Department of Transport & Works
Papua New Guinea

BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
RECONSTRUCTION OF UMI BRIDGE
ALONG THE HIGHLANDS HIGHWAY
IN
PAPUA NEW GUINEA

JANUARY 1998

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.

Department of Transport & Works
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PREFACE

In response to a request from the Government of Papua New Guinea the Government of Japan decided to conduct a basic design study on the Project for Reconstruction of Umi Bridge along the Highlands Highway and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Papua New Guinea a study team from August 12 to September 5,1997.

The team held discussions with the officials concerned of the Government of Papua New Guinea, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Papua New Guinea in order to discuss a draft design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Papua New Guinea for their close cooperation extended to the teams.

January 1998

Kimio Fujita
President
Japan International
Cooperation Agency

LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for Reconstruction of Umi Bridge along the Highlands Highway in Papua New Guinea.

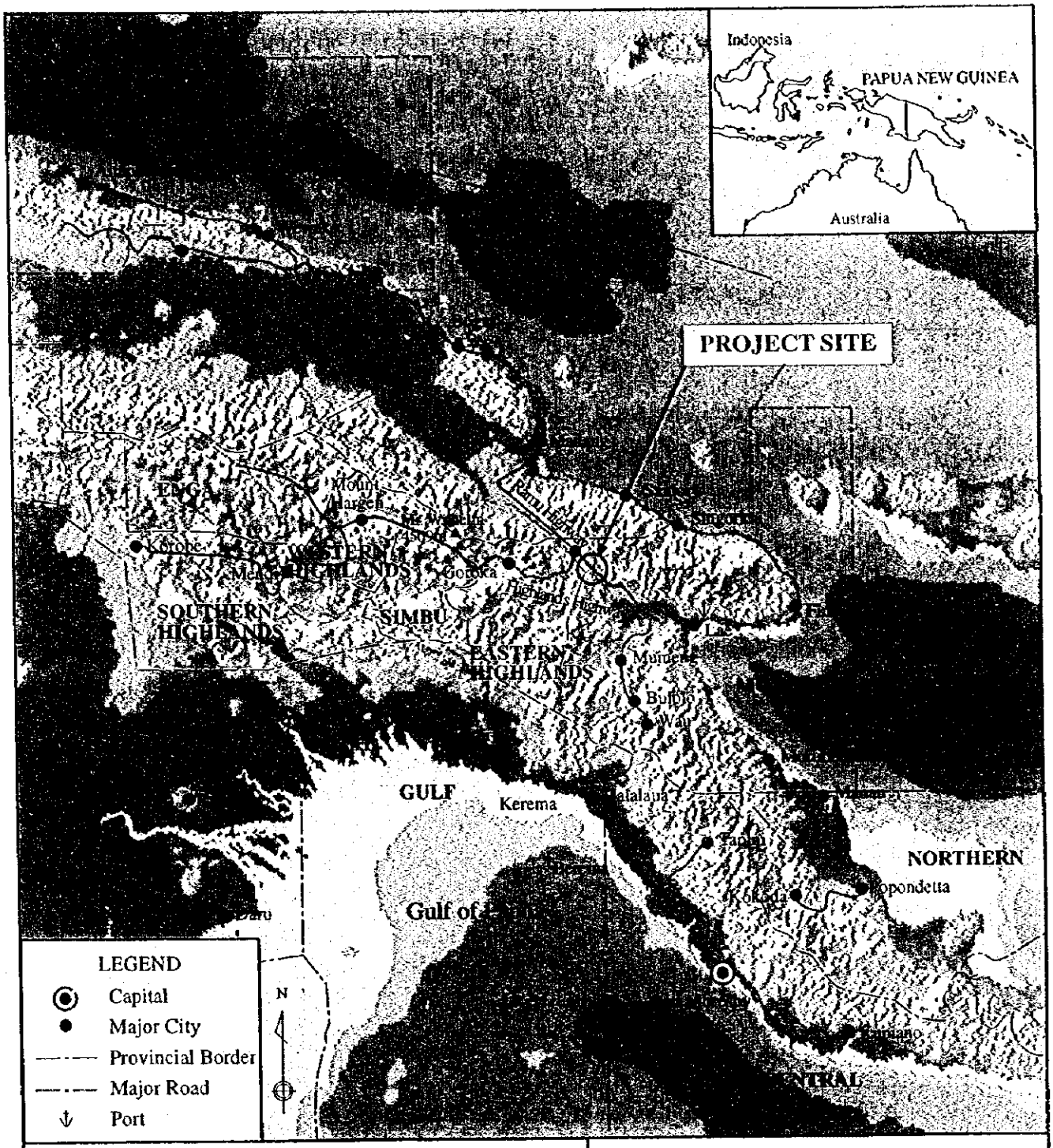
This study was conducted by Nippon Koei Co., Ltd., under a contract to JICA, during the period from 25 July 1997 to 16 January 1998. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Papua New Guinea and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

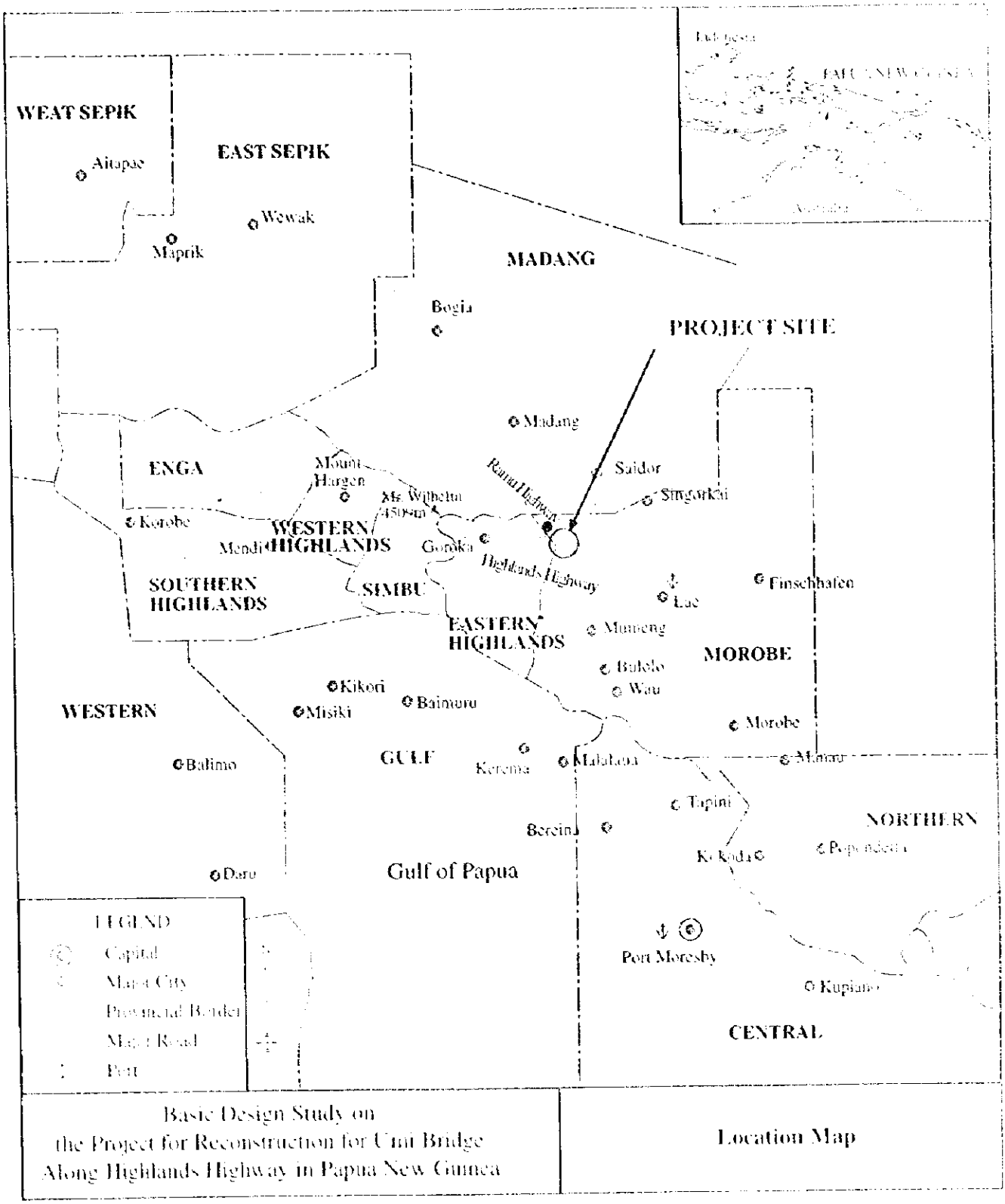
H. Oshima

Hisashi Oshima
Project Manager
Basic design study team on
the Project for Reconstruction of Umi Bridge
along the Highlands Highway in
Papua New Guinea
Nippon Koei Co., Ltd.



Basic Design Study on
the Project for Reconstruction for Umi Bridge
Along Highlands Highway in Papua New Guinea

Location Map



Basic Design Study on
the Project for Reconstruction for Unit Bridge
Along Highlands Highway in Papua New Guinea

Location Map

Perspective of New Umi Bridge

BASIC DESIGN STUDY REPORT
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CONTENTS

Appendices

Abbreviations

AADT	:	Annual Average Daily Traffic
ADB	:	Asian Development Bank
Alt.	:	Alternative
Aus AID	:	Australian Aid
DA	:	Department of Agriculture
DEC	:	Department of Environment & Conservation
DMP	:	Department of Mining and Petroleum
DNPI (Former NPO)	:	Department of National Planning & Implementation (Former NPO- National Planning Office)
DOTW	:	Department of Transport & Works
EL	:	Elevation above the sea level
E/N	:	Exchange of Notes
FAD	:	Fast Assistant Director
GOJ	:	Government of Japan
GOP	:	Government of Papua New Guinea
JICA	:	Japan International Cooperation Agency
KN	:	Kilonewton
Max.	:	Maximum
Mini.	:	Minimum
N	:	Newton
NMB	:	National Mapping Bureau
P.C.	:	Prestressed Concrete
PNG	:	Papua New Guinea
POM	:	Port Moresby
R	:	Radius
ROW	:	Right of way
t	:	Thickness
WB	:	World Bank

1. BACKGROUND OF THE PROJECT

Papua New Guinea (PNG) consists of the eastern half of the second largest island of the world known as New Guinea and some 600 associate islands, the major of which are New Britain, New Ireland, North Solomons (formerly Bougainville) and Manus. Australia and the Solomon Islands lie to the south and east respectively. South Pacific Ocean engulfs it to the north. It lies approximately between 1 and 12 degrees south of the equator and between 141 and 157 degrees east of Greenwich.

The terrain in many parts of PNG is extremely rugged with very sharp mountain ranges and steep valleys with fast flowing rivers. The coastal areas have an extensive system of marshes believed to be one of the largest in the world.

The climate in most part of PNG is tropical, hot and humid, subject to the South East and North West Trade Winds. The highlands regions in the central part of the mainland where mountain ranges extend up to 4000 meters above sea level in several places, is cool and temperature ranges from 12 degrees celsius to 23 degrees celsius.

The capital city in PNG, Port Moresby with population of about 200 thousands, is located in the National Capital District on the south coast. The coastal population is still generally thinly clustered in villages. About a half of the total population live in the highlands regions. The capital city connects with other parts of the country mainly by air and by marine craft. PNG's road network is undeveloped and only a few major roads existing have been deteriorated because of inadequate maintenance. Many divisions and even districts are accessible only by air. Numerous small inhabited islands are reached by boat and air.

Under the situation mentioned above, the Government of PNG has emphasized maintenance and improvement strategies to the infrastructure sector. In light of these strategies, the highest priority in the transportation subsector is to maintain and improve the existing highways. Among the existing national highways totaling 8,970 km in PNG, the Highlands Highway connecting Lae city and the Highlands region is the most vital trunk highway with the heaviest traffic volume in PNG. However, several bridges along the Highlands Highway have aged and became traffic bottlenecks in terms of the load carrying capacity and the traffic flow

capacity. Umi bridge which is located at 138 km from Lae city along the Highlands Highway is one of them and is in critical conditions.

The existing Umi bridge was built in 1960s with 3 spans of 49m single steel truss bridge with a single lane of 3.2 m applying 33ton of the design truck load. In later years, the river bed at the bridge site is aggravating due to excessive sediment load resulting from the devastating land slide in the Umi catchment by 1993 Finisterre earthquake. Furthermore, a trailer with carrying bulldozer collided the end frame of the first span out of three spans in July 1994. The crashed span was collapsed and replaced with Baily bridge which is only temporary. In addition to those potential defects, major structural members such as concrete deck slab and steel chords have critical defects such as corrosion, lamination and deformation in the steel members and wide cracks, flaking and deterioration in the concrete members. The river bed aggradation in progress will cause inadequate bridge opening which will result in the bridge washed out. Due to these reasons i.e. inadequate traffic flow capacity, insufficient load carrying capacity and possible washed out, the Umi bridge is one of major traffic bottlenecks along the Highlands Highway.

Accordingly, the Government of Papua New Guinea (PNG) made a request for grant aid for the reconstruction of Umi Bridge along the Highland Highway (the Project) in April 1997 taking into account its urgency and priority.

2. CONTENTS OF THE PROJECT

2.1 Objectives of the Project

The Government's objectives and strategies to the infrastructure sector in "Economic and Development Policies" in 1995 are; (1) to maintain and improve existing infrastructure and to create new infrastructure so as to promote more efficient production and distribution of goods and services; and (2) to assist in the development of all sectors of the economy. Concretely speaking, the major activities and projects being undertaken in the infrastructure sector in 1996 are:

- Poreporena Freeway in Port Moresby;
- **Maintenance and upgrading of the Highlands Highway;**
- Redevelopment of Jackson's Airport;
- A comprehensive programme of airport maintenance and improvement; and
- Bereina - Malalaua Road.

Furthermore, the Government has emphasized the following objectives for the transport subsector in "Medium Term Development Strategy 1997 - 2000, A Bridge into the 21st Century" on December 1996.

- Immediately restoring existing infrastructure to tolerable conditions;
- Planning and constructing new infrastructure where appropriate;
- Rationalizing current departmental structures; and
- Clarifying responsibilities of various levels of the Government.

In these regards, the highest priority is maintaining the existing network and restoring it to serviceable standards, especially the Highlands Highway.

The Highlands Highway totaling 520 km length connecting Lae City where the largest port in terms of import cargo handling is situated and the Highlands region where is a center of the agriculture and mining development in PNG is the most vital trunk highway. Along the Highway, Umi bridge which is located at 138 km from Lae city was built in 1960s with

3 spans of 49 m single steel truss bridge and a single lane of 3.5m wide.

In July 1994, the trailer with carrying a bulldozer collided with the end frame of the first span out of three spans. The crashed span was collapsed and replaced with baily bridge which is only temporary. Furthermore , the river bed at the bridge site is aggravating due to excessive sediment load resulting from the devastating land slide in the Umi catchment by 1993 Finisterre earthquake. This river bed aggradation in progress will cause inadequate bridge opening which will result in the bridge to be washed out.

In addition to those potential defects, the major structural members such as concrete deck slab and steel chords have critical defects such as corrosion, lamination and deformation in the steel members and wide cracks, flaking and deterioration in the concrete members.

