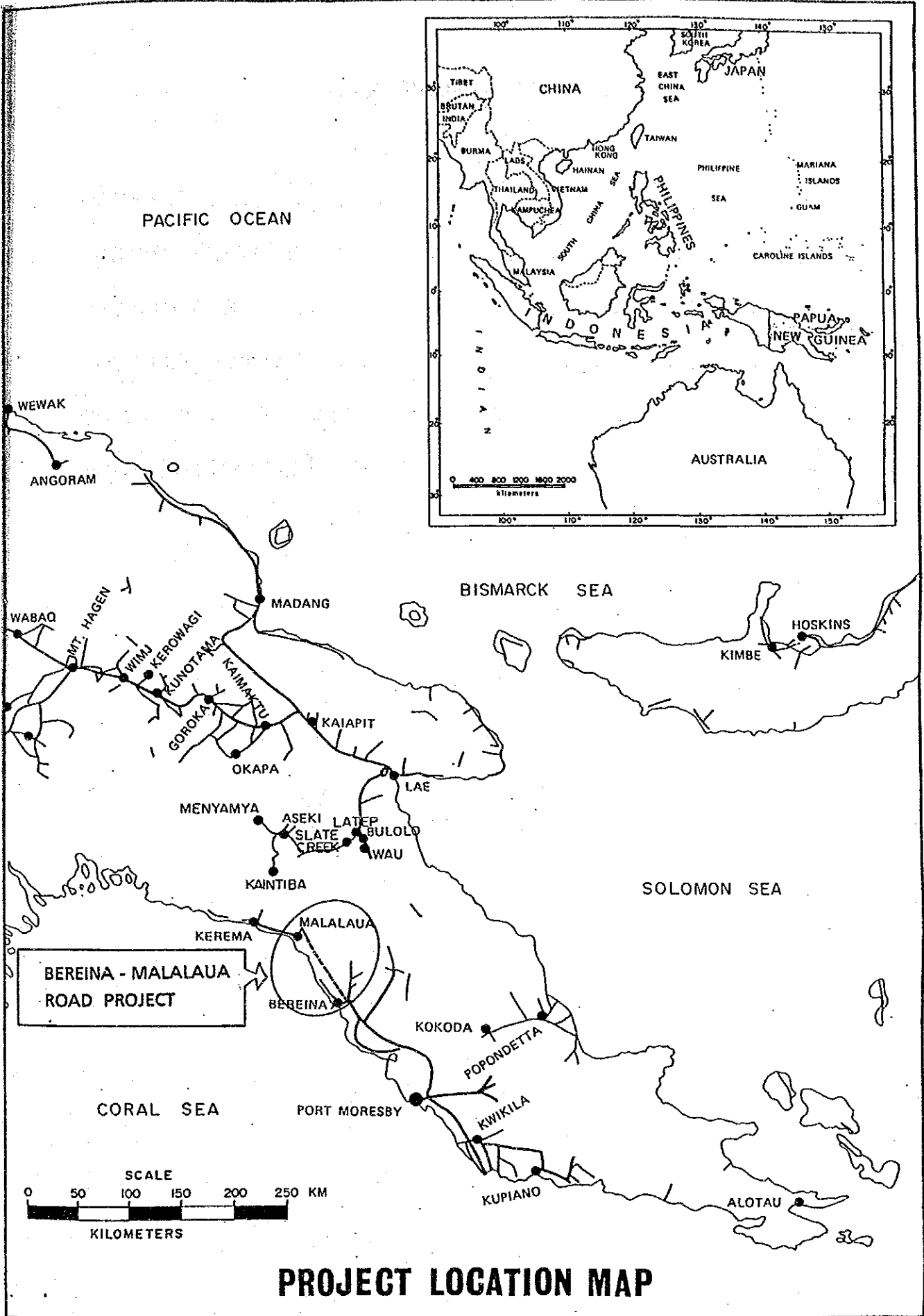
20958

COST ESTIMATES REPORT

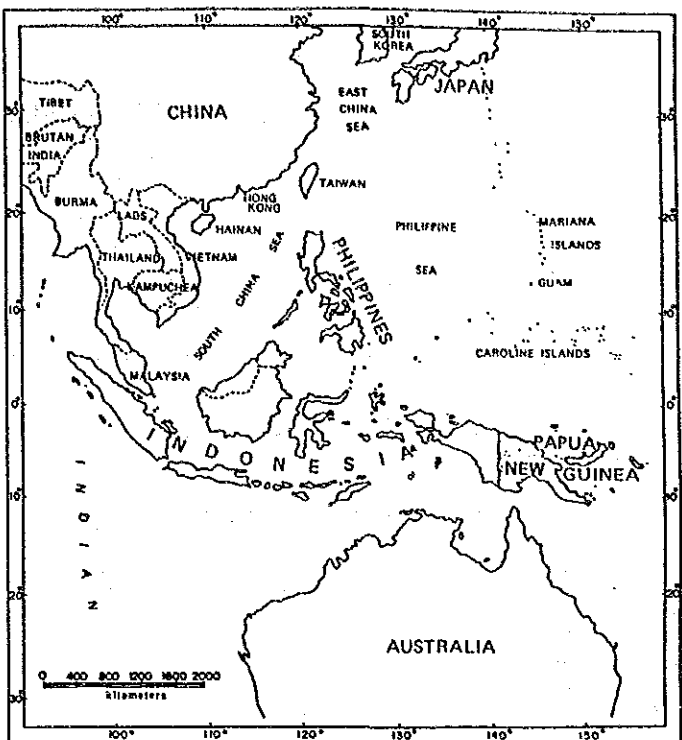
JANUARY 1990

JAPAN INTERNATIONAL COOPERATION AGENCY





PACIFIC OCEAN

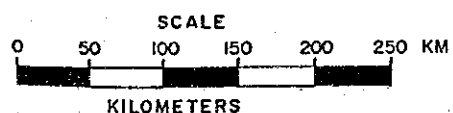


BISMARCK SEA

SOLOMON SEA

CORAL SEA

BEREINA - MALALAU ROAD PROJECT



PROJECT LOCATION MAP

TABLE OF CONTENTS

1.	GENERAL	1
2.	PROJECT FEATURE	2
3.	PROJECT COST	3
4.	COST BREAKDOWN	6
5.	COMPARISON OF CONSTRUCTION COST	7
6.	FUND DISBURSEMENT PLAN	9

CONTENTS OF THE TABLES

Table - 1	SUMMARY OF THE PROJECT COST OF LOT I AND LOT II	3
Table - 2	FUND DISBURSEMENT PLAN	9
Table - 3	CONSTRUCTION COST OF LOT I	10
Table - 4	CONSTRUCTION COST OF LOT II	11
Table - 5	LOT I LAND ACQUISITION COST	12
Table - 6	LOT II LAND ACQUISITION COST	13
Table - 7	SUPERVISION COST LOT I	14
Table - 8	SUPERVISION COST LOT II	14
Table - 9	DAILY MACHINE COST CALCULATION TABLE (1), (2) AND (3)	15
Table - 10	LABOUR WAGES	18
Table - 11	FUEL COST	18
Table - 12	COSTS OF MATERIALS	19

THE CONTENTS OF FIGURES

Figure - 1	LOCATION OF THE PROJECT	20
Figure - 2	TYPICAL CROSS SECTIONS (1)	21
Figure - 3	TYPICAL CROSS SECTIONS (2)	22
Figure - 4	PAVEMENT SECTIONS (1)	23
Figure - 5	PAVEMENT SECTIONS (2)	23
Figure - 6	LOCATIONS OF CONSTRUCTION MATERIAL SOURCES	25
Figure - 7	PROPOSED CONSTRUCTION SCHEDULE FOR THE PROJECT	26

COST ESTIMATES

1. GENERAL

In order to prepare the cost estimates, the JICA study team has collected information on prices of labour, materials, equipment and tools. The cost of land acquisition has been analyzed and the Contractor's overheads and profit have been estimated.

All prices have been related to the levels of the 3rd quarter of 1989.

The prices reflect the price level in Papua New Guinea. However, when obtaining direct quotations from Papua New Guinea, the possibility that the materials for this very large project will be supplied directly from nearby foreign countries at lower prices than the current PNG prices has been taken into account.

As regards salaries, it has not been possible to forecast the labour situation at the time of the road construction. The existing salary rates have thus been applied without including any increase due to a possible labour shortage.

The unit price calculation is based on the aforementioned price information, on a calculation of equipment rates and on certain assumptions regarding methods and productivity. The latter part of the estimate has been based mostly on empirical data.

A comparison of the calculated unit prices with prices from similar projects in Papua New Guinea has been made for reference.

The unit prices resulting from this analysis have also been compared with the study team's experience in other similar areas.

The detailed unit prices can be found in the Breakdown of Unit Prices (Attachment) containing Price Analyses. They are also indicated in the confidential copy of the priced Bills of Quantities.

The unit rates are believed to be realistic and on the conservative side.

2. PROJECT FEATURE

The road construction project of Bereina - Malalaua section is the first step to realize the Trans Island Highway to link Port Moresby to Lae which has been a national goal since PNG gained political independence in 1975.

The detailed design by JICA study team proposed to divide the 80 km project road into (2) lots as follows:

Lot I BEREINA TO MIARU RIVER SECTION
CONTRACT NO. TC 120-33-814/A

Length of Project Road	: 33,500m
Number of Bridges (2 lanes)	: 3nos
Excavation	: 830,000m ³
Embankment	: 740,000m ³
Construction Period	: 36 months

Lot II MIARU RIVER TO MALALAUA SECTION
CONTRACT NO. TC 120-33-814/B

Length of Project Road	: 47.096m
Number of Bridges (1 lanes)	: 6nos
Excavation	: 260,000m ³
Borrow	: 350,000m ³
Embankment	: 590,000m ³
Sandmat	: 170,000m ³
Construction Period	: 48 months

Fig. 1 Attached shows the location of the Project, Figs 2 and 3 shows the typical cross section of each lot, Figs 4 and 5 show the pavement sections and Fig. 6 shows the locations of construction material source for the Project.