Due to above reasons, i.e. inadequate traffic flow capacity, insufficient load carrying capacity and possible submergence or being washed away of the bridge, the Umi bridge is one of major traffic bottlenecks along the Highlands Highway, and reconstruction of Umi bridge is in the top urgency and first priority in accordance with the Government's policies.

The objective of the project is to reconstruct the existing Umi bridge, which inturn will promote the development in the Highland provinces where development potentials are high and contribute the stability of the people's livelihood and the improvement of the economic activities along the Highway.

2.2 Basic Concept of the Project

2.2.1 Outline of the PNG's Request

The Government of PNG requested the Japanese grant aid for the reconstruction of Umi bridge with the following project components.

- Reconstruction of Umi bridge with two (2) lanes,
- Bank protection and river training works, and
- Construction of approach roads.

2.2.2 Principles to Formulate Scheme Outline

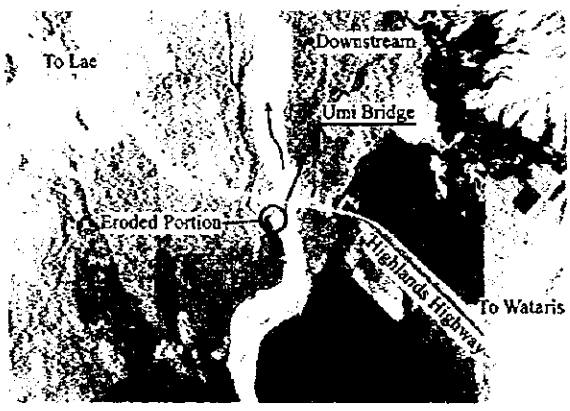
The principles applied in the Study for formulating the scheme outline are as follows:

- Magnitude of the new bridge shall be more or less the same as the existing, but the new bridge shall cope with various natural conditions at the bridge site.
- Capacities in terms of traffic flow and load carrying of the new bridge shall be the same as those of standard existing bridges along the Highlands Highway.
- Incidental facilities such as approach roads and river bank protection in the project shall be within the minimum requirements.
- Implementation of the project shall meet the Japan's grant aid system.

2.2.3 Location of New Bridge Site

The new Umi bridge will be located at 15 m downstream side from the existing bridge and in parallel with it based on the following two reasons.

- The left side river bank (Lae side) at the upstream is hit by the main river water flow and has been extensively eroded as shown in aerial photograph below. The topographic conditions therefore require extensive and solid bank protection for the Lae side abutment in case of the new bridge located at the upstream side.
- The ROW available at the bridge site is 30 m width each side totaling 60 m.



2.2.4 Selection of Bridge Type

(1) Bridge Length

To accommodate the peak flood discharge of the Umi river at the bridge site, a desirable total bridge length is approximately estimated at 145 - 165 m by two different formulas. Consequently the desirable total bridge length was decided at about 160 m taking into account the topography at the new bridge crossing site where the river width is slightly wider than that of the existing.

To cope with the floating debris such as long and big logs, a minimum span length is estimated at 36 m by the formula (recommended by Ministry of Construction in Japan). Based on this figure and the fact that the existing span length is 50 m, the span length of the new bridge should be more than 36 m, but less than 50 m.

It is desirable that the river span arrangement of the new bridge should be 50 m which is the same span arrangement as the existing one in order to prevent the bridge opening clogged by accumulation of the floating debris during the construction period.

Note: Refer to Appendix -5 for the details of above assessment.

(2) Bridge Alternatives

Considering the basic bridge configurations assessed in the above and the need for earthquake resistant structure (Bridge type A - ductile and fully monolithic) as recommended in the Earthquake Engineering for Bridges in Papua New Guinea, 1985 Revision, following five (5) bridge alternatives are formulated.

Alternative	Bridge Type	Total Bridge Length	Span Arrangement
A	3-Spans continuous steel box girder	160 m	55 m + 50 m + 55 m
B	3-spans continuous steel plate girder	160 m	55 m + 50 m + 55 m
C	3-spans continuous steel truss	160 m	55 m + 50 m + 55 m
D	3-spans continuous P.C. box girder	160 m	55 m + 50 m + 55 m
E	4-spans connected P.C. I section girder	160 m	4 @ 40 m

The drawings consisting of the profile and cross section, and the evaluation results of each alternative from eight (8) different aspects are tabulated in Appendix -5 and a summary of the evaluation is as follows:

Alter-native	Bridge Type	Structural Aspect	Construc-tion Cost	Construc-tion Period	Field Work Aspect	Mainte-nance	Aseis-micity	Hydraulic Aspect	Overall Rating
A	3-spans continuous steel box girder	●	×	●	●	▲	●	●	▲
B	3-spans continuous steel plate girder	▲	●	●	●	▲	●	●	●
C	3-spans continuous steel truss	●	▲	▲	●	×	●	●	▲
D	3-spans continuous P.C. box girder	●	×	×	×	●	●	●	×
E	4-spans connected P.C. I section girder	▲	●	▲	×	●	●	×	×

Legend: ● Good, ▲ Fair, × Poor

(3) Selection of Bridge Type

The present situations in PNG with regard to the existing bridges and the bridge construction practice are as follows:

- The cement factory in PNG is the only one available in Lae city which produces normal portland cement. However, the quality test results are widely scattered, and high early strength cement which is requisite for prestressed concrete is not available.

- The major bridge construction materials such as steel plates, reinforcing bars, P.C. cables & tendons are not available locally at all.

- The major type of bridges existing in PNG is steel bridge, which is selected as a consequence of better field quality control and earthquake proof aspects.

- No local contractors with P.C. bridge construction experience.

1) Selection of Superstructure Type

Based upon the construction situations mentioned above and the results of alternative evaluation, Alt-B i.e. 3 spans continuous steel plate girder type is selected as an optimum bridge type for the Umi bridge.

2) Selection of Foundation Type

An open caisson is selected as an optimum foundation type based on the following site conditions.

- The subsoil is entirely very dense sand and gravel with 10 - 20 cm boulders (N value > 50)
- Wide fluctuation of the river bed (possible aggradation of about 2.0 and later lowering 4.5 m below).
- Severe local scouring depth.

2.2.5 Proposed Height of Bridge

Because of the devastating land slides in the Umi catchment caused by October 1993 Finisterre earthquake with 7.1 on the Richter scale, the river bed of the Umi river is considerably aggradating. Hence, proposed height of the new Umi bridge should be considered not only structure depth of the bridge, free board and flood depth but also projected aggradation from the existing river bed.

In the flood depth estimation, it should be considered that the river bed will lower, after reaching the ultimate aggradation, to the stable river bed once the sediment load has been extinct. It is projected that the existing river bed will reach in the stable condition after 20 - 30 years. Under the situations stated above, flood depth with 50 years return period, in stead of Q_{100} stipulated in the Flood Estimation Manual in PNG, is applied in the study since full consideration of the projected aggradation and the flood depth with Q_{100} definitely over design the structure. Based on the Flood Estimation Manual in PNG, the design flood discharge (Q_{50}) is estimated at 1,085 m^3/sec (N = 0.045, S = 0.075) and accordingly the flood water depth is 2.3 m above the projected river bed.

The free board, is estimated at about 1.5 m to be applied in the study

considering the hydraulic swell head of about 0.8 m and size of the driftwood.

The structural depth is 3.00m consisting of 0.21m of the deck slab thickness, 0.09m of the hunch depth and 2.7 m of the web depth.

In estimating the projected aggradation at the bridge site of the Umi river, the dynamic equilibrium theory of alluvial channels is applied and the projected aggradation is estimated at 1.8 m above the average present river bed.

Furthermore, the river bed aggradation due to devastating landslides possibly caused by the future earthquake which is bigger than magnitude 7.1 is not considered in the study based on the following reasons:

- Life span of the new Umi bridge is 50 years according to the Japan grant aid concepts.
- Return period of large earthquakes more than magnitude 7.2 in the Huon seismic zone where the Umi bridge is fell under is 81 years based on the Study Report on Return Periods of Large Earthquakes in PNG.

2.2.6 Approach Roads

The approach roads of the new bridge shall be connected to the existing highway with a minimum length meeting the geometric standard stipulated in the Road Design Manual by the Department of Works. While the pavement composition of the approach roads shall be the same composition as those of the existing one.

2.2.7 Proposed Width

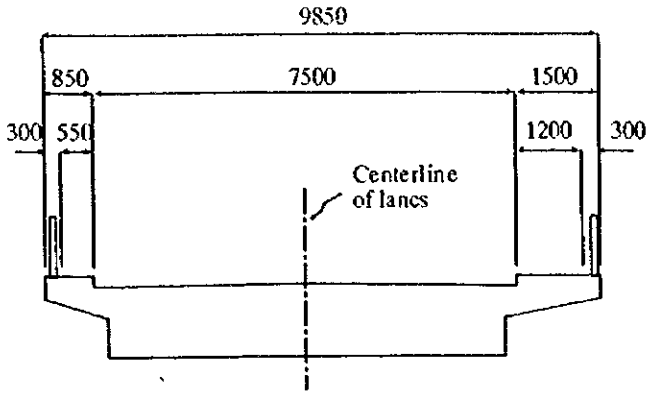
(1) Roadway Width

The standard road width of the Highlands Highway, before and after Umi bridge, is 6.5 m of carriageway (2-lane width) and 2.0 m each side of shoulder in average. Hence, the same width as these are applied to the width of the approach roads in the study.

This width composition meets the requirements stipulated in the Road Design Manual by the Department of Works.

(2) Bridge Width

The standard width of the bridges along the Highlands Highway is as follows:

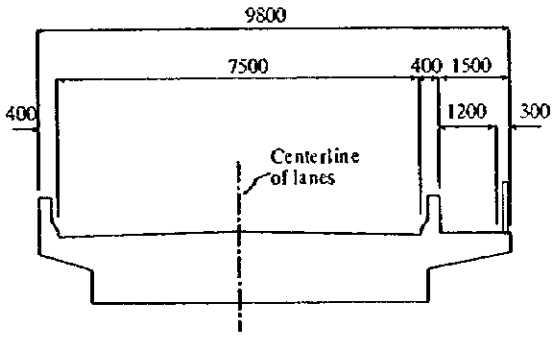


In addition to this fact, the following two factors are considered to determine the bridge width in the study.

- In the recent bridge projects, concrete barrier walls are provided at the lane edge to ensure pedestrian's safety from reckless drivers and to prevent falling vehicles from the bridges.

- 12 hour pedestrian count survey carried out in the study indicates the small number of pedestrian which are only 131. This inturn concludes provision of sidewalk at only one side.

Based on the these situations, the width composite of the new bridge is proposed as shown below:



2.2.8 River Structure

Based on the field inspection at the site, it seems that the river bank protection and spurdyke (groyne) are required to protect the new abutments and to properly re-align the main water course respectively, as a

part of the river training work requested.

The river bank protection around the new abutments which is requisite shall be incorporated in the basic design but installation of the spurdyke is deleted from this project based on the following reasons:

- Long term effect due to installation of the spurdyke is not expected because of the further river bed aggradation.
- Because of extensively eroded area where a series of spurdykes are required, a huge amount of the construction cost which is likely more than the bridge cost is required.

2.3 Basic Design

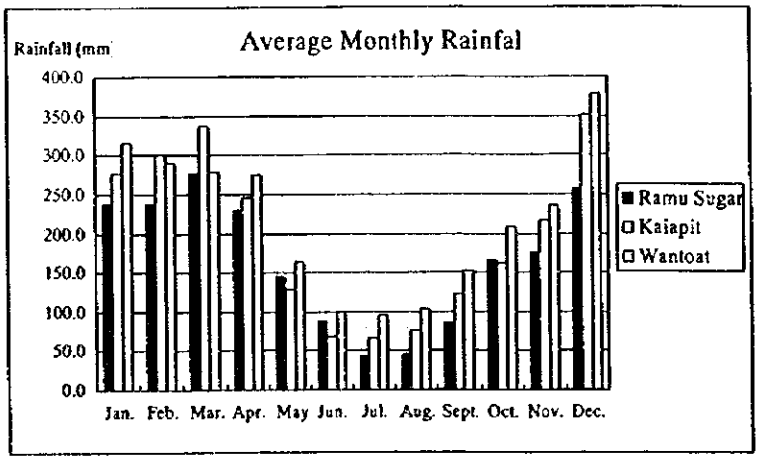
2.3.1 Basic Concept

(1) Natural Conditions

1) Rainfall Pattern

The rainfall data obtained from the agencies concerned are as follows:

- Monthly and yearly rainfall (1953 - 1971) at Kaiapit (About 10 km toward south-east from the site, elevation of 303 m)
- Monthly and yearly rainfall (1953 - 1973) at Wantoat (About 30 km toward north-east from the site, elevation of 1,158 m)
- Monthly, yearly and daily rainfall (1980 - 1996) at Ramu Sugar Factory (About 60 km toward north-west from the site)



According to this figure, it is said that the rainy season is five months period from December to April and the rest of the year (from May to November) goes under dry season.

2) Projected Aggradation

The devastating landslides in the Umi catchment due to the 1993 Finisterre earthquake produces vast sediment discharge which is still aggradating the river bed. The Geological Survey Division of the Department of Mining and Petroleum carried out the study and investigation using aerial photograph and Landsat TM images, and estimated at about 20 km^2 of the destroyed area and 500 million m^3 of the total soil and landslide debris deposited in the Umi catchment.

The study team also estimated those using remote sensing (Er-Mapper) and GIS (Arc/Info) (Refer to Appendix-5) and at 21.5 km^2 of the destroyed area which is about 3% of the total Umi catchment and 125 million m^3 of the total soil and landslide debris, which is one forth of the above estimates.

On the other hand, there is a fact based on the actual measurement of the river bed cross sections that the river bed has aggradated about 1 m one year after the Earthquake and the further 1.5 m four years after, totaling 2.5 m upto date after the Earthquake. It is therefore assumed that the further aggradation ratio per a year will be attenuated considerably.

To estimate the projected aggradation at the bridge site of the Umi river, the dynamic equilibrium theory of alluvial channels is applied and the projected aggradation is estimated at 1.8 m above the average present river bed. The lateral river bed fluctuation due to movement of the sandbars is also estimated at about 1.0 m.

3) Flood Water Depth and Free Board

Based on the Flood Estimation Manual in PNG, the design flood discharge (Q_{50}) is estimated at 1,085 m^3/sec (N = 0.045, S = 0.075) and accordingly the flood water depth is 2.3 m above the projected river bed.

The free board, which is a clearance between the girder soffit to the design high water level is estimated at about 1.5 m to be applied in the study considering the hydraulic swell head of about 0.8 m and size of the driftwood.

4) Local Scouring

Based on the comparison of scouring depth estimated by various formulas, the scouring depth applied in the study is 3.2 m.

(2) Social Conditions

The social conditions to be considered in the study are 1) Land ownership system, and 2) Public security problem in PNG.

1) Land Ownership System

From the statistics, only 3% of the whole land in PNG belongs to private and the remaining 97% are under customary land tenure to each tribe, which inturn causes difficulty of land acquisition even for public projects.