3. PROJECT COST

The detailed estimates of the construction costs are presented as priced copies of the Bills of Quantities, one volume for each construction lot.

The project cost has been estimated including costs of land acquisition, engineering and administration, physical contingencies and price escalation during construction period.

A summary of the project cost broken down to Lot I and Lot II, and to foreign and local currency components is presented in Table 1.

The average foreign exchange rates for the cost estimates were:

1.0 kina = 1.176 US\$

1.0 kina = 165 J-Yen

Table-1 CONSTRUCTION COST OF LOT I & LOT II

Unit : 1,000 kina () shows percentage of F.C

Item	Lot I		Lot II		Total	
1. Construction Cost						
Group 1	1,913	(68.5)	2,737	(67.8)	4,650	(68.1)
Group 2	1,515	(49.9)	2,440	(50.4)	3,955	(50.2)
Group 3~18	12,258	(67.1)	23,296	(68.4)	35,555	(68.0)
Bridge No. 1	220	(65.3)			220	(65.3)
Bridge No. 2	232	(65.0)			232	(65.0)
Bridge No. 3	273	(66.3)			273	(66.3)
Bridge No. 4			825	(67.4)	825	(67.4)
Bridge No. 5			568	(69.8)	568	(69.8)
Bridge No. 6			1,143	(66.6)	1,143	(66.6)
Bridge No. 7			1,145	(66.5)	1,145	(66.5)
Bridge No. 8			442	(70.7)	442	(70.7)
Bridge No. 9			463	(71.4)	463	(71.4)
Group 19	126	(56.1)	351	(67.9)	477	(64.8)
Sub Total	16,537	(65.5)	33,410	(67.0)	49,947	(66.5)
2. Land Acquisition Cost	68	(0.0)	308	(0.0)	376	(0.0)
3. Engineering & Administration Cost	2,883	(64.3)	5,280	(52.7)	8,163	(56.8)
4. Physical Cont. (7.5% of Above)	1,462	(65.1)	2,925	(64.5)	4,387	(64.7)
5. Price Escalation (12.0% of Above)	2,514	(65.1)	5,031	(65.5)	7,545	(64.7)
Total	23,464	(65.1)	46,954	(64.5)	70,418	(65.0)

The cost for supervision by foreign Consulting Engineers was estimated to corresponds to about 13.7 percent, and administration cost including land acquisition survey, equivalent to about 2.6 percent of the total construction cost.

The land acquisition cost is relatively small, of which Royalties for quarry materials is the main item. Temporarily possessed lands for Contractor's camps, Engineer's residences/offices and borrow pits/quarry sites were estimated at 10 percent rates of land acquisition costs given by the Government Valuer-General's Office.

The cost of physical contingencies to cover possible increases in the calculated quantities as well as additional items, and construction supervision has been estimated at 7.5 percent of the construction cost.

Price escalation of 12 percent overall is allowed for and calculated below, taking into account the forth year counting from 1989, which will be the middle of the construction of the Project. The 35 percent L.C. portion will experience an estimated 6.0 percent per annum escalation, and the 65 percent F.C. portion will experience an estimated 1.0 percent. The rate for F.C. portion was determined by the study team seeing the different escalation rates by respective industrial countries: The minus rate of Japanese exporting prices, 0.8 percent of USA industrial goods, 6.3 percent of New Zealand all industry products and 6.7 percent of Australia manufactural output etc..

Details of Escalation

6.%	Local Currency:	$0.35\{(1+0.06)^4-1\}=0.092$	
1.%	Foreign Currency:	$0.65\{(1+0.010)^4-1\}=0.026$	
			0.118
		say	12%.

4. COST BREAKDOWN

The detailed cost breakdowns are presented together with priced copies of the Bill of Quantities.

The unit costs of all pay items are composed of;

- equipment operation charge
- material cost in Port Moresby
- transportation to the site
- labours for installation
- overhead of 22.5 percent

The equipment operation charges were calculated as daily cost including equivalent daily depreciation cost, operator charge, and fuel cost. The equipment daily depreciation costs were compared with the DOW's rental rate in Port Moresby and adjusted to keep the same levels. Fuel consumption per working hours was estimated with empirical data.

Labours daily charges were estimated by respective category of job, foreman, technician, skilled labour, common labour comparing with the data collected 1987 which showed no significant change except low wage of village workers of temporary employment.

These basic costs were charged to respective work items of unit cost based on their average working capacities which were calculated by empirical formulas.

In the above calculations, each price component was divided into foreign and local currency costs.

Main local currency components are listed below:

- Tax, mainly custom duty
- Port handling charge for imported equipment and goods
- Labour's cost except a part of foreman or technical
- Wooden materials and furniture

- Land cost and royalty for quarry
- Surveyors/inspectors for supervision.

Other costs are estimated as foreign currency.

The data applied for the cost estimates are attached to this report, Tables 3 and 4 show the Construction Cost by the Group of Specifications, Tables 5 and 6 show the land acquisition cost, tables 7 and 8 show the supervision cost, Tables 9 to 12 show the basic cost data on equipment, labour, fuel, materials applied for the cost estimates.

5. COMPARISON OF CONSTRUCTION COST

The construction cost for this project, about 80 kilometers long road constructions was compared with the experience of other projects in DOW. Recently, the highest bid price of about 0.4 million kina per kilometer was experience in DOW, while the project price shows average 0.875 million kina per kilometer.

However, the above project which showed the highest bid price in 1989 was up-grading project to cover the 28 kilometer-section of Hiritano Highway which was not to be newly constructed

Unfortunately there have been no road construction contracts to compare with this magnitude containing low speed embankment on swamp area under the difficult accessibility to the site in PNG.

Through the cost estimates of the Project, main factors to rise up the costs (of 0.7 million kina per kilometer for Lot I and about 1.0 million kina per kilometer for Lot II) can be mentioned as follows:

- All subbase course materials available in the sites are disqualified from the standards specified in the DOW specifications due to high PI and low CBR, accordingly cement treated improvement was introduced in the 10 cm thick top subbase course layer in the design which makes the cost high.
- There was no natural sandy gravel qualified for base course material in the sites, the study team found the Eboa rocky hill which is located at 14 kilometers far from Bereina which increases

the cost of the base course of Lot I. And no rocky hill in the Lot II so that plant mixed cement treated based course was designed for Lot II. In addition, the Malalaua quarry is only one quarry to produce sandy gravel for Lot II has thick overburden of about six (6) meters which increases the cost of the base course.

- Geotextile to be spread on soft swamp area is requested the tension strength more than 50 kg per cm together with its permeability under the load of embankment, the price of this material is not negligible.
- Sand mat layer is essential work item to proceed the road embankment in the swampy area. This work shall be done prior to other work items at whole sections of Lot II, therefore, sand quarries were selected at Iokea beach for Miaru river area, at Ilavala hill for near Kapuri river area and at Koaru beach for Malalaua area. Their long hauling distance of 16~20 kilometers rises up the cost of sand mat layer.

Every effort has been made by the study team to minimize the construction cost for the following points:

- Hydrological and hydraulic analysis made decision to cancel the bridge construction and employed the pipe culverts at originally proposed bridge sites of Ungongo flood viaduct, and Anina creek for Lot I, and Alikea swamp, Divola creek and Opou swamp for Lot II.
- Geotechnical analysis made the settlement depth clearer on soft ground, so that additional embankment volumes due to settlement are taken into account in the Bill of quantities which may not invite unexpected cost overrun, due to unknown factor on soft ground for the tenderes.
- Boring survey made the subsurface conditions clearer, so that pile lengths are friction piles for bridges were determined based on the specified design manual which result thus reasonable bridge plan to propose.

The cost of bridges are estimated under the average prices of DOW. The two (2) lane permanent bridges for Lot I are estimated at 11.650 kina to 13.650 kina per meter less than 14,000 kina per meter of DOW average cost, one lane permanent bridges for Lot II are estimated at 8,800 kina to 11.575 kina per meter less than or nearly to 10,000 kina per meter of DOW average cost.

6. FUND DISBURSEMENT PLAN

Based on the construction schedule attached in Fig. 7 and the project cost described in the previous sections, the fund disbursement plan of the project is worked out as shown in the Table 2.

The funds required in the preparatory year are mainly land acquisition cost and land acquisition survey cost including helicopter charge.

The construction will be commenced form the forth quarter of the first year and the Lot I will be completed at the end of third quarter of fourth year, and the Lot II be completed at the end of third quarter of the fifth year.

- Group 1 & 2 show general items of Contractor's site establishment and Engineer's residences of offices preparation.
- Group 3 & 4 show clearing works and earth works of road construction.
- Group 7 shows drainage works.
- Group 5 shows subbase and base course construction
- Group 6 & 8 show bituminous surface treatment, road signs and markings.
- Group 9 & 18 show miscellaneous works.
- Group 19 shows day-works as provisional.

The fund of the first year is mainly 10 percent of the contract amount for the advance payment.

The land costs in the last year of respective Lots are Royalties charge for quarries.

The maximum fund of 22 million kina will be required at the forth year, and second maximum of 17.6 million kina at the third year. Other years will require about 10 million kina for the Project.

F.C./L.C. components are calculated based on the F.C. component rates of each group or Item as shown in the Table. These components are resulted from cost breakdown presented under confidential cover.

According to the table, the maximum local fund of 7.5 million kina will be required at the fourth year which is not so remarkable amount if compared with the latest expenditure for road projects in PNG.