Taking into account this situation, it is one of the concepts that the project facilities shall be planned within the ROW limit of 30 m each side presently available.

2) Public Security Problem

It is difficult to say that the public security in PNG is in peace and good order. Hence, it is strongly requested to the Government of PNG to secure the safety of Japanese nationals engaged in the Project and to provide tight security against riot, insurrection, civil commotion and usurped power.

(3) Circumstances of Construction Conditions

1) Labor Conditions

In PNG, wage rate and other regulation have been stipulated in the Port Moresby Common Rule by the Department of Labor and Employment. For public servants, the General Order regulates those.

At the several construction job sites, it has been observed that local staff are assigned as operators and common labors under supervision by Australian field foremen. This personnel assignment is likely standard.

2) Procurement of Construction Materials

- Capacity of Lae Port

Lae Port, which is the largest port in PNG in terms of dry cargo handling capacity of 1,520 thousand ton and liquid bulk capacity of 590 thousand ton, has not equipped with lifting machines. Hence, the imported construction materials and equipment in the project will be unloaded by a crane equipped with the vessels or temporally mobilized crane from the out side.

- Cements

Only normal portland cement being produced by the Halla Cement Factory at Lae City is available locally for the project. It is noted that importing cement is prohibited by the Government.

- Steel Plates and Reinforcing Bars

Steel plates, reinforcing bars and secondary steel products such as steel pipes, wire meshes, corrugated metal pipes, angle bars, etc. are mostly imported form either Australia or New Zealand.

- Sand & Gravel, Plywood, and Timber

Plywood and timber required for the form works are available at Lae City, while sand & gravel with acceptable quality are also available near the job site.

3) Procurement of Construction Equipment

Some construction equipment such as bulldozers, dump trucks, truck cranes, generators, etc. owned by local contractors (Australian or New Zealander local subsidiary) are available but the long term rental rate of these are not available and should be

on a negotiation basis. Construction plants such as concrete batching plants and crashing plants are not available locally.

(4) Applicability of Local Contractors

Local contractors, who are mostly Australian or New Zealander local subsidiary, should participate the project as sub-contractors of Japanese constructor. It is important that technology of the caisson construction and quality control be transferred to the local contractors through the joint operation.

(5) Capability of Executing Agency for Maintenance and Operation Works

The Department of Transport and Works (DOTW) is responsible for operation and maintenance of the roads and bridges under the National Highways, and is the counterpart agency for the Study and the project implementation. It seems obvious that DOTW faces shortage of fund for the construction and maintenance of roads and bridges, and has not enough experienced middle class local engineers.

It is important to have the DOTW recognize the needs of periodical maintenance after the completion of the project, and to enhance local engineer's technical and managerial capability on the job-training during the project implementation.

(6) Construction Schedule

The construction schedule is formulated considering the following factors:

- Rainfall pattern (dry and rainy seasons) at the job site,
- Period required for the materials and equipment procurement,
- Custom clearance situation at Lae Port,
- Possible field works and appropriate construction method during rainy season,
- Safety measures, and
- Public security problems in PNG.

The construction works are divided into two (2) fiscal years as summarized below:

The first year
- Mobilization
- Demolition of collapsed bridge
- Installation of temporary jetty
- Construction of Pier 1 and Abutment 1
- Procurement of steel plates
- Fabrication of steel bridge
- Installation of river bank protection (Lae side)

The second year
- Construction of Pier 2 and Abutment 2
- Transportation of steel bridge members
- Erection of steel bridge
- Deck slab work
- Installation of incidental facilities
- Construction of approach roads
- Installation of river bank protection (Wataris side)
- Removal of existing bridge
- Demobilization

2.3.2 Basic Design

(1) Whole Scheme

The whole scheme of the project is outlined as follows:

- Bridge location	:	The centerline of the new bridge is located in parallel with the existing at the down stream side 15 m apart from the centerline of the existing bridge.
- Total bridge length	:	160.0 m between the backwalls.
- Bridge type	:	3 spans continuous plate girder bridge
- Span length	:	54.5 m + 50.0 m + 54.5 m
- Abutment	:	Rectangular wall type, H = 8.6 m
- Pier	:	Rectangular wall type, H = 8.8 m
- Foundation	:	Oval shape caisson • Abutment - 13 m x 7 m x 11 m (depth) • Pier - 10 m x 7 m x 10.5 m (depth)
- Approach road length	:	285 m (Lae side) 285 m (Wataris side)
- Bridge width	:	9.8 m (7.5 m of lane width and 1.5 m sidewalk)
- Road width	:	10.5 m (6.5 m of lane width and 2.0 m of shoulder each side)
- Finished grade elevation	:	375.100 (which is 3.8 m higher than that of the existing)
• Structural depth	:	3.0 m in total

- Girder soffit elevation : 372.100
  - Free board : 1.5 m
- Design flood elevation : 370.600
  - Flood water depth (Q_{50}) : 2.3 m
- Projected river bed elevation : 368.300
  - Projected sediment depth : 1.8 m
- Present river bed elevation in average : 366.500
  - Sediment depth up to date after the 93 earthquake : 2.5 m
- Average stable riverbed elevation in future : 364.000

(2) Design Condition

1) Applicable Design Standard

In principle, the specification for Highway Bridge by the Japan Road Association is applied for the bridge design except those due to local conditions such as thermal and seismic effects.

2) Geometric Criteria

Referring to Part 2 of the Road Design Manual by the Department of Works, the following geometric criteria are applied in the Study.

Geometric Elements	Applicable Criteria	Remarks
- Road classification	National Highway	
- Design speed	Mini. 80 km/h	Traffic category is heavy (400 vpd)
- Horizontal curves	Desirable R = 340 m Minimum R = 250 m	
- Min. curvature length	140 m	V = 80 km/h
- Gradient	General max. 6% Absolute max. 8%	
- Crossfall	3%	Sealing Surface
- Super elevation	Max. 7%	When radius is less 300 m and more than 100 m
- Super elevation transition length	65 m	When V = 80, Wh = 6.5, SR = 0.075
- Number of lanes	one each way	
- Lane width	3.25 m wide with bituminous surface treatment	
- Shoulder width	2 m wide	As same as the existing

3) Design Flood Level, Projected Aggradation & Free Board

- Design Flood Level
  With the return period of 50 years, the flood level is estimated at 2.3 m depth under the peak run-off discharge of 1,085 m^3/sec (Q_{50}).

  It is noted that the return period of 100 years (Q_{100}, H = 2.7 m) which is the requirement in PNG is not applied as mentioned in 2.2.5.

- Projected Aggradation
  As described in 2) of 2.3.1 Basic Concept, the riverbed aggradation of 1.8 m depth is applied in the Study.

- Free Board
  The free board of 1.5 m is applied.

4) Applicable Live Load

Based on the composition of the bending moment with the live loads (T44 & L44 loadings) in 92 Austroads Bridge Design Code and those (A and B Loadings) in the Japanese Bridge Standard (Refer to Appendix-5), it is decided that B-Loading in the Japanese Specification is applied in the study based on the following reasons:

- The bending moment at a span center due to the B-loading is about 14% heavier at a span length of 50 m than that due to the L44 loading.

- It has been reported that the number of heavy vehicle passing on the Highlands Highway is high ratio (22%) of the total traffic volume and most of them have been overloaded.

However, the heavy load platform loading specified in the Austroads Bridge Code shall not apply.

5) Seismic Load

In accordance with the Earthquake Engineering for Bridges in Papua New Guinea, 1985 Revision, static lateral load coefficient of

0.25 is applied in the Study.

6) Local Souring Depth

The local scouring depth of 3.2 m is considered in the stability analysis of substructure of the Study.

7) Thermal Effect

The effective temperature gradient shall be ±10°C in the Study.

8) Log Impact

The forces due to log impact shall be calculated in accordance with Article 2.10.6 of the Austroads Bridge Code.

9) Unit Weight of Materials

The unit weight of materials applied in the Study is as follows:

Steel	:	77 KN/m^3 (7,850 kgf/m^3)
Reinforced Concrete	:	27 KN/m^3 (2,500 kgf/m^3)
Concrete	:	27 KN/m^3 (2,500 kgf/m^3)
Asphalt Concrete	:	22 KN/m^3 (2,300 kgf/m^3)

10) Material Strength

- Superstructure

• Structural Steel		Mini. Yield Point	Mini. Tensile Strength
SS400	(t < 16 mm)	245 N/mm^2	400 ~ 510 N/mm^2
SS400	(16 < t < 40 mm)	235 N/mm^2	400 ~ 510 N/mm^2
SM490Y	(t < 16 mm)	365 N/mm^2	490 ~ 610 N/mm^2
SM490Y	(16 < t < 40 mm)	355 N/mm^2	490 ~ 610 N/mm^2
SM520	(t < 16 mm)	365 N/mm^2	520 ~ 640 N/mm^2
SM520	(16 < t < 40 mm)	355 N/mm^2	520 ~ 640 N/mm^2
• Reinforcing bar (SD295A)		295 N/mm^2	440 ~ 600 N/mm^2
• Concrete (28 days)		23,500 KN/cm^2 (240 kgf/cm2)	

- Substructure

• Concrete (28 days)	20,600 KN/cm2 (210 kgf/cm2)	
	Mini. Yield Point	Mini. Tensile Strength
• Reinforcing bar		
For column (SD345)	345 ~ 400 N/mm^2	490 N/mm^2
For others (SD295A)	295 N/mm^2	440 ~ 600 N/mm^2

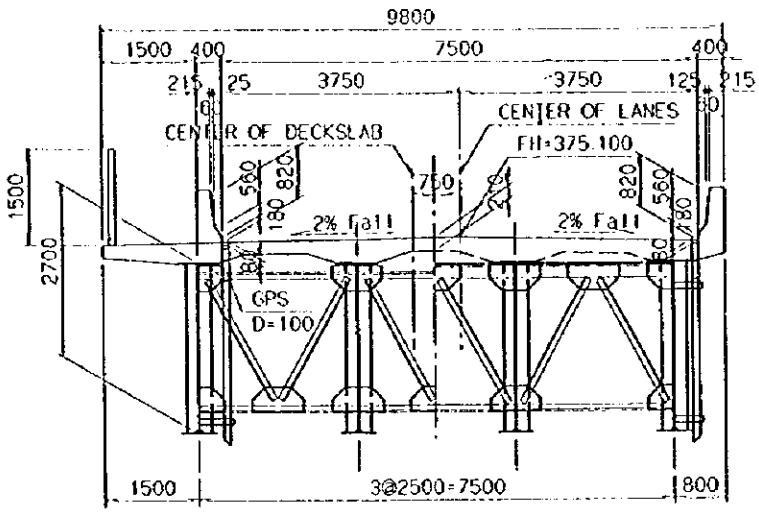
(3) Contents of Basic Design

Based on the whole scheme formulated and the design conditions applicable to the study, the basic design of the superstructure, substructure, approach roads and river bank protection is carried out and the design results are as follows:

1) Superstructure

Considering the girder height and the flange width & thickness to be unified, the girder arrangement was assessed and it is designed that the interval of girder is 2.5 m and cantilever lengths of the deck slab at the side walk is 1.5 m and 0.8 m for the carriageway side.

The configuration of the superstructure is depicted in below.



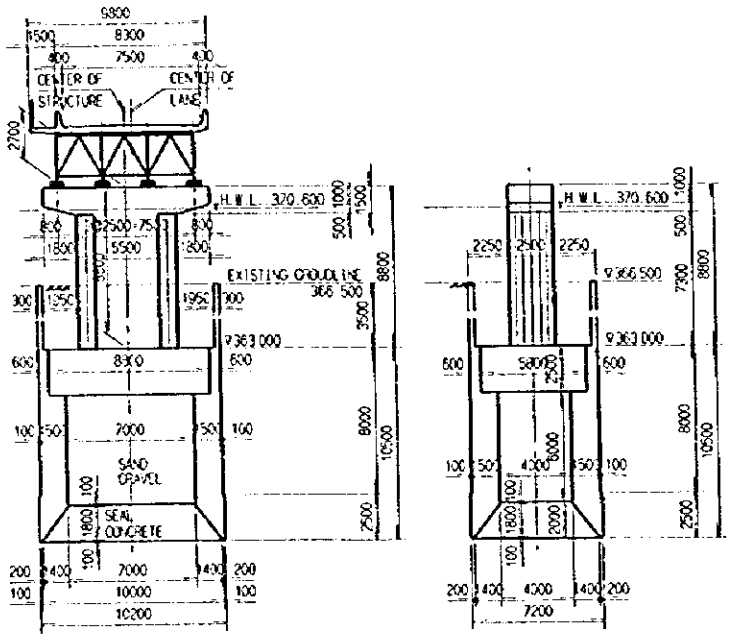
2) Substructure

- Pier design

Taking into account the further lowering the river bed up to

the stable condition at EL. 364.000 resulting from the longitudinal fluctuation and the lateral river bed fluctuation estimated at 1.0 m, top of the caisson i.e. bottom of the pier wall is set at EL. 363.000 which is 1.0 m below the stable river bed or 3.5 m below the present river bed.

In the stability analysis of caisson, the design ground level, which is set at 3.2 m below the stable river bed or 2.2 m below the top of caisson, is applied considering the local scouring depth of 3.2 m from the stable river bed. The configuration of pier rested on the caisson foundation is depicted in below:

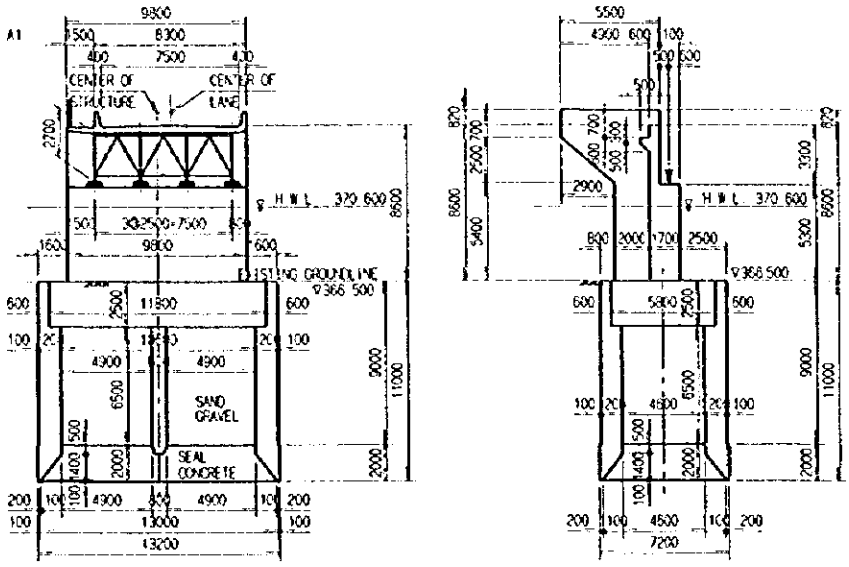


- Abutment design

In the abutment design, the top of caisson is set at the present river bed elevation of EL. 366.500 based on the following two reasons:

- The abutments have been protected by the flexible revetments made by wire mesh gabions.
- It is expected that the revetment will be also settled becaused of the flexibility together with lowering the river bed at the same time.