Table-2 FUND DISBURSEMENT PLAN

Unit: 1000 Kina

Item	Year	Preparation	1st year	2nd year	3rd year	4th year	5th year	Total (C.F)
Lot I	Engineering & Administration	70	280	938	938	657		2,883 (64.3)
	Land Acquisition & Compensation	22	-	-	-	46		68 (0.0)
	Construction Group 1 & 2		2,503	308	308	309		3,428 (60.3)
	-Roadworks Group 3 & 4		447	2,012	2,013	-		4,472 (68.3)
	Group 7		126	568	568	-		1,262 (70.6)
	Group 5		482	-	2,171	2,171		4,824 (64.5)
	Group 6 & 8		151	-	544	816		1,511 (70.9)
	Group 9 & 18		19	85	85	-		189 (54.3)
	-Bridgeworks No. 1 & No. 3		72	-	196	457		725 (64.7)
	Group 19		-	26	50	50		126 (56.1)
	Price Escalation & Contingencies		-	795	1,193	1,988		3,976 (65.1)
	Subtotal	90	4,080	4,732	8,066	6,494		23,464 (65.1)
	F.C. required	45	2,557	3,136	5,322	4,205		15,265 (65.1)
	L.C. required	47	1,523	1,596	2,744	2,289		8,199 (34.9)
Lot II	Engineering & Administration	109	387	1,293	1,293	1,293	905	5,280 (52.7)
	Land Acquisition & Compensation	39	-	-	-	-	269	308 (0.0)
	Construction Group 1 & 2		3,546	420	419	419	373	5,177 (59.6)
	-Roadworks Group 3 & 4		1,094	1,969	3,938	3,938	-	10,939 (68.1)
	Group 7		120	325	434	325	-	1,204 (66.3)
	Group 5		837	-	-	3,767	3,766	8,370 (71.2)
	Group 6 & 8		245	-	-	1,102	1,101	2,448 (65.4)
	Group 9 & 18		33	151	151	-	-	335 (35.7)
	-Bridgeworks No. 4 & No. 9		459	1,032	1,238	1,857	-	4,586 (68.0)
	Group 19		-	70	105	105	71	351 (67.9)
	Price Escalation & Contingencies		-	1,193	1,989	2,785	1,989	7,956 (64.5)
	Subtotal	148	6,721	6,453	9,567	15,591	8,474	46,954 (64.5)
	F.C. required	56	4,222	4,061	6,151	10,361	5,432	30,283 (64.5)
	L.C. required	92	2,499	2,392	3,416	5,230	3,042	16,671 (35.5)
	Total Cost	240	10,801	11,185	17,633	22,085	8,474	70,418
	F.C. required	101	6,779	7,197	11,473	14,566	5,432	45,548 (65.-)
	L.C. required	139	4,022	3,988	6,160	7,519	3,042	24,870 (35.-)

Table-3 CONSTRUCTION COST OF LOT I

Unit : Kina					
GROUP	F.C (%)		L.C (%)		TOTAL
Group 1	1,310,405	(69.5)	602,595	(31.5)	1,913,000
Group 2	755,790	(49.9)	758,820	(50.1)	1,514,610
Sub total	2,066,195		1,361,415		3,427,610
ROAD WORK					
Group 3	57,370	(41.2)	81,878	(58.8)	139,248
Group 4	2,985,194	(68.9)	1,347,453	(31.1)	4,332,649
Group 5	3,111,661	(64.5)	1,712,620	(35.5)	4,824,281
Group 6	1,026,460	(71.3)	413,175	(28.7)	1,439,635
Group 7	891,127	(70.6)	371,093	(29.4)	1,262,220
Group 8	45,058	(63.4)	26,011	(36.6)	71,069
Group 9	4,653	(61.3)	2,937	(38.7)	7,590
Group 12	376	(22.1)	1,324	(77.9)	1,700
Group 13	7,787	(70.5)	3,258	(29.5)	11,045
Group 14	5,168	(70.6)	2,152	(29.4)	7,320
Group 18	84,890	(52.5)	76,806	(47.5)	161,696
Sub total	8,219,744		4,038,707		12,258,451
BRIDGE WORK					
Group 3~18					
No. 1	143,900	(65.3)	76,468	(34.7)	220,368
No. 2	150,955	(65.0)	81,284	(35.0)	232,239
No. 3	181,032	(66.3)	92,018	(33.7)	273,050
Sub total	475,887		249,770		725,657
DAYWORKS					
Group 19	70,570	(56.1)	55,224	(43.9)	125,794
TOTAL	10,832,396	(65.5)	5,705,116	(34.5)	16,537,512

Table-4 CONSTRUCTION COST OF LOT II

					Unit : Kina
GROUP	F.C (%)		L.C (%)		TOTAL
GENERAL					
Group 1	1,855,686	(67.8)	881,314	(32.2)	2,737,000
PRELIMINARIES					
GROUP 2	1,230,002	(50.4)	1,210,478	(49.6)	2,440,480
Sub total	3,085,688		2,091,762		5,177,480
ROAD WORK					
Group 3	103,914	(44.8)	128,036	(55.2)	231,950
Group 4	7,345,003	(68.6)	3,361,999	(31.4)	10,707,002
Group 5	5,959,678	(71.2)	2,410,657	(28.8)	8,370,335
Group 6	1,519,528	(65.2)	793,300	(34.3)	2,312,828
Group 7	798,225	(66.3)	405,734	(33.2)	1,203,959
Group 8	82,118	(60.9)	52,722	(39.1)	134,840
Group 9	14,129	(61.7)	8,771	(38.3)	22,900
Group 12	1,055	(19.9)	4,245	(80.1)	5,300
Group 13	1,613	(69.9)	694	(30.1)	2,307
Group 14	9,127	(68.8)	4,137	(31.2)	13,260
Group 18	93,872	(32.2)	197,656	(67.8)	291,528
Sub total	15,928,258		7,367,951		23,296,209
BRIDGE WORK					
Group 3~18					
No. 4	555,957	(67.4)	268,906	(32.6)	824,865
No. 5	396,378	(69.8)	171,499	(30.2)	567,877
No. 6	761,282	(66.6)	381,784	(33.4)	1,143,066
No. 7	761,555	(66.5)	383,640	(33.5)	1,145,195
No. 8	312,337	(70.7)	129,441	(29.3)	441,778
No. 9	330,813	(71.4)	132,510	(28.6)	463,323
Sub total	3,118,324		1,467,780		4,586,104
DAYWORKS					
Group 19	238,038	(67.9)	112,533	(32.1)	350,571
TOTAL	22,370,308	(67.0)	11,040,056	(33.0)	33,410,364

Table-5 LOTILAND ACQUISITION COST

				K : Kina
ITEM	UNIT	QUANTITY	RATE	AMOUNT
(1) Roadway Land				
(a) Unused Common land	ha	130.5	130	16,970
(b) Good plantation	ha	2.8	250	700
(c) Swamp		23.6	10	40
(d) Compensation for Crops/House	L. S			1,000
Sub total		136.9		18,710
(2) Temporary Possession				
(a) Quarry, Pit, Spoil banks	ha	54	45	2,430
(b) Camp Sites	ha	12.4	75	930
Sub total		66.4		3,360
(3) Royalty for Quarry	cu.m	185,000	0.25	46,250
Total (1.2 & 3)				68,320

Table-6 LOT II LAND ACQUISITION COST

				K : Kina
ITEM	UNIT	QUANTITY	RATE	AMOUNT
(1) Roadway Land				
(a) Unused Common land	ha	82.4	130	10,710
(b) Good plantation	ha	70.0	250	17,500
(c) Swamp		28.0	20	560
(d) Compensation Crops/House	L. S			4,500
Sub total		180.4		33,270
(2) Temporary Possession				
(a) Quarry, Pit, Spoil banks	ha	93.2	60	5,590
(b) Camp Sites	ha	11.6	60	700
Sub total		104.8		6,290
(3) Royalty				
Quarry	cu.m	1,075,000	0.25	268,750
Total				308,310

Table-7 ENGINEERING & ADMINISTRATION FOR LOT I
SUPERVISION COST

				K : Kina
ITEM	UNIT	RATE	QUANTITY	AMOUNT
Expatriate	M/M	13,450	138	1,856,100
National	M/M	6,000	42	252,000
Admstaff	M/M	725	233	169,000
Others	L. S			105,000
				2,382,100

ADMINISTRATION COST

ITEM	UNIT	RATE	QUANTITY	AMOUNT
Land Survey	L. S		(33.5 km)	62,250
Helicopter	hr	700	30	21,000
pre - Const.	L.			417,500
				500,750
				<u>Total : 2,882,850</u>

Table-8 ENGINEERING & ADMINISTRATION FOR LOT II

SUPERVISION COST

				K : Kina
ITEM	UNIT	RATE	QUANTITY	AMOUNT
Expatriate	M/M	13,700	205	2,808,500
National	M/M	7,000	160	1,120,000
Admstaff	M/M	725	365	265,000
Others	L. S			292,000
				4,485,500

ADMINISTRATION COST

ITEM	UNIT	RATE	QUANTITY	AMOUNT
Land Survey	L. S		(47.1 km)	94,650
Helicopter	hr	700	60	42,000
pre - Const.	L.			658,500
				794,650
				<u>Total : 5,280,150</u>

Table-9 DAILY MACHINE COST CALCULATION TABLE

DESCRIPTION	Unit Price : Kina	
	F.C	L.C
1. Bull Dozer (Soft Ground) 4t	69.7	6.0
2. Bull Dozer (Soft Ground) 10t	135.0	11.4
3. Bull Dozer (Common) 11t	86.5	7.1
4. Bull Dozer (Common) 21t	156.1	13.0
5. Bull Dozer (With Ripper) 21t	177.5	15.3
6. Clamshell (Soft Ground) 0.4m ³	325.9	27.7
7. Excavator (Back hou) 0.35m ³	142.6	11.5
8. Excavator (Back hou) 0.6m ³	174.8	14.1
9. Clamshell (Common) 0.6m ³	258.3	21.1
10. Wheel Loader 1.0m ³	56.1	4.8
11. Tractor Shovel (Crawler) 1.4m ³	82.4	7.8
12. Wheel Loader 2.1m ³	111.9	9.6
13. Tractor Shovel (Crawler) 2.2m ³	151.1	12.7
14. Pick up 2t	36.8	3.4
15. Dump Truck 8t	95.1	21.9
16. Dump Truck 11t	128.3	32.6
17. Crawler Drill 10m ³ /min	122.3	10.0
18. Air Compressor 13.5m ³ /min	73.1	6.2
19. Trailer 28t	101.5	8.1
20. Truck Crane 5t	106.4	8.1
21. Truck Crane 16t	300.9	24.4
22. Crawler crane 35t	503.7	41.0
23. Crawler Crane 50t	847.5	70.1

Table-9 DAILY MACHINE COST CALCULATION TABLE (Continued)

DESCRIPTION			Unit Price : Kina	
			F.C	L.C
24.	Crushing Plant	20t/hr	167.3	10.3
25.	Crushing Plant	69t/hr	442.0	30.1
26.	Soil Plant	100t/hr	195.0	13.5
27.	Screening Plan	20t/hr	64.5	33.3
28.	Vibro Hammer (Without Crane)	30t	70.5	6.4
29.	Diesel Pile (Hammer)	2.5t	88.6	8.0
30.	Diesel Pile (Hammer)	4.5t	160.0	14.5
31.	Sand Pump (ϕ 100 cm)	H = 15m	4.8	0.4
32.	Sand Pump (ϕ 10 cm)	H = 30m	11.3	1.1
33.	Suction Pump	5m ³ /min	76.3	6.6
34.	Bore Pile boring Machine	2.5m/hr	468.0	38.9
35.	Portable Concrete Plant	20m ³ /hr	269.6	23.1
36.	Truck Mixer	0.9m ³	51.4	3.2
37.	Generator	10KVA	9.9	0.9
38.	Generator	45KVA	25.3	2.2
39.	Generator	125KVA	45.5	4.1
40.	Generator	250KVA	90.2	8.1
41.	Motor Grader	3.7m	107.4	8.7
42.	Vibrating Roller	4t	21.1	1.8
43.	Vibrating Roller	8t	75.9	6.6
44.	Road Stabilizer	1.6m	384.7	33.8
45.	Chip Spreader	2.0m	108.6	9.7
46.	Tire roller	10~30t	74.4	6.3

Table-9 DAILY MACHINE COST CALCULATION TABLE (Continued)

DESCRIPTION	Unit Price : Kina	
	F.C	L.C
47. Macadam Roller 8~10t	67.6	5.5
48. Tandem roller 8~10t	83.2	7.0
49. Sprinkler 5kℓ	72.8	5.3
50. Water Truck 1.8kℓ	40.5	2.5
51. Road Sweeper 3m ³	153.4	13.1
52. Asphalt Kettle 6,000ℓ	22.6	1.5
53. Asphalt Distributor 6,000ℓ	76.6	6.3
54. Engine Sprayer (Without Car) 25ℓ/min	2.1	0.1
55. Line Marker (W=15 cm) 7ℓ/min	101.8	8.7
56. Vibrating (Compactor) 100kg	5.2	0.5
57. Vibrating (Jack) 250t	100.6	9.1
58. Winch 5t	48.6	4.4
59. Truck Scale 25t	19.7	1.4
60. Tug Boat 50t	310.4	28.5
61. Soil Carrying Barge 30m ³	34.5	2.1
62. Pontoon 100t	80.6	4.6
63. Unit Float 150t	229.1	8.7
64. Breaker 600kg	43.5	4.0

Table-10 LABOUR WAGES

K : Kina				
DESCRIPTION	UNIT	TOTAL	F.C	L.C
a) Village Labour	K/day	6.50	—	6.50
b) Common Labour	K/day	19.90	—	19.90
c) Skilled Labour	K/day	29.30	—	29.30
d) Car Driver	K/day	27.40	—	27.40
e) Operator	K/day	35.00	—	35.00
f) Technician	K/day	82.30	49.38	32.92
g) Foreman	K/day	58.40	11.68	46.72

Table-11 FUEL COST

T : Toea				
DESCRIPTION	UNIT	TOTAL	F.C	L.C
a) Diesel (D)	T/l	24.9	20.5	4.4
b) Petrol (G)	T/l	39.8	22.9	16.9
c) Kerosene (L)	T/l	29.3	26.3	3.0
d) Black (H)	T/l	20.4	16.0	4.4

Table-12 COSTS OF MATERIALS

K : Kina				
DESCRIPTION	UNIT	TOTAL	F.C	L.C
a) Shaped Steel/ Steel Plate G.250	K/tonne	668.73	603.00	38.73
b) Steel Pipe Pile	K/tonne	953.90	889.00	64.90
c) Round Bar	K/tonne	650.0	607.75	42.25
d) Deformed Bar (TC)	K/tonne	600.00	561.00	39.00
e) Steel Plate G.350	K/tonne	762.71	714.00	48.71
f) Universal Beam	K/tonne	833.72	779.00	54.72
g) High Tension Bolt	K/tonne	2,300.00	2,150.00	150.00
h) Cement	K/tonne	140.00	130.90	9.10
i) Geotextile (Polystrac c)	K/sq. m	2.00	1.88	0.12
j) Geotextile (KFG sheet)	K/sq. m	3.50	3.29	0.21
k) Corrugated pipe				
ϕ 600 mm	K/m	44.25	40.48	3.77
ϕ 900 mm	K/m	88.02	80.52	7.50
ϕ 1,200 mm	K/m	120.77	110.48	10.29
ϕ 1,500mm (t=3.5)	K/m	192.34	175.95	16.39
ϕ 1,800mm (t=3.5)	K/m	228.15	208.45	19.70
ϕ 2,100 mm (t=3.0)	K/m	391.61	358.24	33.37
ϕ 2,500mm (t=3.0)	K/m	491.99	450.09	41.92
l) Slotted Pipe UPVC ϕ 100 m	K/m	5.00	4.61	0.39
m) Combined Cut back Bitumen for Prime coat	K/l	0.65	0.595	0.055
n) Bitumen Class 170	K/l	0.501	0.458	0.043
o) Aviation Kerosene	K/l	0.293	0.263	0.030

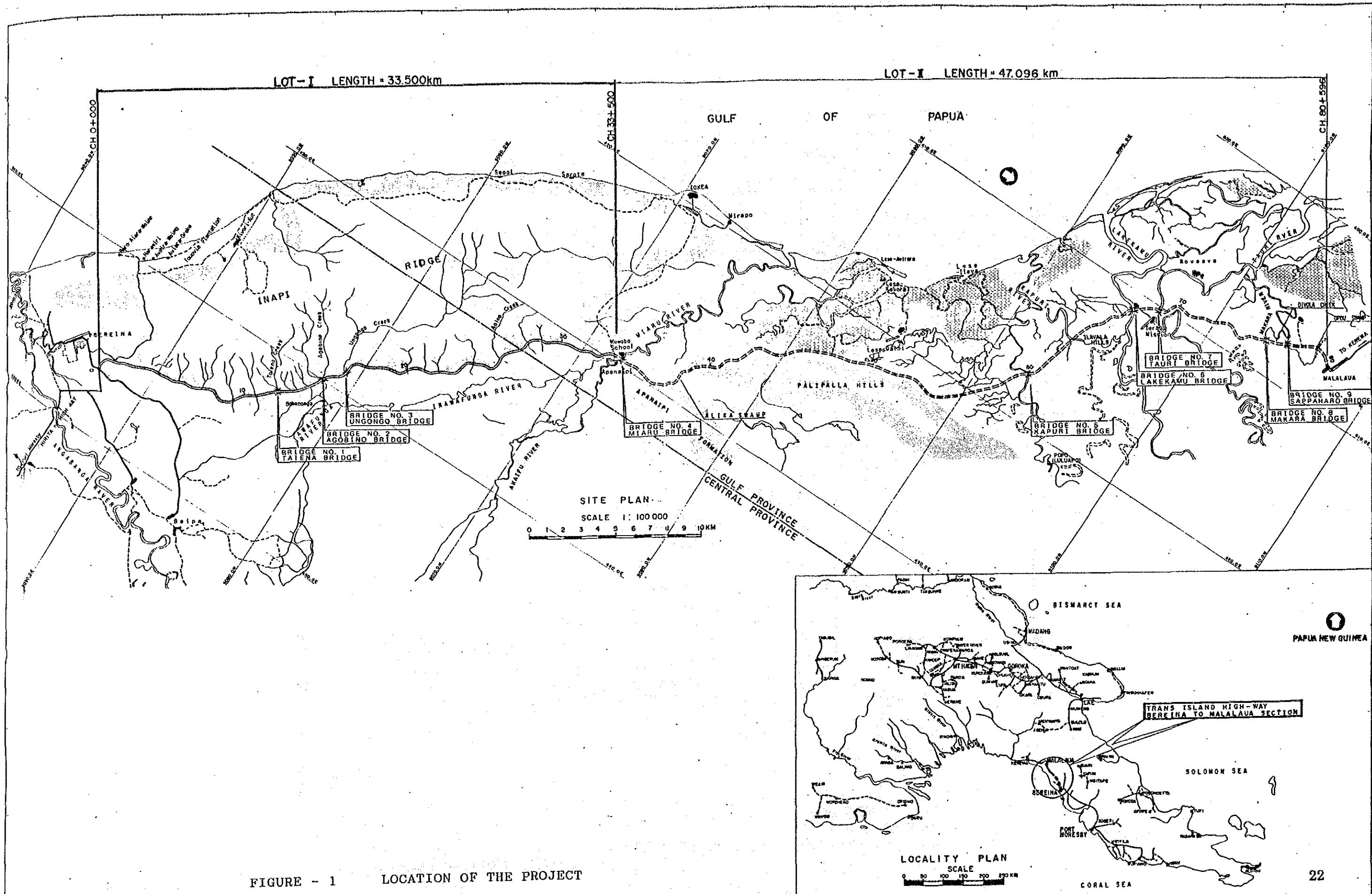


FIGURE - 1 LOCATION OF THE PROJECT

SURVEY JICA Date _____ VERTICAL DATUM MEAN SEA LEVEL HORIZONTAL DATUM SURVEY BOOK NOS. _____		DESIGN JAPAN INTERNATIONAL CO-OPERATION AGENCY J. Hahn Date _____		DRAWN K.E. CHECKED <i>C. J. A.</i> DESIGNED <i>A. M. J.</i> CHECKED <i>T. K.</i>		RECOMMENDED PROJECT ENGINEER APPROVED PRINCIPAL ENGINEER SECRETARY		SCALES AS SHOWN SHEET OF _____ PROJECT No. S.C.120-33-814/A		CENTRAL / GULF PROVINCES TRANS-ISLAND HIGHWAY BEREINA-MALALAUA SECTION SITE AND LOCALITY PLAN PAPUA NEW GUINEA DEPARTMENT OF WORKS DRAWING No. A1/ 87760	
---	--	---	--	--	--	--	--	---	--	--	--