However, the design ground level applied in the stability analysis of caisson is set at the same as the stable river bed elevation of EL. 364.000 considering possibility of the revetment washed out or severe local scouring. The configuration of abutment with the caisson foundation is depicted in below:



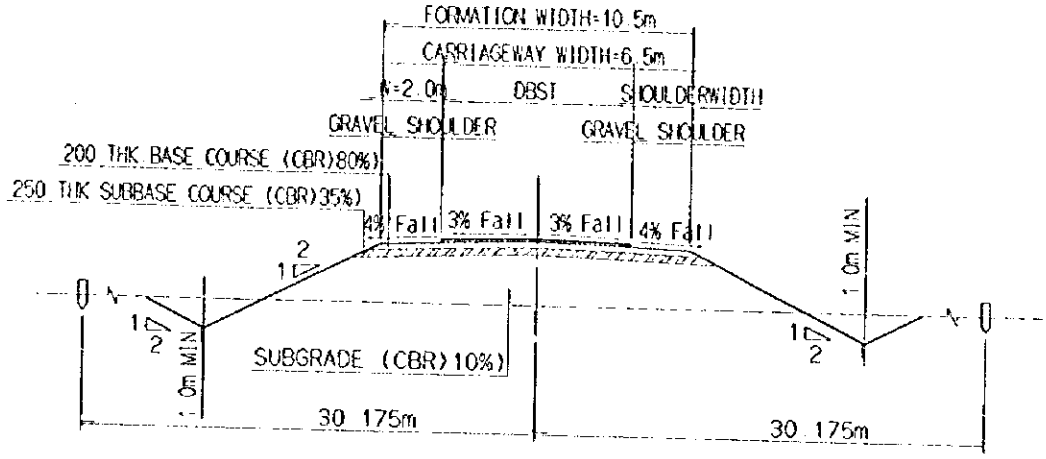
3) Approach Roads

The compositions of width and pavement applied in the study are the same as those of the existing one.

The horizontal curves applied in the study (R = 1,290, R = 1,320) are determined resulting from meeting the requirement of mini. curve length of 140.0 m, because of close distance of 15.0 m between the new and old centerlines.

The max. gradient applied in the study is 3.7% to meet the site conditions.

The typical cross section of the approach roads is shown in below:

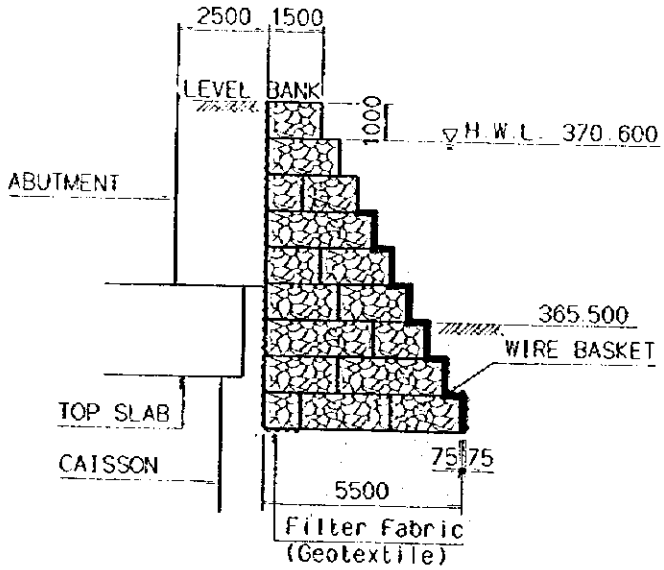


4) River Bank Protection (Revetment)

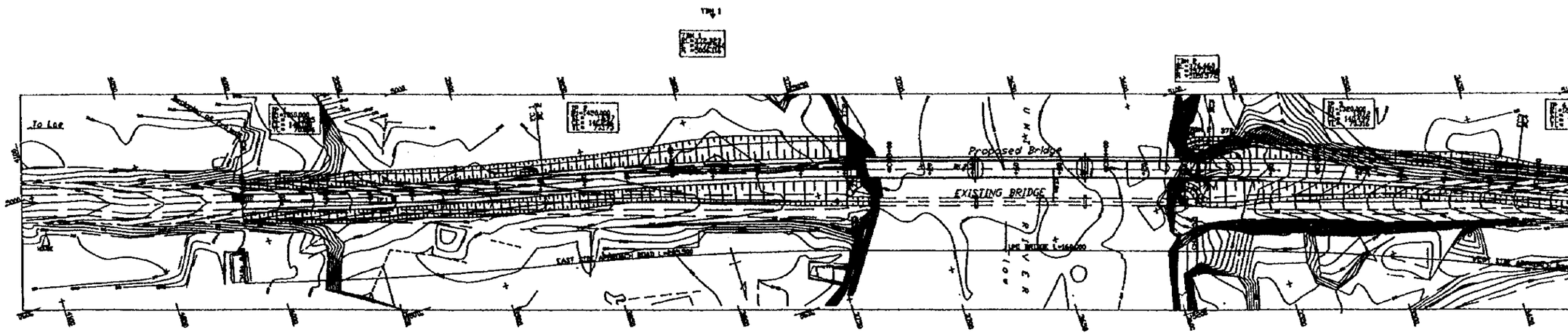
Referring to the River Training Manual by the Department of Works, the river bank protection for both abutments is designed and wire mesh gabions are applied based on the following reasons:

- Wire mesh gabions are commonly used in PNG.
- Wire mesh gabions which are flexible can cope with lowering the river bed.

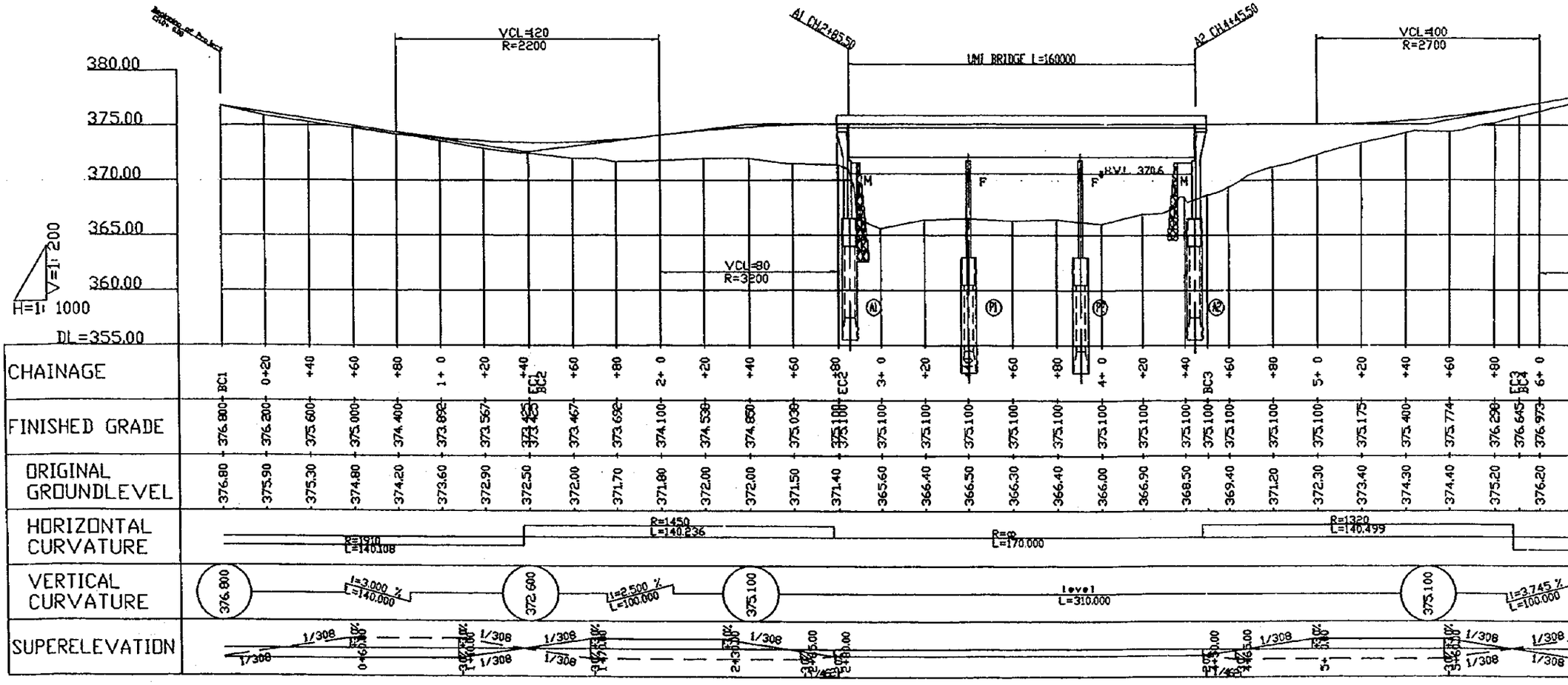
In the design, weak points of the gabions of which wires are easily ruptured by abrasion and of which backfill materials are washed away have been improved by provision of concrete facing at the surface and installation of geotextiles at the backside, respectively.



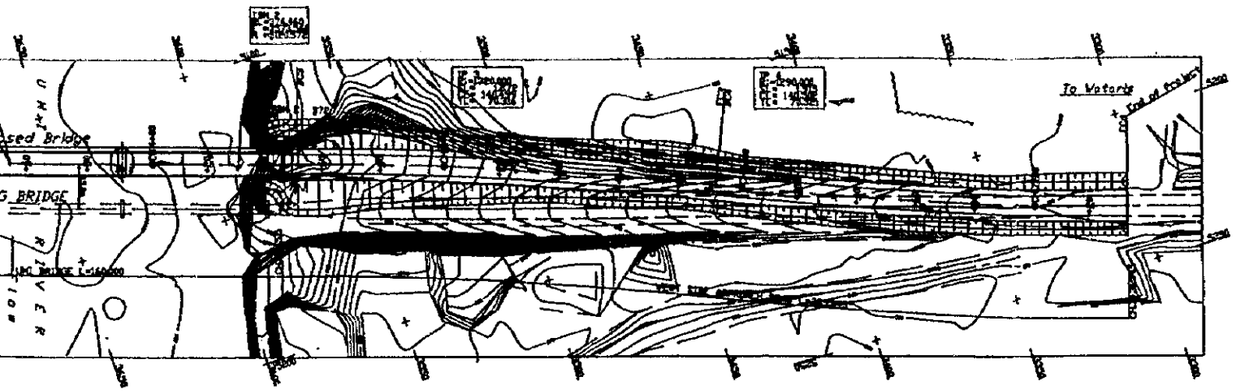
The basic design drawings consisting of the new Umi bridge and the approach roads are attached in following pages.



PLAN SCALE 1:1,000



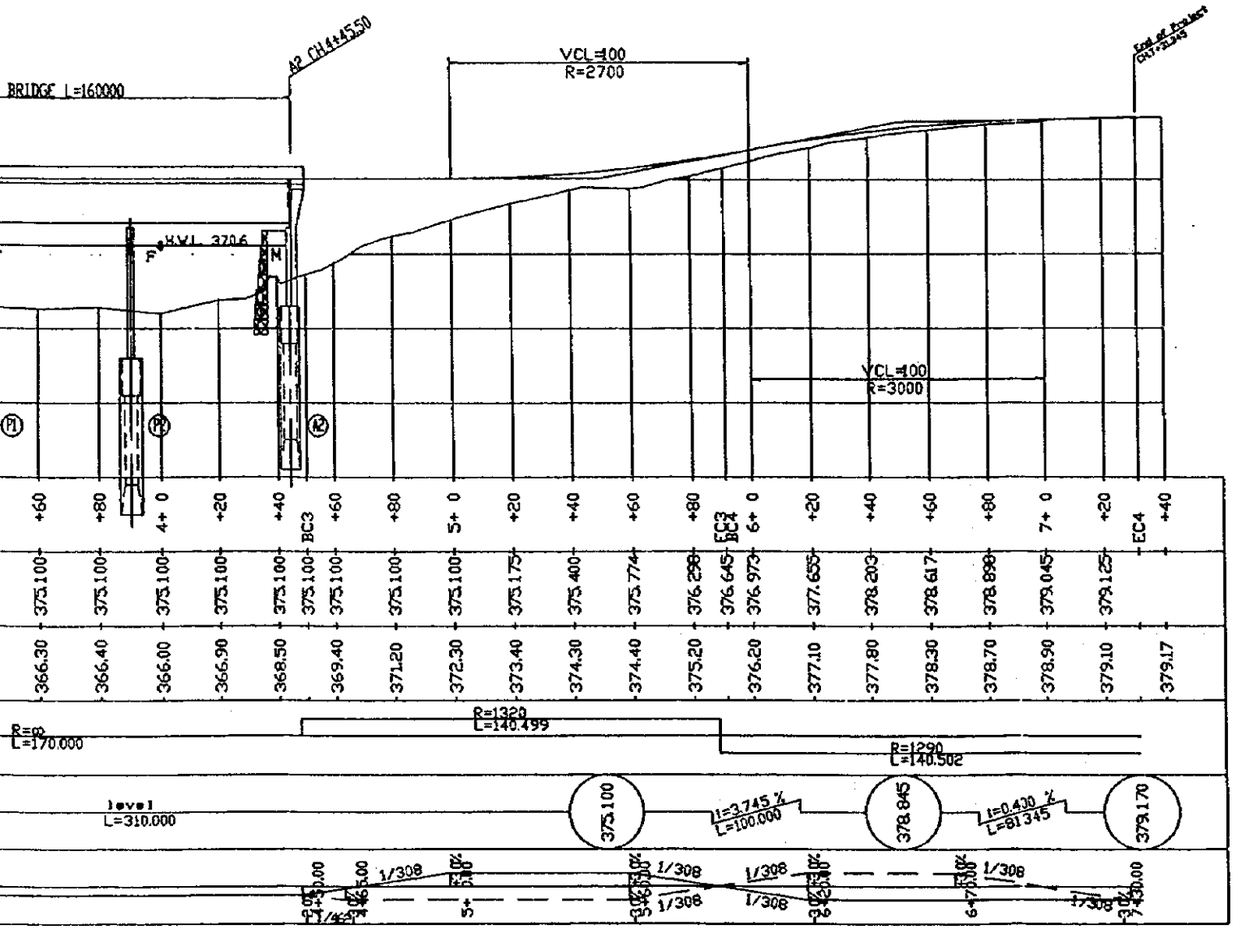
PLOFILE SCALE H=1:200 V=1:1000



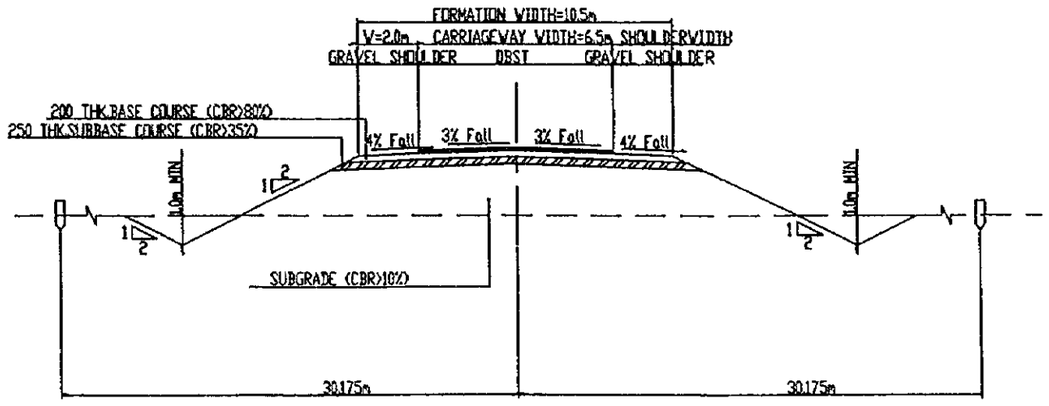
E 1:1,000

COORDINATE LIST

NAME	X	Y
B.P	5029.176143	4006.720531
IP 1	5046.969091	3938.931157
IP 2	5072.538655	3801.023478
IP 3	5158.356842	3502.630242
IP 4	5211.367303	3372.366865
E.P	5230.636213	3304.737768