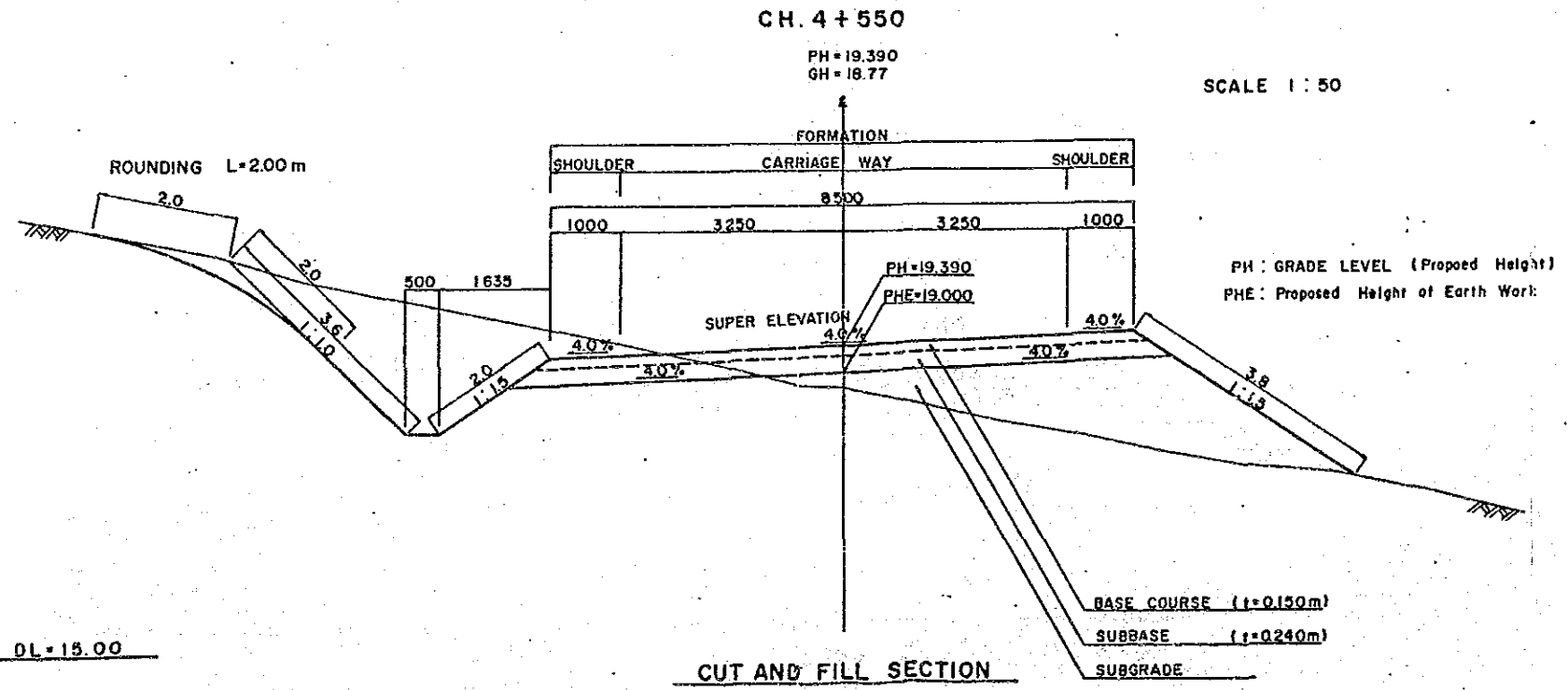
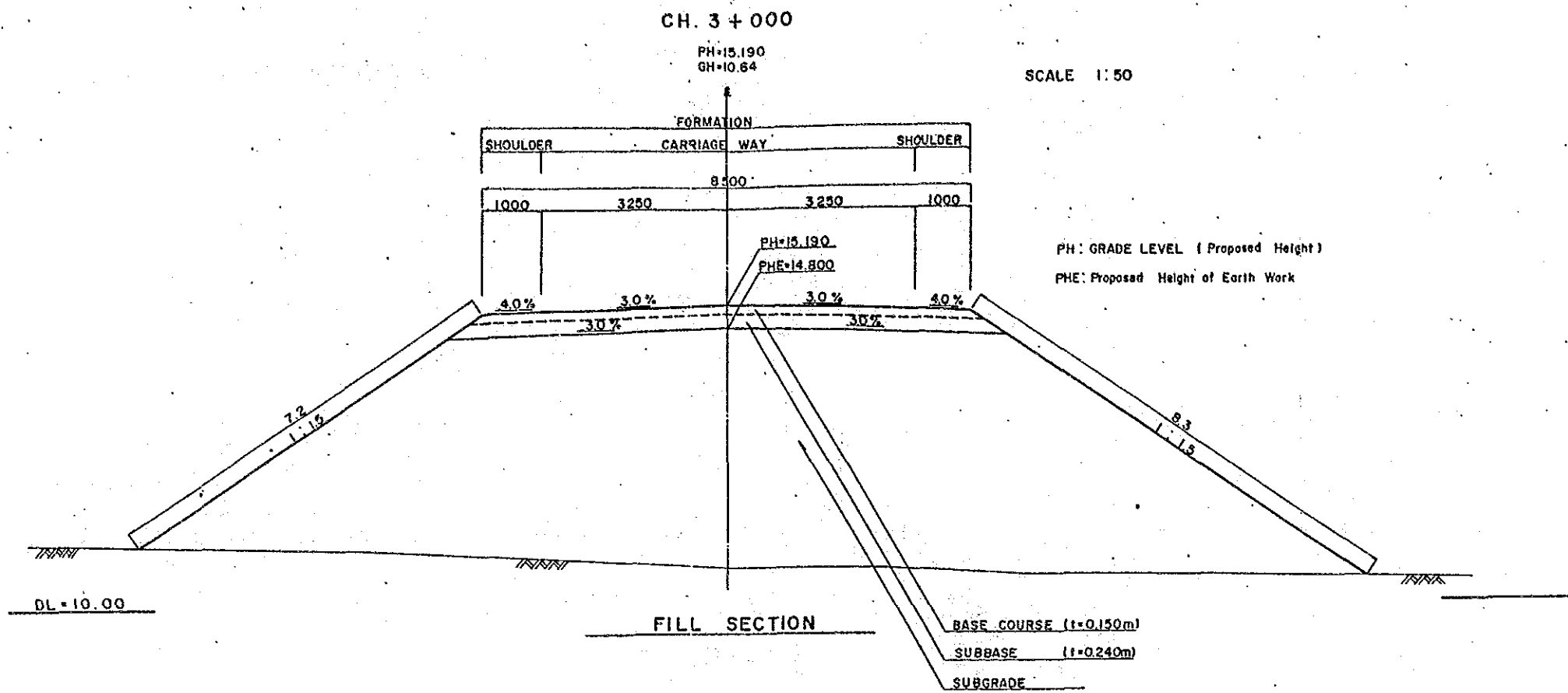
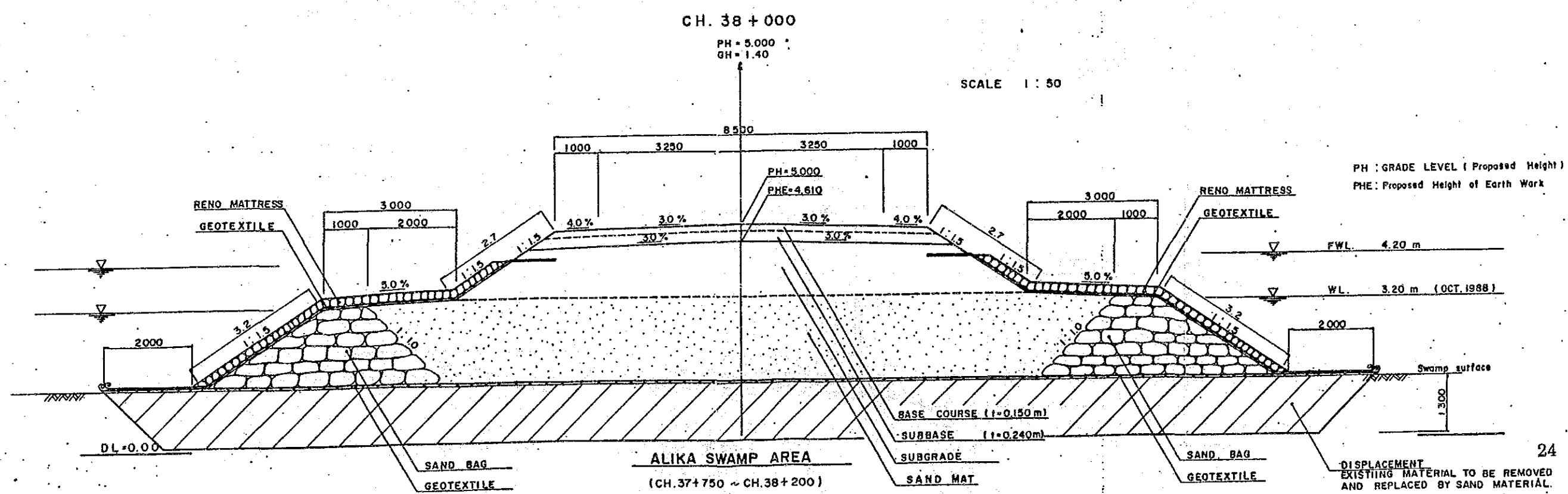
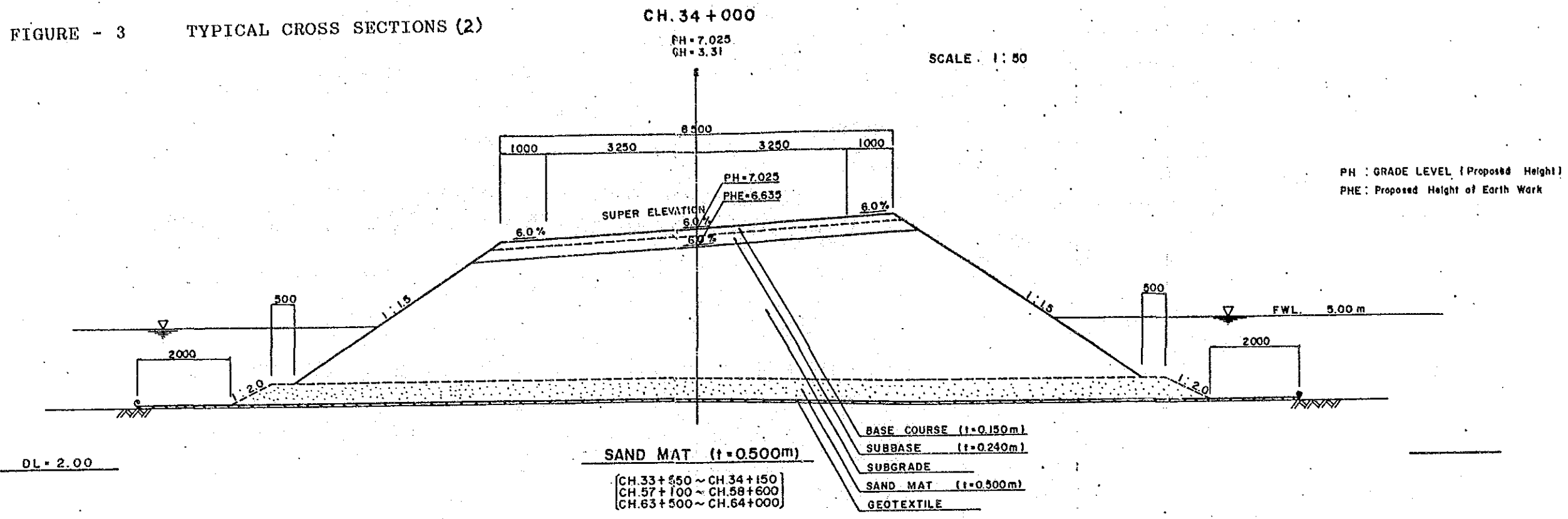


FIGURE - 2 TYPICAL CROSS SECTIONS (1)

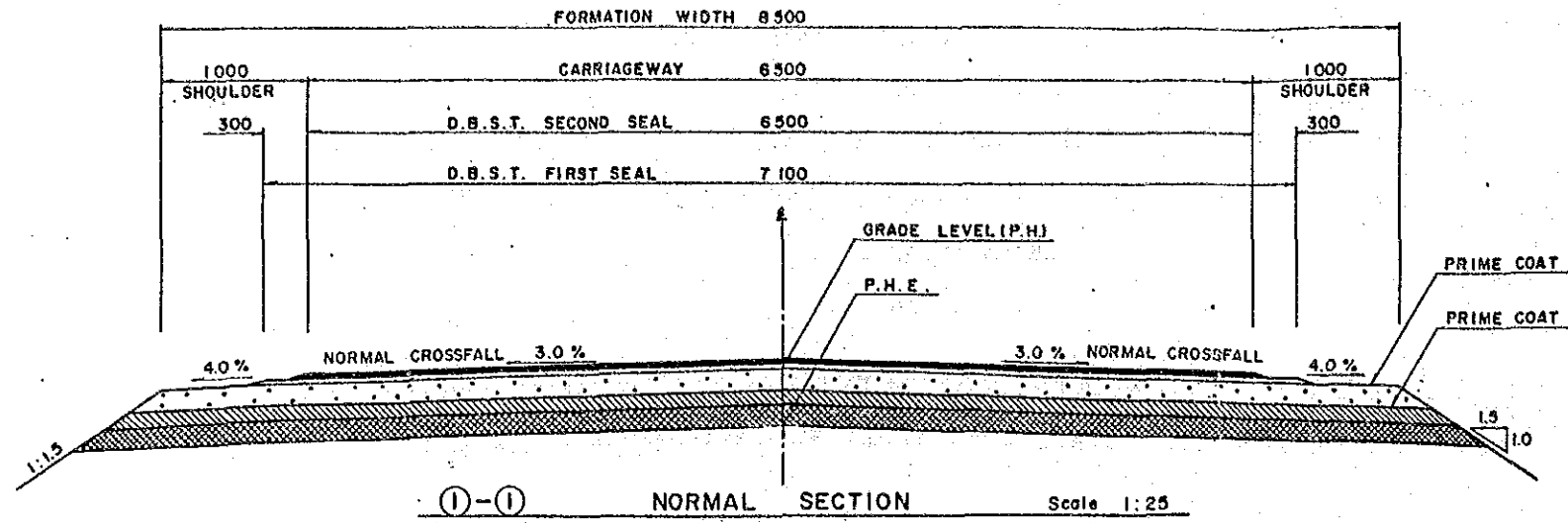
SURVEY JICA		DESIGN JAPAN INTERNATIONAL CO-OPERATION AGENCY		DRAWN K. E.		RECOMMENDED		SCALES AS SHOWN		CENTRAL / GULF PROVINCES		
VERTICAL DATUM MEAN SEA LEVEL		J. H. H. H.		C. E. J.		PROJECT ENGINEER		APPROVED		TRANS-ISLAND HIGHWAY BEREINA-MALALAU SECTION		
HORIZONTAL DATUM		Date		A. Magano		APPROVED		PRINCIPAL ENGINEER		TYPICAL CROSS SECTION (FILL & CUT AND FILL SECTION)		
SURVEY BOOK NO.		Date		7. Kanokorn		EXECUTIVE ENGINEER		SECRETARY		CH. 3+000, CH. 4 + 550		
AMENDMENTS		BY		DATE		PROJECT No.		SHEET OF		PAPUA NEW GUINEA DEPARTMENT OF WORKS		
						S.C. 120-33-814/A				DRAWING No. A1/ 87763		

FIGURE - 3 TYPICAL CROSS SECTIONS (2)



SURVEY JICA Date VERTICAL DATUM MEAN SEA LEVEL HORIZONTAL DATUM SURVEY BOOK NO.		DESIGN JAPAN INTERNATIONAL CO-OPERATION AGENCY Date		DRAWN K. E. CHECKED DESIGNED CHECKED		RECOMMENDED PROJECT ENGINEER APPROVED EXECUTIVE ENGINEER		SCALES AS SHOWN SHEET OF		PROJECT No. B.C. 120-33-814/II		CENTRAL / GULF PROVINCES TRANS-ISLAND HIGHWAY BEREINA-MALALAU SECTION TYPICAL CROSS SECTION (SANDMAT t=0.500m, ALIKA SWAMP) CH. 34+000, CH. 38+000 PAPERIA NEW GUINEA DEPARTMENT OF WORKS DRAWING No. A1/ 88054	
--	--	---	--	--	--	---	--	--------------------------------	--	-----------------------------------	--	--	--

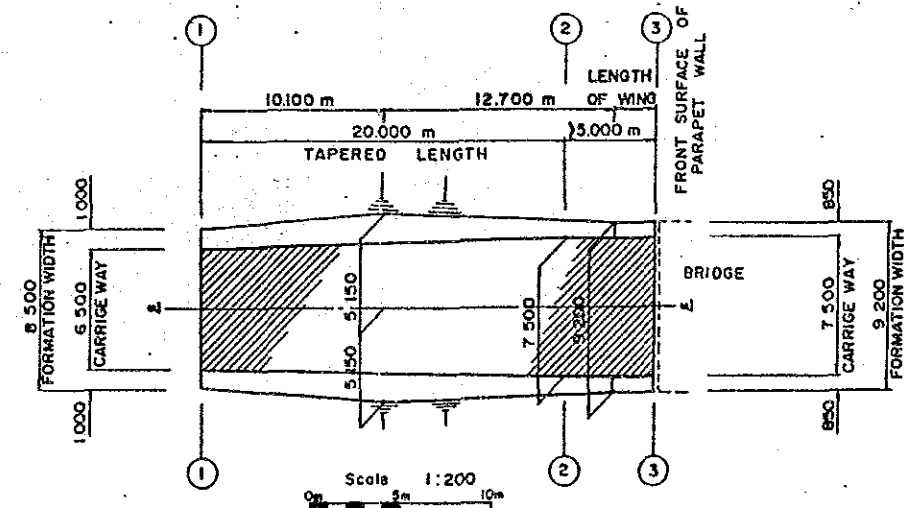
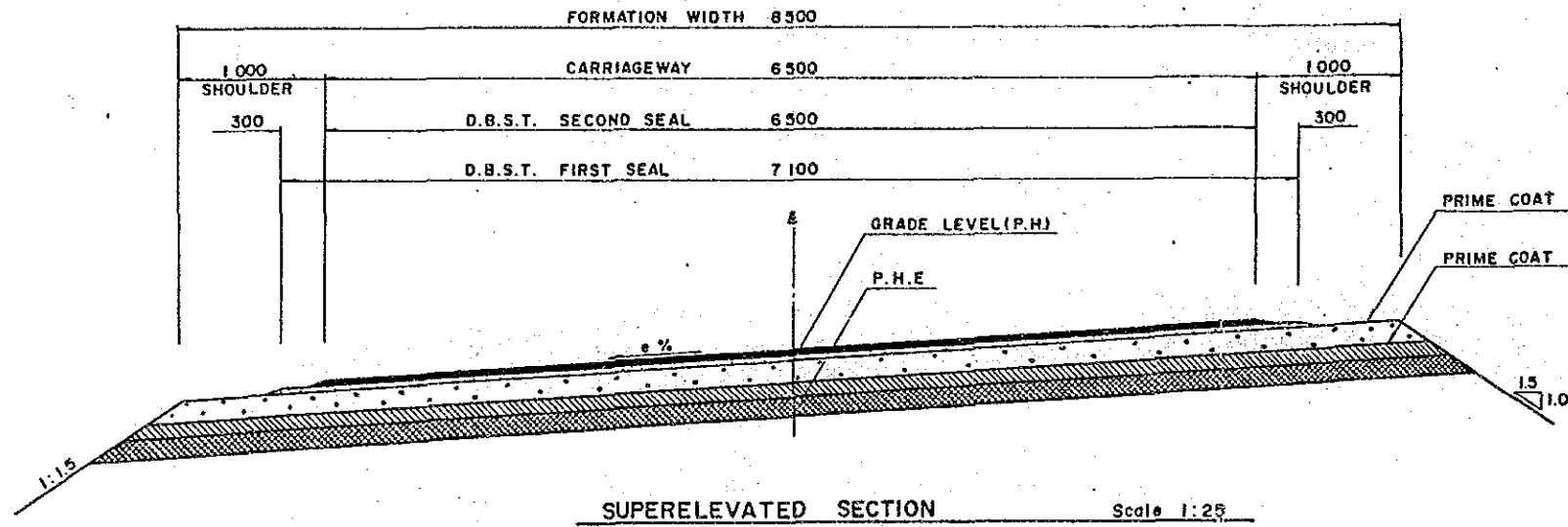
FIGURE - 4 PAVEMENT SECTIONS (L)