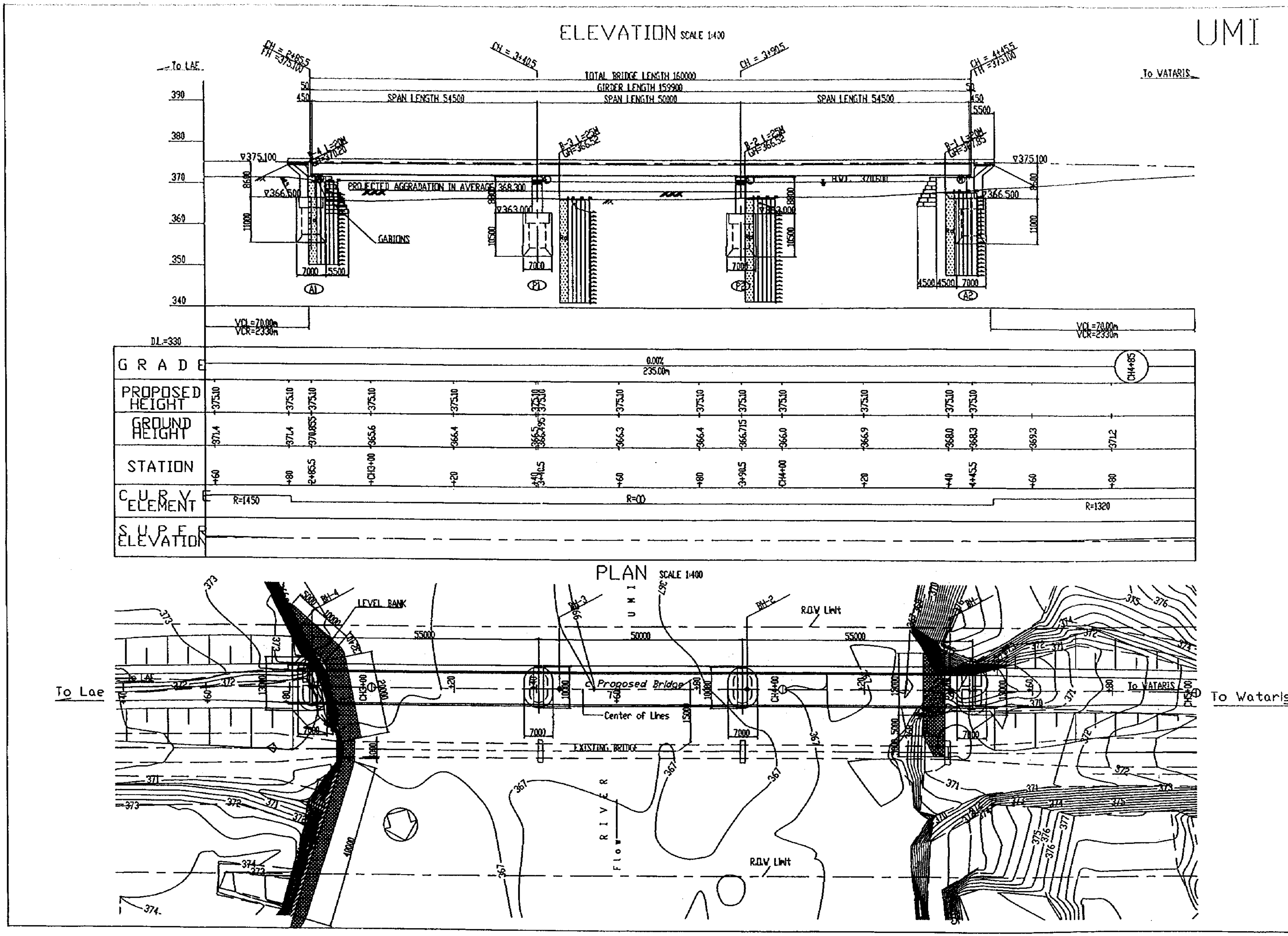
SCALE H= 1:200
V=1:1000



TYPICAL CROSS SECTIONS

SCALE 1:100

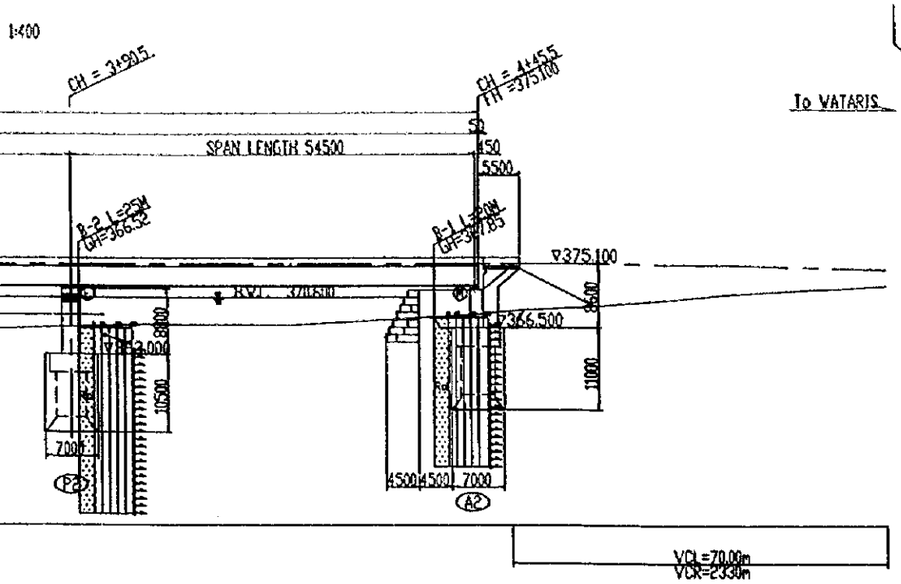
JAPAN INTERMATIONAL COOPERATION AGENCY	THE PROJECT FOR RECONSTRUCTION OF UMI BRIDGE ALONG THE HIGHLANDS HIGHWAY	PLAN AND PLOFILE OF ROADS	SCALE AS SHOWN / DWG.No.

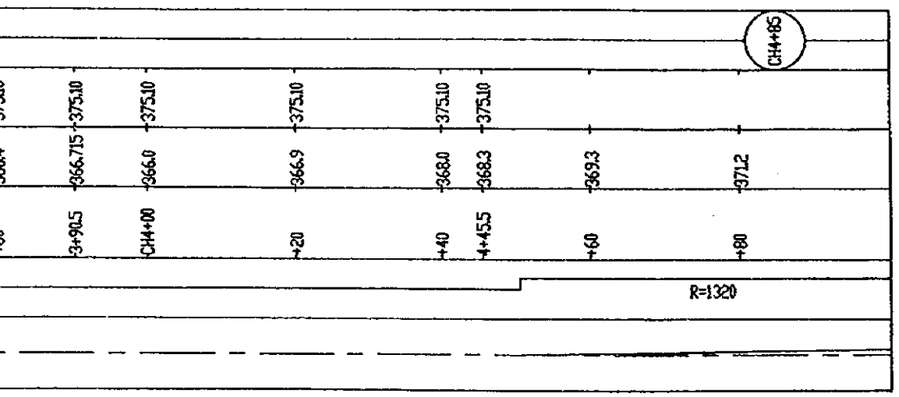


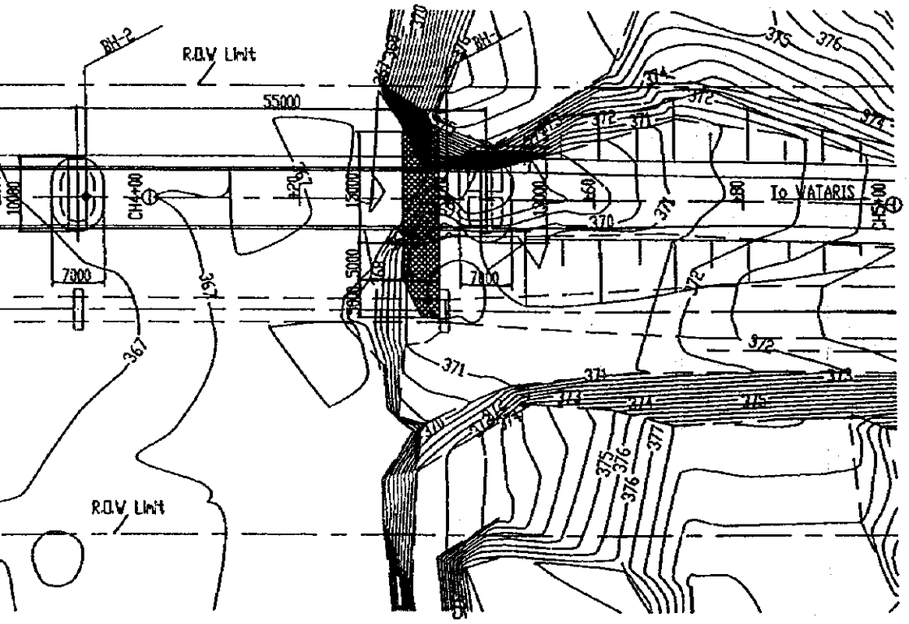
UMI
ELEVATION SCALE 1:400
To LAE
To VATARIS
CH = 2+85.5
FH = 375.100
CH = 3+40.5
CH = 3+90.5
CH = 4+45.5
FH = 375.100
TOTAL BRIDGE LENGTH 160000
GIRDER LENGTH 159900
SPAN LENGTH 54500
SPAN LENGTH 50000
SPAN LENGTH 54500
PROJECTED AGGRADATION IN AVERAGE 368.300
H.W.L. 370.600
GABIONS
▽375.100
▽366.500
▽363.000
A1
P1
P2
A2
VCL=70.00m
VCR=2330m
D.L.=330
GRADE
0.00%
235.00m
CH4+85
PROPOSED HEIGHT
GROUND HEIGHT
STATION
CURVE ELEMENT
R=1450
R=∞
R=1320
SUPER ELEVATION
PLAN SCALE 1:400
To Lae
To Wataris
LEVEL BANK
R.O.W Limit
Proposed Bridge
Center of Lines
EXISTING BRIDGE
RIVER
Flow
UMI