CH.0+000 TO CH.33+500

- { DOUBLE BITUMINOUS SURFACE TREATMENT } SECOND SEAL AT Cover aggregate : 9.5mm · 100-135 m²/m² Bitumen 170 0.6-1.0 l/m²
- PRIME COAT AT Cutback Bitumen : 0.4 ~ 0.8 l/m²
- 150mm COMPACTED BASE COURSE (CRUSHED STONE)
- PRIME COAT AT Cutback Bitumen : 0.4 ~ 0.8 l/m²
- 100mm COMPACTED SUBBASE (CEMENT TREATED SANDY GRAVEL)
- 140mm COMPACTED SUBBASE (SANDY GRAVEL)

NOTE : ALL DIMENSIONS ARE IN MILLIMETRES.



LOCATION OF APPROACH SECTION FOR BRIDGE

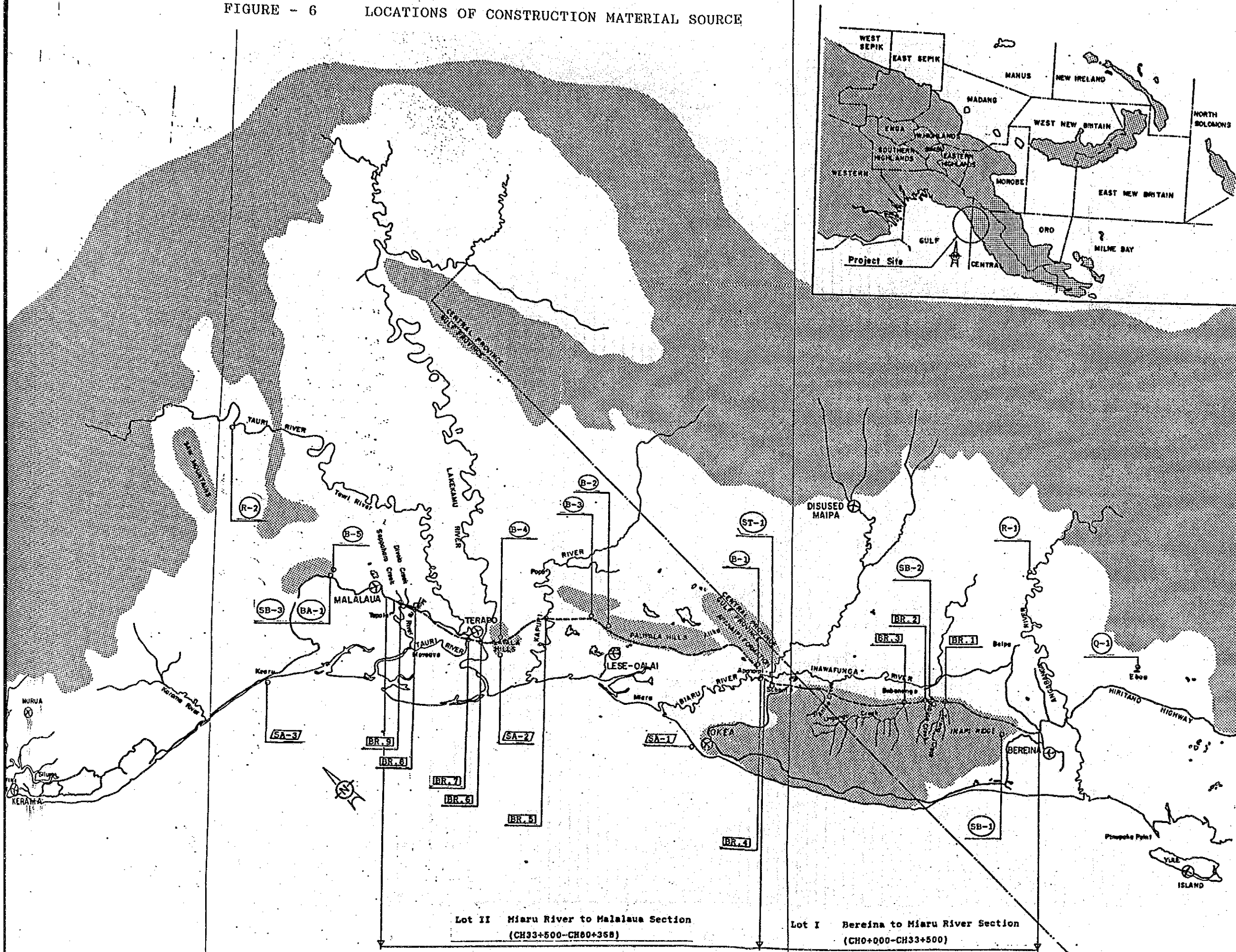
①	②	③	NAME OF BRIDGE	③'	②'	①'
CH. 11 +971	+991	+996.400	TAIENA Br.	CH. 12 +914.600	+020	+040
CH. 14 +697	+717	+722.900	AGOBINO Br.	CH. 14 +744.100	+750	+770
CH. 16 +083	+103	+108.861	UNGONGO Br.	CH. 16 +130.139	+138	+158

NOTES: ③ & ③' are located front surface of parapet wall.
UNGONGO Br. is skewed.

②-② APPROACH SECTION FOR BRIDGE Scale 1:25

SURVEY JICA		DESIGN JAPAN INTERNATIONAL CO-OPERATION AGENCY		DRAWN K. E.		RECOMMENDED		CENTRAL / GULF PROVINCES	
VERTICAL DATUM MEAN SEA LEVEL		DESIGNED A. Magata		CHECKED C. K. S.		APPROVED		TRANS-ISLAND HIGHWAY BEREINA-MALALAU SECTION	
HORIZONTAL DATUM		Principal J. Y. H. H.		PROJECT ENGINEER		PRINCIPAL ENGINEER		TYPICAL PAVEMENT SECTION FOR ROAD	
SURVEY BOOK NO. 6		Date		EXECUTIVE ENGINEER		SECRETARY		CH. 0 + 000 TO CH. 33 + 500	
AMENDMENTS		BY APP'D DATE		EXECUTIVE ENGINEER		SECRETARY		PAPUA NEW GUINEA DEPARTMENT OF WORKS	
				EXECUTIVE ENGINEER		SECRETARY		DRAWING NO. A1/ 87765	
				EXECUTIVE ENGINEER		SECRETARY		PROJECT No. S.C.120-33-814/A	
				EXECUTIVE ENGINEER		SECRETARY		SHEET OF	

FIGURE - 6 LOCATIONS OF CONSTRUCTION MATERIAL SOURCE



Abbreviation:

- BR-1 Taiena Bridge
- BR-2 Agobino Bridge
- BR-3 Ungongo Bridge
- BR-4 Miaru Bridge
- BR-5 Kapuri Bridge
- BR-6 Lakekamu Bridge
- BR-7 Tauri Bridge
- BR-8 Makara Bridge
- BR-9 Sappaharo Bridge

- B-1 Borrow Pit No.1
- B-2 Borrow Pit No.2
- B-3 Borrow Pit No.3
- B-4 Borrow Pit No.4
- B-5 Borrow Pit No.5
- ST-1 Stockpile No.1

- SB-1 Subbase Borrow Pit No.1 (Bereina)
- SB-2 Subbase Borrow Pit No.2 (Babanongo)
- SB-3 Subbase Borrow Pit No.3 (Malalaua)
- BA-1 Base Borrow Pit No.1 (Malalaua)
- Q-1 Quarry Site No.1 (Eboa Quarry)
- R-1 River Deposit No.1 (Angabanban River)
- R-2 River Deposit No.2 (Tauri River)
- SA-1 Sand Borrow Pit No.1 (Iokea)
- SA-2 Sand Borrow Pit No.2 (Iisavala Hill)
- SA-3 Sand Borrow Pit No.3 (Koaru)

ATTACHMENT

ALTERNATIVE DISBURSEMENT PLAN
FOR
EXTENDED CONSTRUCTION SCHEDULE

JANUARY 1990

1. EXTENDED CONSTRUCTION SCHEDULE

Based on the request by the letter (13-5-2) dated 27 December, 1989, an alternative construction schedule was prepared in the Attachment-4 of the Final Report for the Study and shown in the Figure-8 as attached.

Summary of the extended schedule is as follows :

- Pre-construction schedule is not changed
- Lot I construction period was extended from the 36 months to the 60 months
- Lot II construction period was extended from the 48 months to the 84 months which may be the longest project among those financed by OECF, accordingly may not be attractive for international tenderers.

2. REVIEW ON CONSTRUCTION COST FOR ALTERNATIVE PLAN

The construction costs for the extended schedule were reviewed and increased from the points mentioned below:

- (1) Contractor's Site Establishment (Group-1)
 - Items 1.2 Maintenance and 1.8 others are to be increased reflecting the increased numbers of months for the construction.
- (2) Engineers Establishment (Group-2)
 - Items 2.3, 2.4 and 2.11 are to be increased reflecting the increased numbers of month for the extension.
- (3) Pavement Works (Group-5)
 - In related to the lower subbase course, a new work, subgrade preparation shall be newly considered. Because re-leveling and re-compacting works will be required on the once finished sub-grade surfaces before starting the pavement works which were proposed to be delayed two years for Lot I and three years for Lot II.
- (4) Price-escalation for the construction cost shall be reviewed due to change of the construction periods as follows:

$$\text{Local Currency} : 0.35\{(1+0.06)^6-1\} = 0.105$$

$$\text{Foreign Currency} : 0.65\{(1+0.010)^6-1\} = 0.040$$

$$0.145$$

Say 14.5%

This 14.5 percent is a price escalation for the construction cost overall but annual escalation rate.