UMI BRIDGE

1:400

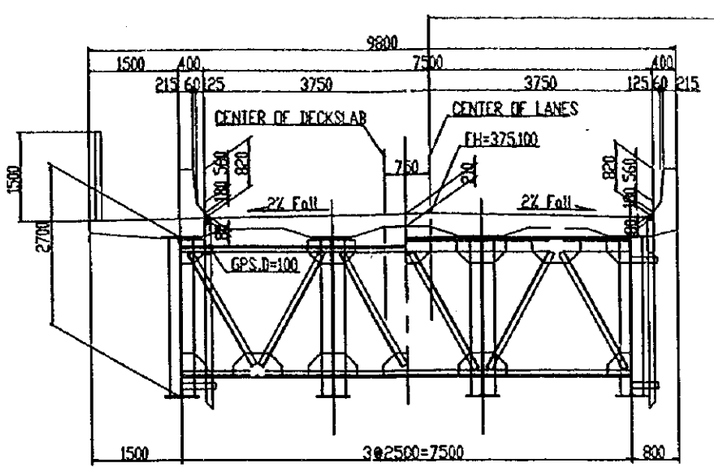




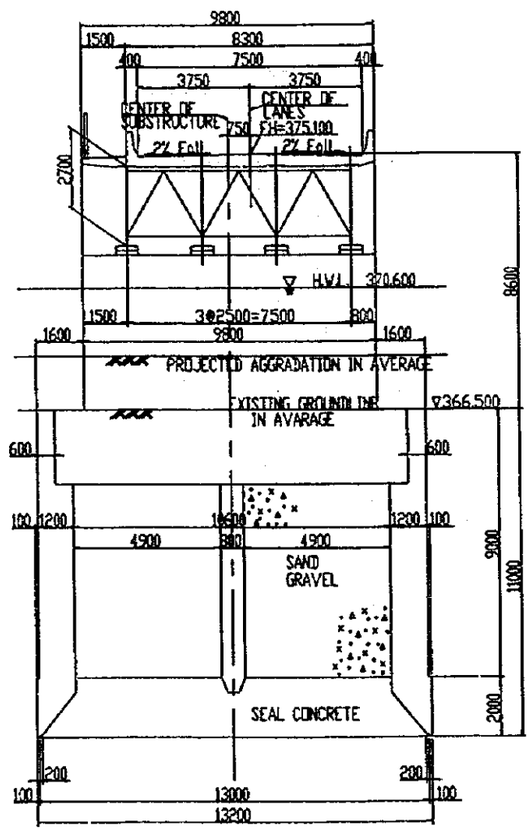


To Wataris

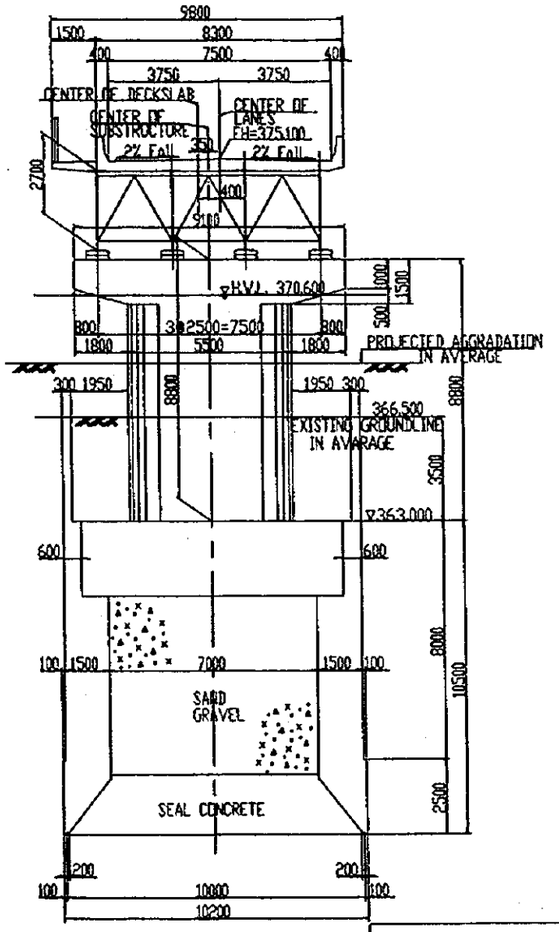
SECTION SCALE 1:50



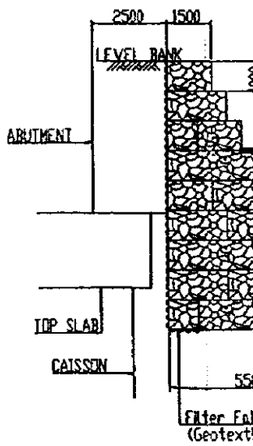
SECTION (ABUT) SCALE 1:100



SECTION (PIER) SCALE 1:100



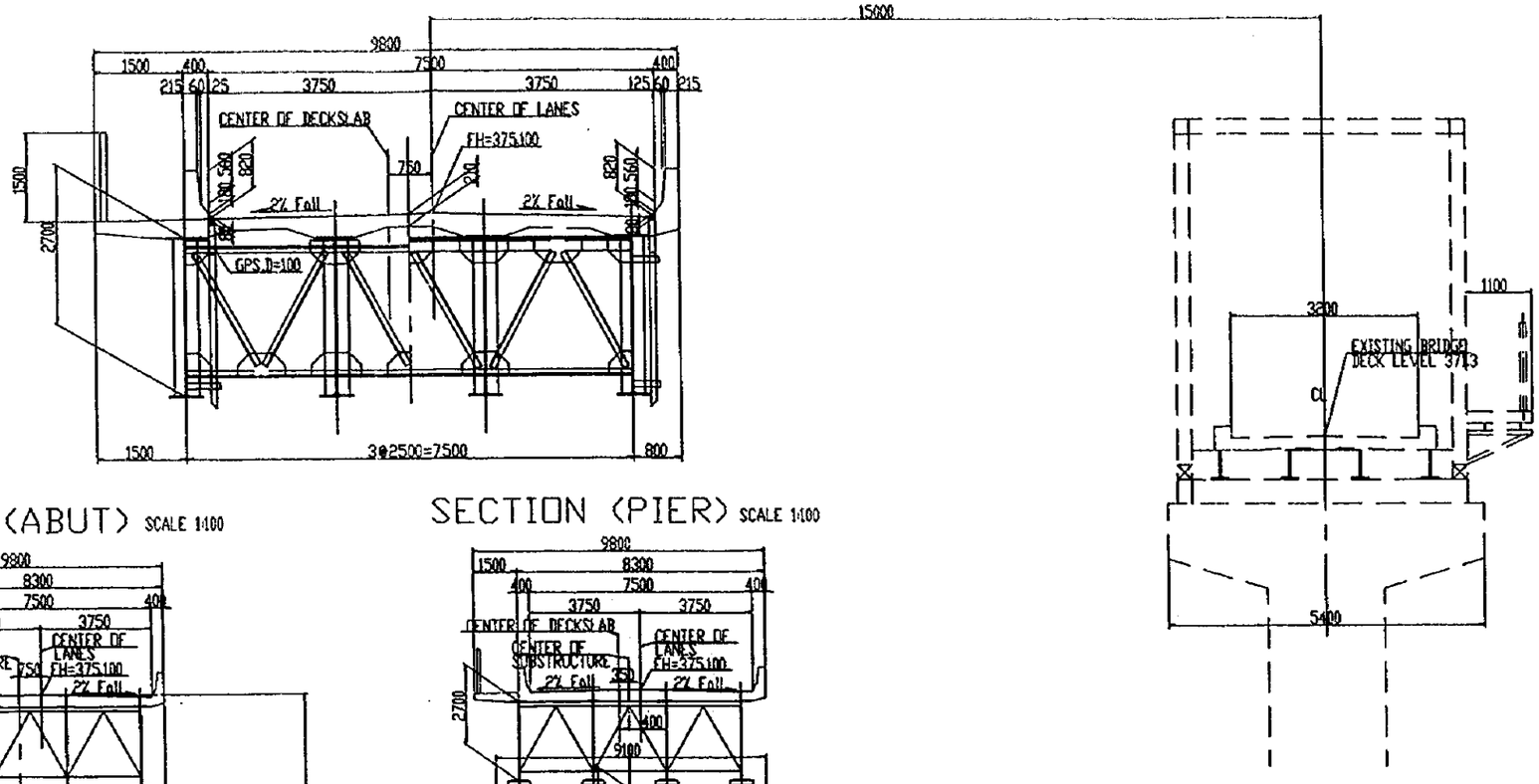
A1



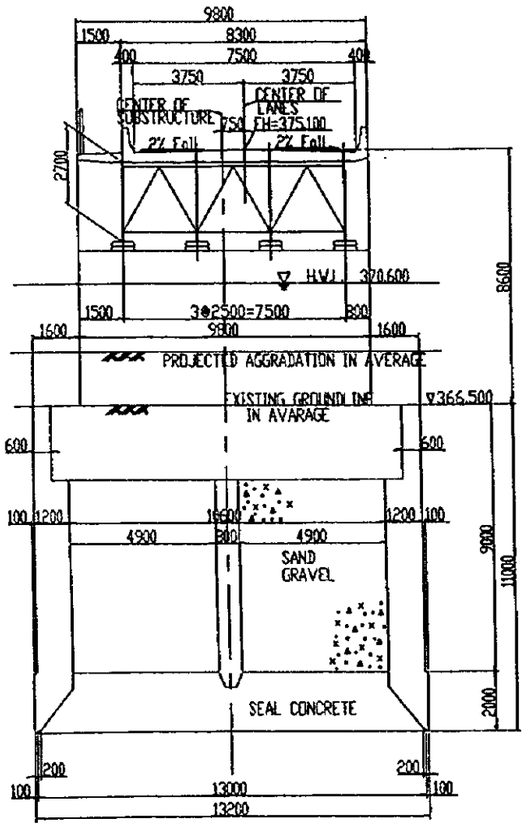
JAPAN INTERMATIONAL COOPERATION AGENCY	THE PROJECT FOR UMI BRIDGE ALON

BRIDGE

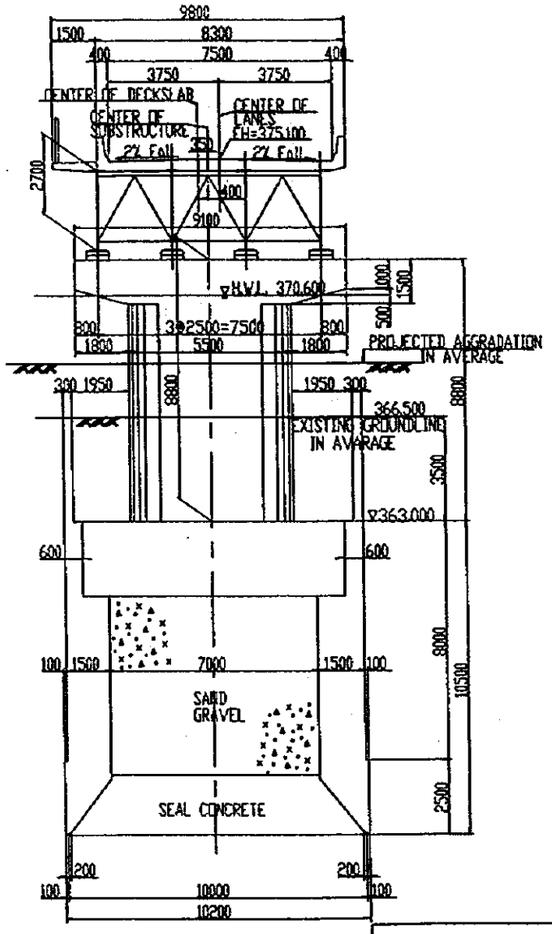
SECTION SCALE 1:50



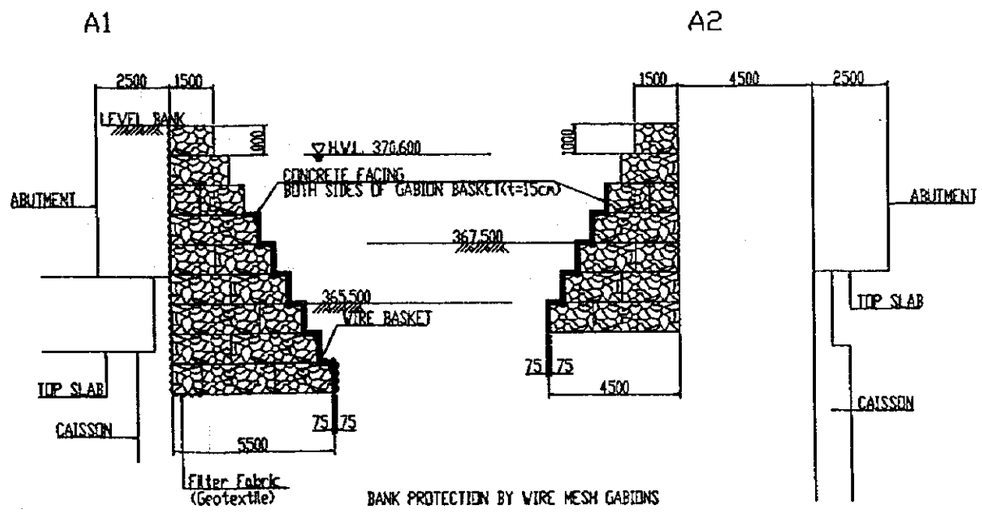
SECTION (ABUT) SCALE 1:100



SECTION (PIER) SCALE 1:100



DETAIL SCALE 1:100



JAPAN INTERMATIONAL COOPERATION AGENCY	THE PROJECT FOR RECONSTRUCTION OF UMI BRIDGE ALONG THE HIGHLANDS HIGHWAY	GENERAL VIEW	SCALE AS SHOWN	DWG.No.

3. IMPLEMENTATION PLAN

3.1 Implementation Plan

The Department of National Planning & Implementation (DNPI) is responsible for the administrative matters of the project implementation and the Department of Transport and Works (DOTW) is responsible for the technical matters of the project implementation. Hence, the DNPI shall engage in the coordination, adjustment, preparation, and etc. of the administrative matters on the Grant Aid and technical cooperation agreed between two countries. While the DOTW shall be responsible for management, supervision and maintenance of the Project.

A Japanese consultant will involve in the following services as the Engineer on behalf of the Government of PNG.

- Detailed engineering design including preparation of the tender documents,
- Pre-construction activities for the prequalification and tendering, and
- Construction supervision

A Japanese contractor to be selected by open tender according to the Japan's Grant Aid system shall undertake the construction in accordance with the work program and schedule of the project.

The contractor should be responsible for maintenance of the completed works until the final acceptance.

3.1.1 Implementation Concepts

Taking into account that the project will be implemented under the Japan's Grant Aid Scheme, the implementation concepts are established as follows:

- Maximize the procurement of local labors, materials and equipment in PNG so as to increase employment opportunities, to facilitate technology transfer and to provide positive impact to the local economy.
- Establish good communication among the Government of PNG, the consultant and the contractor for the project implementation as smooth

as possible.

- Prepare a practical construction plan taking into account the local rainfall pattern, period required for materials and equipment procurement, application of appropriate construction methods.

- Establish safe camp and plant yard, and program secured the operation plan considering the present public security in PNG.

3.1.2 Implementation Conditions

Special considerations for the project implementation are as follows:

- Labor Low

  The contractor shall administer labors properly under adequate safety control and prevent conflict with local labors in accordance with the prevailing government laws in PNG.

- Tight Security at Job Site

  Special security measures to be provided by the Government agency concerned shall be requisite to secure the project personnel and properties.

- Religious and Local Restriction

  Besides national and public holidays, there are religious or local traditional holidays in PNG. These activities shall be taken into consideration in estimation of the workable days.

- Custom Clearance

  All the project equipment and materials imported from Japan and the third countries will be unloaded at Lae port which is the most important accounting for about 37 percent of the total cargo handling in PNG. Thus, close cooperation and assistance from the Lae Harbor Boards is indispensable in the unloading and custom clearance in order to complete the mobilization on a timely manner.

- Caisson Excavation

  The most difficult field work which possibly causes delay is caisson

excavation under the water in the dense sand and gravel with boulders. The contractor should mobilize enough equipment and drain facilities such as hydraulic clam shells, submersible pumps, backhoe with long arm and drain pits to ensure the construction schedule.

3.1.3 Scope of Works

The scope of works for which the Japanese Government and the Government of PNG are respectively responsible are as follows:

(1) Works and Facilities to be Provided by Japanese Government

- Removal of the existing Umi bridge and the collapsed steel truss bridge deposited in the river.
- Construction of the new Umi bridge with the incidental facilities such as drainage, expansion joints, railings and concrete barriers,
- Construction of the approach roads with miscellaneous facilities such as traffic sign boards, lane markers and drainage,
- Construction of the river bank protections by wire mesh gabions,
- The temporary construction facilities such as camp & plant yard, and temporary road, and
- Others such as transportation of the construction materials and equipment from Japan and the third countries to PNG and the consulting services.

(2) Works and Facilities to be Provided by the Government of PNG

- Installation of traffic sign boards of load and speed limitation, and grantry barrier for vehicular clearance in order to ensure the safety of the existing bridge until the completion of the new bridge.
- Provision of tight security in and around the construction camp and plant yard, and during transportation of the materials and equipment.
- Payment for banking services

- Compensation crop payment
- Environmental cost
- Land legalization and compensation

3.1.4 Consultant Supervision

(1) Schedule of the Consulting Services

The project will commence after signing an Exchange of Notes (E/N) pertaining to the engineering services for the detailed design between the Governments of Japan and PNG. The contract for the detailed design will be concluded between the DOTW and the Japanese Consultant who will provide the following engineering services within the limits of the Grant Aid.

1) Detailed Design Phase

The consultant shall carry out the detailed engineering design of the bridge and approach roads in compliance with specifications and concepts in the basic design.

- Design criteria and standard
- Design report
- Drawings
- Quantity and cost estimate
- Construction planning
- Tender and relevant documents

2) Pre-Construction Phase

After signing an Exchange of Notes (E/N) pertaining to the engineering service for the constructions supervision and the construction, the DOTW shall initiate to select a Japanese contractor who will implement the project through an open tender. The consultant shall assist the DOTW on the following tasks;

- Bid announcement
- Prequalification of contractors
- Pre-bid conference and site inspection

- Tender and the tender evaluation
- Contract negotiation

3) Construction Supervision Phase

The engineering services for construction supervision will begin after issuance of the Notice of Proceed to the contractor by the DOTW.

The consultant shall perform his duties in accordance with criteria and standards applicable to the construction works and shall exercise the powers vested in him as the Engineer under the contract to supervise the filed works by the contractor.

The consultant within his capacity as the Engineer shall directly report to the DOTW about the field activities and shall issue field memo or letters to the contractor regarding the various matters in terms of the progress, quality, safety and payment of the project.

(2) Staffing

1) Staffing for the Detailed Design

In the preparation of the detailed design including the tender documents, Japanese staff of the following expertise are needed;

- Team Leader
- Bridge Engineer (Superstructure)
- Bridge Engineer (Substructure)
- Highway Engineer
- Construction Planner/Cost Estimator
- Specification Writer

2) Staffing for Construction Supervision

With reference to the major field works required for close supervision during the construction period, following consulting staff are considered during the construction supervision stage:

- Team Leader
- Resident Engineer

- Material Engineer
- Foundation Specialist

(3) Construction Plan

1) Temporary Work

- Camp and plant yard

Immediately after issuance of the Notice to Proceed to the contractor by the DOTW, the contractor shall mobilize the project equipment, materials and staff. At the beginning, the contractor shall establish camp and plant yard as shown in Figure 2.1.

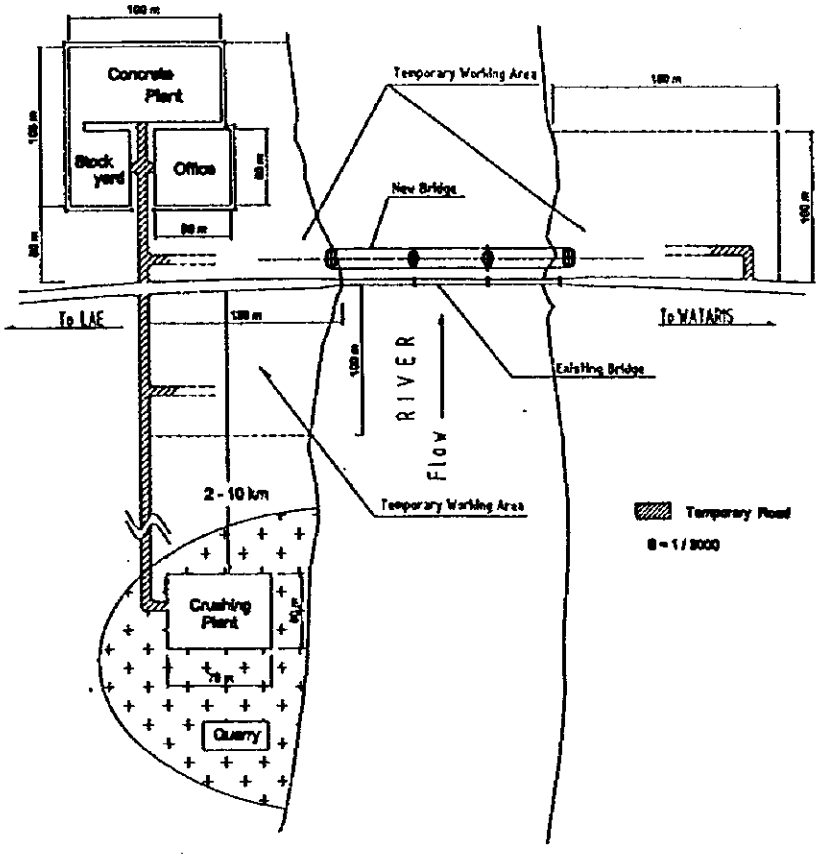


Figure 2.1 Temporary Construction Yard

Power supply

Power supply required in the field work and camp is provided with generators.

Water supply

Drinking water is obtained from a new well to be provided. For mixing and curing of the concrete in the construction, water from the river will be used after filtering.

- Demolition of Collapsed Bridge

Immediately after completion of mobilization, the collapsed bridge deposited in the river shall be demolished by the contractor.

- Diversion of River Flow

The main river flow will be diverted from Lae side to Wataris side by provision of temporary earth dikes, in order to dry the site in the vicinity of abutment A_1 and pier P_1.

- Installation of Temporary Access Road in the River

To provide temporary access from the lift bank to pier 1 through abutment 1, the temporary access road, which will be located at 26 m down stream from the existing bridge, will be provided using embankment fill with a width of 8 m.

2) Construction of Substructure

- Caisson construction

The caisson which is the foundation of the pier and the abutment will be constructed applying a segmental method. One lot (segment) length is about 2.5 ~ 3 m and the work sequence of the lot is as follows:

Leveling of casting bed → Installation of forms → Setting rebars → Pouring concrete → Curing concrete → Excavation of inside caisson by backhoe, clamshell with drainage facility → Sinking caisson

In the caisson excavation, it is assumed to be able to excavate the soil inside the caisson under dry condition with enough drainage facilities.

After completely sinking the whole caisson, the seal concrete is poured and subsequently sand and gravel with compaction is provided inside the caisson.

- Construction of wall pier shaft and abutment shaft

On the top slab of the caisson, supporting and scaffolding will be provided with the forms for the shaft. Meantime, the reinforcing bars which have been cut and bent will be installed. After these works have been completed, the concrete (210 kgf/cm^2) is poured by the pump with application of vibrators, and curing the concrete by watering will follow.

After confirmation of the concrete strength reaching 70% of 210 kgf/cm^2, about 7 days after the pouring, the scaffolding, supporting and forms will be dismantled.

After completion of Pier 1 and Abutment 1, the main river flow is diverted from Wataris side to Lae side and the temporary access road from the right bank to pier 2 will be provided. The pier 2 and the abutment 2 will be constructed using the same work sequence mentioned above.

3) Construction of Superstructure

- Procurement of steel plates

After approval of the shop drawing by the consultant, the contractor can order the steel plates and shaped steels specified in the approved drawing.

- Fabrication of Steel Bridge

Based on the full scale drawings of the steel bridge, the contractor initiate to fabricate the structural members such as girders, sway bracing, lateral bracing by cutting and welding to be done by licensed welders. After completion of the fabrication, the contractor should carry out the shop assembly for the Engineer's inspection. After acceptance of the shop assembly, the contractor can pack the structural members, of which maximum length is 12 m, for the transportation.

- Transportation of Steel Bridge

  After marine transport, all the members will be unloaded at Lae port and transported on land for the job site using local trailers. During the unloading operation, it is scheduled to use cranes equipped with the vessel.

  All the way from Lae port to the job site are in acceptable horizontal alignment to accommodate the trailer with carrying the 12 m long bridge members except in two sites, before and after Leron Bridge where sharp curves are located. At these sites, shifting the rear axles by a crane will solve the problem

- Erection of Steel Bridge

  Erection method of the girders applied in the planning is firstly to install the temporary supports at splice points of the girder and secondly to launch one member of the girder by two track cranes located on the temporary access road. After launching girders and tightening the bolts, the steel members of sway bracing and lateral bracing are installed by the crane or manpower, and tightening the bolts follows. After erection of all the members, final tightening the bolts will be carried out.

- Deck Slab Work

  The supporting for the forms will be firstly installed on the lower flanges and the form work will follow. Installation of the rebars is the following work item. Pouring the concrete will be done at three (3) stages. At the first stage, the deck slab of the center span will be concreted. The side span of both sides will follow at the same time in the second stage. Finally the deck slab at the intermediate supports on the piers will be concreted. Curing the concrete will be done by watering.

- Field Painting

  The filed painting shall be done on two layers after completely cleaning the steel surface, especially of the splicing part. The 2nd layer shall be painted after completely dry of the first

layer.

- Incidental facilities

  After completion of the deck slab work, expansion joints, concrete wall barriers, handrails, drainage pipes will be installed at the same time.

4) River Bank Protection Works

During the construction of the abutment when the river flow has been diverted and the bed is in dry condition, excavation and installation of the wire mesh gabions will be executed with draining the subsurface water by submersible pumps.

The concrete facing to prevent abrasion of the wires will be also done simultaneously.

5) Approach Roads

Proper blended materials for each base and subbase courses, and proper sized and crushed aggregates for the surface treatment will be produced at the near camp yard. The river bed materials will be used for the embankment, which will be constructed with compaction on a layer by layer of 20 cm thickness.

6) Removal of the Existing Bridge

After completion of the new bridge and diverting the traffic to the new bridge, the existing bridge consisting of 2spans of steel truss and one span of baily bridge shall be demolished including the two river piers.

3.1.5 Procurement Plan

(1) Construction Materials

Sand and gravel for the concrete, crushed aggregate for DBST pavement and plywood for the form work and lumber of the supporting and form work are available locally. However, other construction materials, except bearing pads and laboratory equipment which will be procured from Japan, are recommended to be procured

in the neighboring countries.

A list of construction materials where the procurement is shown in Table 3.1.

Table 3.1 Procurement of Major Construction Materials

Item	Procured in PNG	Procured in third Country	Procured in Japan
Cement	O		
Reinforcing bar		O	
Structural Steel		O	
Gas pipe		O	
Shaped steel		O	
Paint		O	
Straight asphalt		O	
Concrete admixture		O	
Bearing pad			O
Welding lot		O	
Gabion wire	O		
Sand & Gravel	O		
Timber	O		
Plywood	O		
Gasoline	O		
Laboratory Equipment			O

(2) Construction Equipment

There are no rental companies of the construction equipment in PNG. The equipment owned by the local contractors will be lent to the Japanese contractor but the rates are likely quite high compared with those in Japan. Hence, major construction equipment with long term period required will be procured in Japan from the cost wise aspect.

The procurement of the construction equipment is shown in Table 3.2.

3.1.6 Implementation Schedule

After signing Exchange of Note for the detailed design, the project implementation will officially commence. The detailed design will take 3 months period including one (1) month site survey. After the detailed

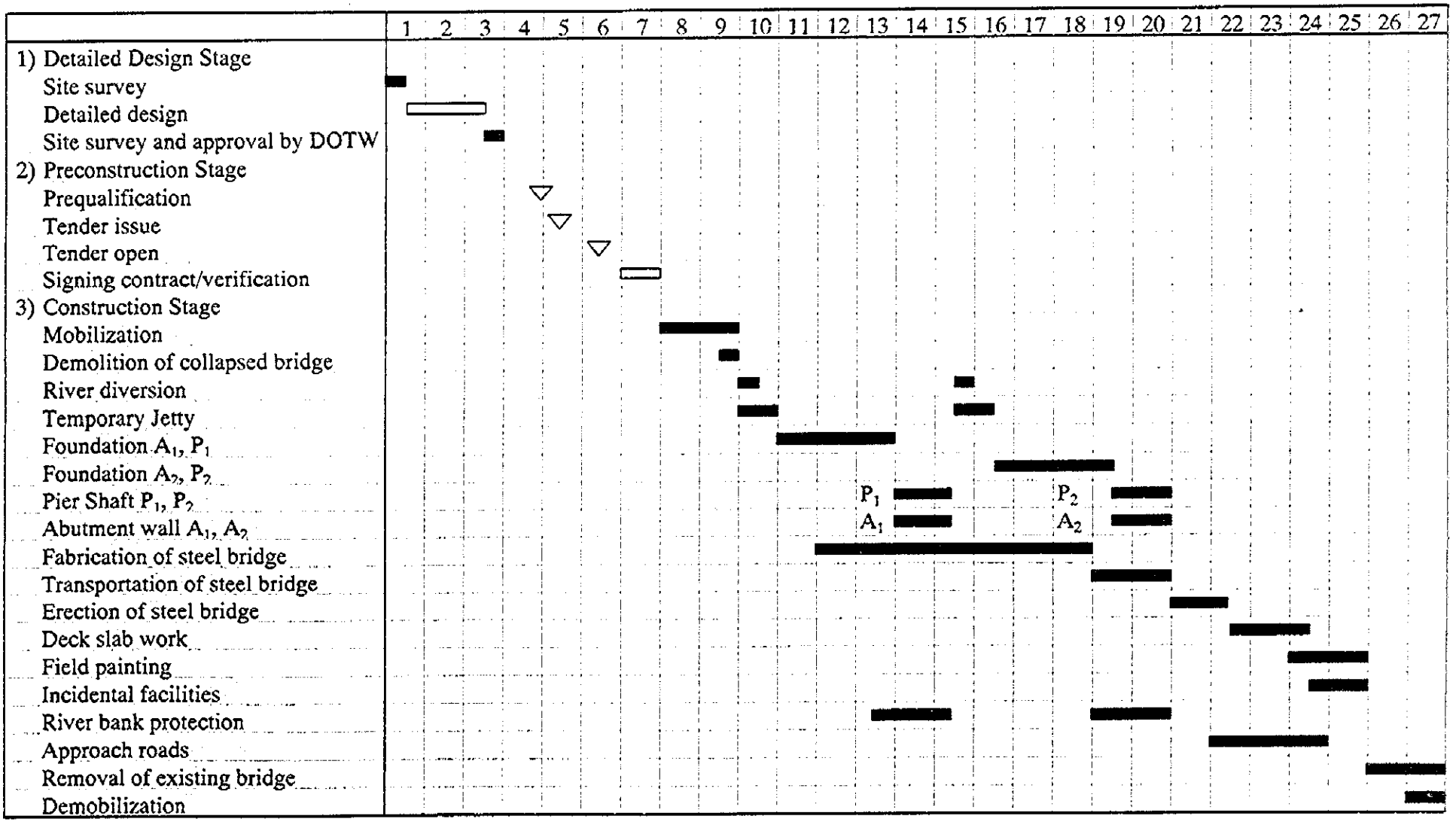
design completed, the Notes for the construction and the engineering services for construction supervision are exchanged by the two Governments, and pre-construction activities such as prequalification of the contractors, selection of the contractors, contract award, etc. will follow and take about four (4) months period.

Following those, the construction will commence and takes twenty (20) months to complete the project. The total implementation period is therefore estimated at twenty-seven (27) months as shown in Table 3.2.

Table 3.2 Procurement for Major Construction Equipment

Item	Capacity	Procured in PNG	Procured in third Country	Procured in Japan
Bulldozer	15 t			O
Pay Loader	1.4 m3	O		
Dump Truck	8 t	O		
Back Hoe w/long arm	0.6 m3			O
Vibrating Roller	3 - 4 t	O		
Road Roller	10 t	O		
Motor Grader	3.1 m	O		
Clamshell	0.6 m^3			O
Asphalt Distributor	2,000 lit	O		
Crawler Crane	50 t			O
Truck Crane	50 t			O
Truck Mixer	3 m3			O
Trailer	40 t	O		
Cargo Truck	8 t	O		
Generator	75 kVA	O		
Generator	100 kVA	O		
Air Compressor	7 m3/min			O
Welding Machine	300 A			O
Hydraulic Jack	100 t			O
Tamper	60 - 100 kg	O		
Water Pump	4" dia., 30 m			O
Water Pump	6" dia., 30 m			O
Vibrator	45 mm			O
Lane Marker	2 lit/min.	O		
Vibro-Hammer	60 kW			O
Crashing Plant	80 m3/h			O
Concrete Batching Plant	50 m3/h			O

Table 3.3 Implementation Schedule of the Project



3.1.7 Obligations of Recipient Country

The following necessary measures should be undertaken by the Government of PNG on condition that the Grant Aid by the Government of Japan is extended to the Project:

1. To provide data and information necessary for the Project.
2. To secure the land for the execution of the Project, such as land for approach road, bridge construction, working areas, storage yard, etc.
3. To clear the sites prior to the commencement of the construction.
4. To bear commissions to the Japanese foreign exchange bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commission.
5. To ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation in PNG and prompt international transportation therein of the materials and equipment for the Project purchased under the Grant Aid.
6. To exempt Japanese juridical and physical nationals engaged in the Project from customs duties, internal taxes and other fiscal levies which may be imposed in PNG with respect to the supply of the products and services under the verified contracts.
7. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into PNG and stay therein for the performance of their work.
8. To provide necessary permissions, licenses and other authorizations for implementing the Project, if necessary.
9. To maintain and use properly and effectively the facilities constructed under the Project.
10. To bear all the expenses other than those to be borne by the Japan's Grant Aid within the scope of the Project.