- (5) Engineering cost shall be increased reflecting the extended service periods.

The alternative construction cost was estimated at 75 million kina based on the above points discussed and following assumptions, and shown in Table-13.

- The rate of FC is supposed to be same as the original plan
- The monetary factors including exchange rate of foreign currency is same with those in 1989.

3. ALTERNATIVE FUND DISBURSEMENT PLAN

Based on the extended construction schedule attached in Fig. 8 and the reviewed project cost described in the previous sections, the alternative fund disbursement plan is worked out as shown in the Table-14.

According to the table, the L.C is required K 4-2 million annually in the next eight (8) years which may not be a big pressure on the cash flow in the National Budget.

Table-13 CONSTRUCTION COST FOR ALTERNATIVE SCHEDULE

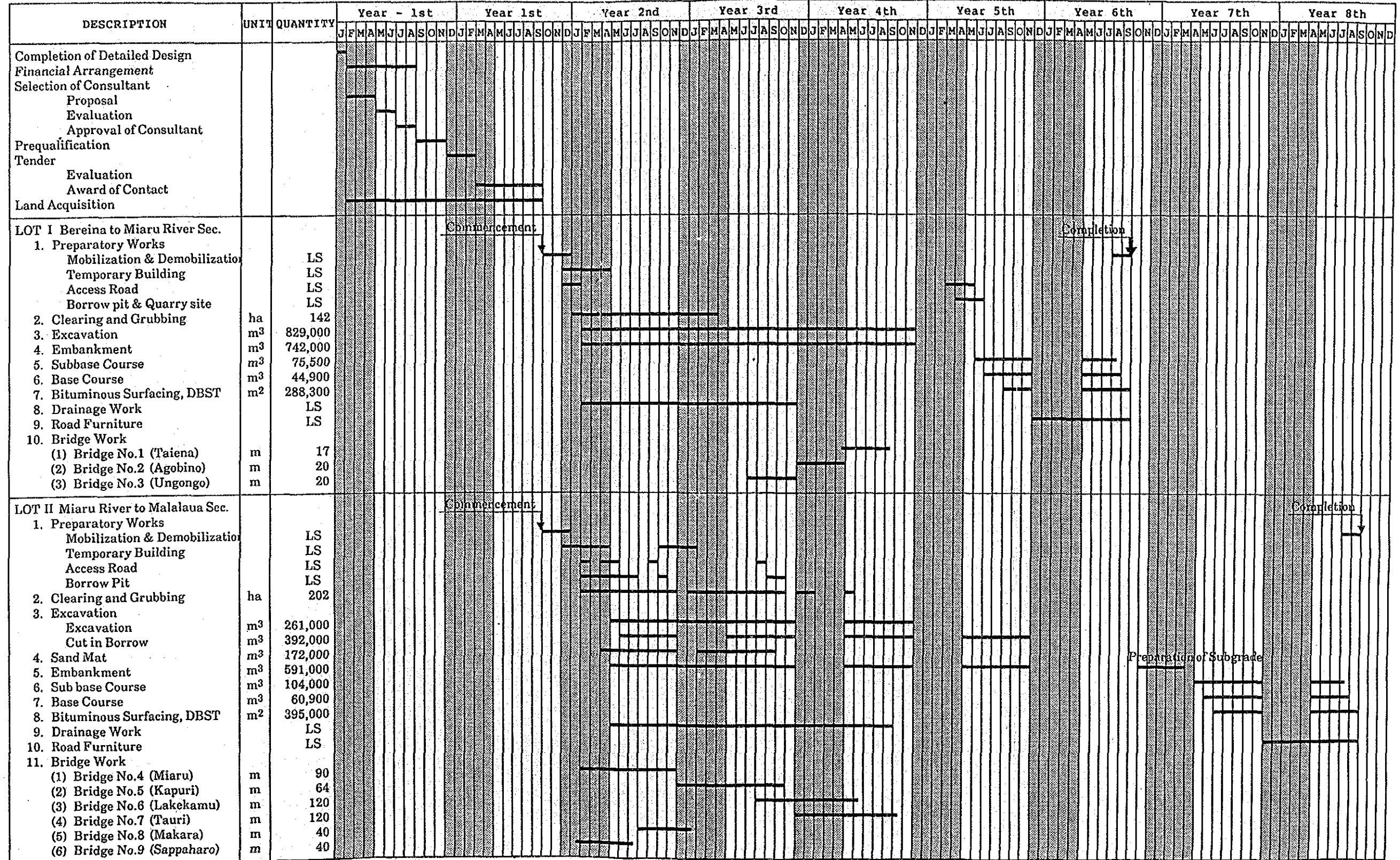
Unit : 100 kina, () shows percentage of FC

Item	Lot I	Lot II	Total
1. Construction Cost			
Group 1	2,235 (68.5)	3,277 (67.8)	5,512 (68.1)
Group 2	1,793 (49.9)	3,000 (50.4)	4,793 (50.2)
Group 3~18	12,312 (67.1)	23,372 (68.4)	35,684 (68.0)
Bridge No.1	220 (65.3)		220 (65.3)
Bridge No.2	232 (65.0)		232 (65.0)
Bridge No.3	273 (66.3)		273 (66.3)
Bridge No.4		825 (67.4)	825 (67.4)
Bridge No.5		568 (69.8)	568 (69.8)
Bridge No.6		1,143 (66.6)	1,143 (66.6)
Bridge No.7		1,145 (66.5)	1,145 (66.5)
Bridge No.8		442 (70.7)	442 (70.7)
Bridge No.9		463 (71.4)	463 (71.4)
Group 19	126 (56.1)	351 (67.9)	477 (64.8)
Sub Total	17,191 (65.5)	34,586 (67.0)	51,777 (66.5)
2. Land Acquisition Cost	68 (0.0)	308 (0.0)	376 (0.0)
3. Engineering & Administration Cost	3,218 (64.3)	5,673 (52.7)	8,891 (56.8)
4. Physical Cont. (7.5 % of Above)	1,536 (65.1)	3,042 (64.5)	4,578 (64.7)
5. Price Escalation (14.5% of Above)	3,192 (65.1)	6,323 (65.5)	9,515 (64.7)
Total	25,205 (65.1)	49,932 (64.5)	75,137 (65.0)
(Increased)	(+7.4%)	(+6.3%)	(+6.7%)

Table-14 ALTERNATIVE FUND DISBURSEMENT PLAN

Unit: 1000 Kina

Item	Year	Preparation	Year 1st	Year 2nd	Year 3rd	Year 4th	Year 5th	Year 6th	Year 7th	Year 8th	Total (F.C)
Lot I	Engineering & Administration	70	280	900	900	650	209	209			3,218 (64.7)*
	Land Acquisition & Compensation	22	-	-	-	-	-	46			68 (0.0)
	Construction Group 1 & 2		2,503	308	308	308	301	300			4,028 (60.3)
	-Roadworks Group 3 & 4		447	1,341	1,341	1,343	-	-			4,472 (68.3)
	Group 7		126	568	568	-	-	-			1,262 (70.6)
	Group 5		488	-	-	-	2,219	2,171			4,878 (64.5)
	Group 6 & 8		151	-	-	-	544	816			1,511 (70.9)
	Group 9 & 18		19	42	43	42	-	43			189 (54.3)
	-Bridgeworks No. 1 & No. 3		72	-	196	457	-	-			725 (64.7)
	Group 19		-	26	25	25	25	25			126 (56.1)
	Price Escalation & Contingencies		-	473	709	709	946	1,891			4,728 (65.1)
	Subtotal	92	4,086	3,658	4,090	3,534	4,244	5,501			25,205 (65.1)
	F.C. required	45	2,563	2,431	2,711	2,318	2,764	3,564			16,396 (65.1)
	L.C. required	47	1,523	1,227	1,379	1,216	1,480	1,937			8,809 (34.9)
Lot II	Engineering & Administration	109	387	1,250	1,250	1,250	400	27	500	500	5,673 (54.0)*
	Land Acquisition & Compensation	39	-	-	-	-	-	-	-	269	308 (0.0)
	Construction Group 1 & 2		3,546	420	419	419	373	300	400	400	6,277 (59.6)
	-Roadworks Group 3 & 4		1,094	1,969	2,626	2,625	2,625	-	-	-	10,939 (68.1)
	Group 7		120	325	434	325	-	-	-	-	1,204 (66.3)
	Group 5		845	-	-	-	-	-	3,835	3,766	8,446 (71.2)
	Group 6 & 8		245	-	-	-	-	-	1,102	1,101	2,448 (65.4)
	Group 9 & 18		33	60	61	60	60	-	-	61	335 (35.7)
	-Bridgeworks No. 4 & No. 9		459	1,032	1,238	1,857	-	-	-	-	4,586 (68.0)
	Group 19		-	51	50	50	50	50	50	50	351 (67.9)
	Price Escalation & Contingencies		-	702	937	1,171	1,405	234	2,341	2,575	9,365 (64.5)
	Subtotal	148	6,729	5,809	7,015	7,757	4,913	611	8,228	8,722	49,932 (64.5)
	F.C. required	56	4,233	3,692	4,503	5,001	3,187	378	5,503	5,626	32,182 (64.5)
	L.C. required	89	2,496	2,117	2,512	2,756	1,726	233	2,725	3,096	17,750 (35.5)
	Total Cost										75,137
	F.C. required	104	6,796	6,123	7,214	7,319	5,951	3,942	5,503	5,626	48,578 (65-)
	L.C. required	136	4,019	3,344	3,891	3,972	3,206	2,170	2,725	3,096	26,559 (35-)



Note : The year - 1st is 1990 in the earliest.

Fig. - 8 ALTERNATIVE CONSTRUCTION SCHEDULE FOR THE PROJECT



JICA