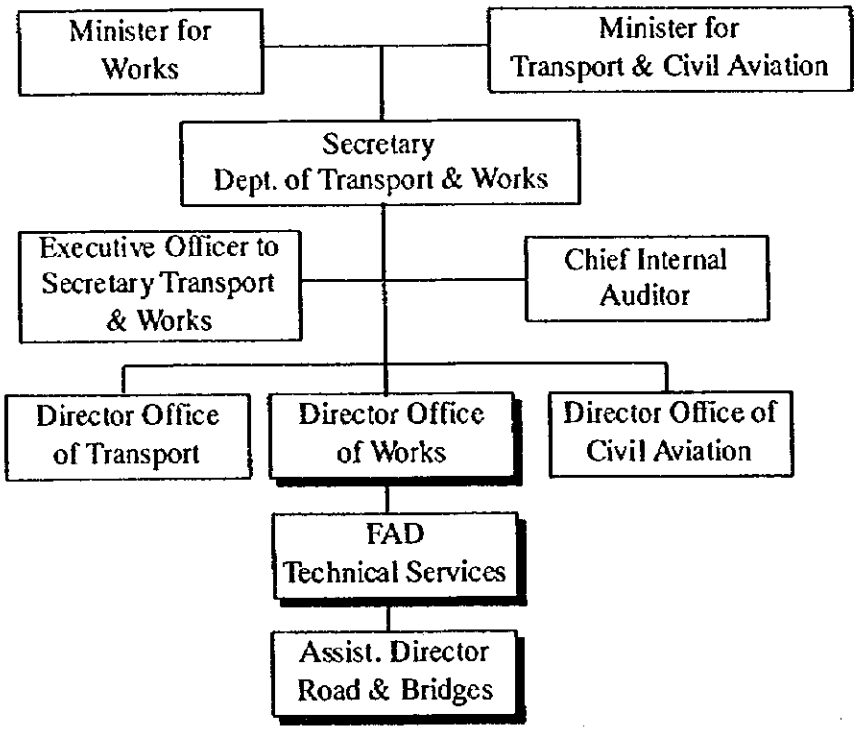
11. To coordinate and solve any issues related to the Project which may be raised from third parties or inhabitants in the Project area during implementation of the Project.

12. To secure the safety of Japanese nationals including the other personnel engaged in the Project and to provide tight security against riot, insurrection, civil commotion, rebellion, and usurped power.

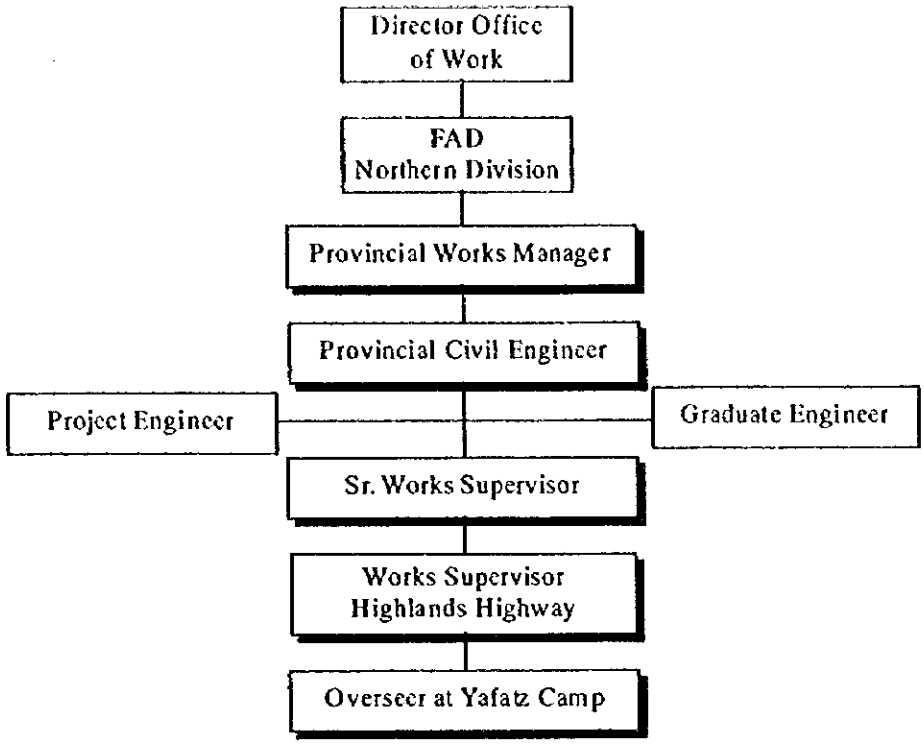
3.2 Operation and Maintenance Plan

3.2.1 Operation and Maintenance Organization

The Director of Works in the DOTW is responsible for overall operation and maintenance of the project. Under the Director of Works through the Fast Assistant Director (FAD) for Technical Services, Assistant Director of the Roads and Bridges, who is in charge of planning and designing of all the road and bridge projects in the Department, is directly responsible for the project operation as shown below:



While for the actual maintenance works after the completion of the project, the Provincial Works Manager under the Director of Works through FAD of the Northern Division is directly responsible as shown below:



The Road & Bridge Branch under the Assistant Director, which is the key branch of the project implementation, has only 3 Engineers among ten (10) positions allocated to the Branch. Among 3 Engineers, 1 Engineer is seconded from the funding agency concerned, one is on a contract basis and only one is a permanent local engineer. For those of the maintenance works, practically only one (1) overseer with six (6) casual labours under the Works Supervisor is presently available.

3.2.2 Need of Technical Cooperation

In general, the number of local government staff at a middle class are very limited in PNG and this situation is not exceptional to the DOTW, especially to the Technical Services Division that is one of the key functional divisions as mentioned earlier.

Under this situation, it is suitable opportunity to transfer various technology to the local government staff at a middle class on the occasion of the project implementation. The transfer of technology will be carried out by the following manners.

(1) Overseas Training in Japan for one trainee for the Road and Bridge Branch

- Bridge engineering technology
- Bridge planning
- Bridge design
- Construction and management of bridge projects
  Quality control
  Progress control
  Safety control
- Bridge inspection and maintenance
  Bridge inspection technique
  Bridge maintenance technique

(2) On the job Training for two trainee from the Provincial Works Department

- Construction management of the bridge project
  Quality control
  Progress control
  Safety control

- Bridge inspection and maintenance
  Bridge inspection technique
  Bridge maintenance technique

3.2.3 Operation and Maintenance Plan for Umi Bridge

After the completion of the project, following operation and maintenance with the corresponding frequency are required to keep the structures in sound conditions.

Category	Frequency	Items to be Inspected	Scope of Works
Inspection/ Maintenance for the Bridge	Once a year	Expansion Joint	Cleaning of expansion joints, photographing a damage if any.
		Drainage	Cleaning of drainage pipes, photographing a damage if any.
		Bearing	Cleaning of the bridge seats especially around the bearings.
		Handrail/Concrete Barrier	Detect a damage if any and recording and the repair work
Inspection/ Maintenance for the River Structure	Once a year after heavy flood	River bed fluctuation	River cross section survey and recording
		Local scouring and river bank structure	Detect any excessive local scouring and settlement of the bank protection
Inspection/Maintenance for the Road	Once a year	Pavement	Patching work if there are potholes
		Shoulder	Grass cutting and leveling
		Embankment Slope	Detect any surface erosion and repair
		Ditch	Removal of sediments
Periodical Maintenance for the River Structure	Every 5 year or less when requires	Local scouring and river bank structure	Installation of river bed protection around piers if required and rehabilitation of the bank protection.
Periodical Maintenance for the Bridge	Every 10 year	Steel Members	Repainting and minor repair

It is definite to fluctuate the river bed of the Umi river in a wide range, but is difficult to predict the exact bed elevation with a time frame even within a life span of the bridge. After the aggradation upto a certain level within several years period, the river bed will conversely lower due to the less sediment load. Under these conditions, the following excessive phenomena will be possibly ocured and accordingly the corresponding countermeasures should be taken place by the DOTW immediately.

Phenomena	Countermeasures
• Excessive river bed lowering under E.L. 364 .000	• Provision of river bed protection around piers by gabion mattress
• Extreme settlement or washed out of the gabion mattress of bank protection due to severe local scouring	• Reinstallation of river bank protection

It should be noted that gabion mattresses applied to the river bank protection in the project are not permanent and should be maintained properly by the DOTW, once the defects have been observed, in order to keep the bridge in a sound condition.

3.2.4 Maintenance Cost

Based on the maintenance works mentioned in the above, the periodical maintenance cost required by the DOTW is estimated at Kina 10,600 /every year, Kina 259,400 /every five year or less and Kina 138,800 /every 10 year or less.

Followings are a breakdown of the above.

Maintenance Cost in Kina

Category	Frequency	Approx. Estimated Cost
Inspection/Maintenance for the Bridge	Once a year	3,500
Inspection/Maintenance for the River Structure	Once a year	1,200
Inspection/Maintenance for the Road	Once a year	59,000
Periodical Maintenance for the River Structure	Every 5 years or less when required	259,400
Periodical Maintenance for the Bridge	Every 10 years	138,800

(Sept. 1997 price)

4. PROJECT EVALUATION AND RECOMMENDATION

4.1 Project Effect

As a result of the socioeconomic and field survey and the basic design carried out in the study, the gist of the impact and effect generated by the project implementation ,which are broadly divided into direct and indirect are as follows:

(1) Direct Impact and Effects

Present Condition and Problems	Countermeasures taken in the Study	Direct Impact and Effects
1. The most of the structural members in the Umi bridge consisting of 2 spans of steel truss bridge and 1 span of baily bridge have been severely deteriorated due to aging and inadequate maintenance. Furthermore, the design live load presently applied in PNG and the gross weight of heavy truck/trailers passing along the Highlands Highway are heavier than the design live load of the existing bridge. Hence, it can be concluded that the Umi bridge is in inadequate load carrying capacity and in dangerous condition.	The existing Umi bridge is replaced by a new modern bridge with application of B-Loading in the Japanese Bridge Design Specification.	- The maintenance cost saving derived from balance of maintenance cost for between the existing and new bridges. - Decreasing the bridge collapse probability generates socio-economic stability in the Highland regions.
2. The Umi bridge with 3.2 m of lane width is a traffic bottleneck since most of the existing bridges along the Highlands Highway have been in 2 lanes (7.5m).	It is applied in the basic design that the new Umi bridge has a dual lane of 7.5 m width which is the same width as the standard bridges along the Highlands Highway.	- Both time and operation cost saving are generated. - It is also expected to decrease traffic accident, to increase driving comfort, and to reduce drivers' physical fatigue.
3. In the absence of the sidewalk in the baily bridge, the pedestrians suffer danger in crossing the bridge.	Provision of a sidewalk of 1.5m width at one side is incorporated in the basic design.	- It is expected to reduce accidents resulting in injury or death.
4. Due to the river bed aggradation, the existing bridge opening will be inadequate. It is therefore possible to be washed away the bridge.	The bridge opening of new bridge is designed to cope with sediment depth of 1.8m, flood depth of 2.3m and 2.5m free board for drift woods.	- Decreasing the bridge collapse probability generates socio-economic stability in the Highland regions.

(2) Indirect Effects and Impact

The indirect effects and impact derived from the project implementation are likely acceleration of the agricultural and mining development in the Highland regions, improvement of the stability of production and transportation schedule, correction of regional disparties, and expansion of market spheres. Furthermore, it is expected to improve the stabilization of people's livelihood and national consciousness in the area where the public security is being aggravated.

(3) Verification of Effects and Impact

The effects and impact mentioned above are verified or measured by traffic volume and beneficiary population.

- Traffic Volume

  The daily traffic volume counted in the study in August 1997 is 549 vehicles. Based on this data, the future traffic volume is projected 983 AADT in year 2007 and 1760 AADT in year 2017 with using 6% of the annual growth rate.

- Beneficiary Population

  The total beneficiary population based on 1990 census data is estimated at about 1.7 million and the breakdown is as follows:

Name of Province	Population in 1990
Morobe	380,117
Madang	253,195
Eastern Highlands	300,648
Chinbu	183,849
Western Highlans	336,178
Enga	235,561
Total	1,689,548

4.2 Recommendation

As the existing Umi bridge is a traffic bottleneck and in a very severe and dangerous condition in the Highlands Highway , it should be replaced

urgently by a new one. This project coincides with the Government's objectives and strategies in the current National Development Plan. Moreover, it is presumed that the project would be implemented without any special problems in Japan's Grant Aid system and will be maintained properly by the DOTW after completion of the project. Considering the project scheme and the enumerated impact and effects derived from the project implementation, it is concluded that the project implementation through the cooperation of the Japan's Grant Aid Program would be very meaningful and thus its early implementation is most desirable.

Appendices

1. Member List of the Survey Team
2. Survey Schedule
3. List of Party Concerned in the Recipient Country
4. Minutes of Discussion
5. Other Relevant Data
6. References

Appendix-1. Member List of the Survey Team

(1) The First Field Survey (August 11-September 6, 1997)

Team Leader	Tetsuo YABE	Japan International Cooperation Agency, Grant Aid Project Study Department
Coordinator	Tadashi KAGEYAMA	Japan International Cooperation Agency, Training Affairs Department
Chief Consultant	Hisashi OSHIMA	Nippon Koei Co., Ltd.
Bridge Designer	Tetsu NAKAGAWA	Nippon Koei Co., Ltd.
River TrainingPlanner/ Hydrogist	Takuro TERASHIMA	Nippon Koei Co., Ltd.
Geologist	Seiju IKEDA	Nippon Koei Co., Ltd.
Construction Planner/ Cost Estimator	Seinosuke MASAKI	Nippon Koei Co., Ltd.

(2) The Second Field Survey (October 20-October 31, 1997)

Team Leader	Akira HARA	Japan International Cooperation Agency, Institute for International Cooperation
Chief Consultant	Hisashi OSHIMA	Nippon Koei Co., Ltd.
Bridge Designer	Tetsu NAKAGAWA	Nippon Koei Co., Ltd.
Construction Planner/ Cost Estimator	Seinosuke MASAKI	Nippon Koei Co., Ltd.

Appendix -2. Survey Schedule

(1) The First Field Survey (August 11-September 6, 1997)

Day	Date	Week	Activities	Stay
1	Aug.11	Mon.	Transfer from TYO to Cairns	Cairns
2	Aug.12	Tue	Courtesy Call to Embassy of Japan, JICA Office in PNG	Port Moresby
3	Aug.13	Wed	Meeting with NPO ,and with DOTW	Port Moresby
4	Aug.14	Thu	Meeting with AusAID, and with EU	Port Moresby
5	Aug.15	Fri	Transfer from Port Moresby to Lae	Lae
6	Aug.16	Sat	Site Inspection and data collection	Lae
7	Aug.17	Sun	Site Inspection and data collection	Lae
8	Aug.18	Mon	Meeting w/ Provincial Officials and Return to Port Moresby, and site survey / data collection	Port Moresby/Lae
9	Aug.19	Tue	Discussion on the Minutes of Discussion w/DOTW ,and Site survey /data collection	Port Moresby/Lae
10	Aug.20	Wed	Discussion on the Minutes of Discussion w/DOTW ,and Site survey / data collection	Port Moresby/Lae
11	Aug.21	Thu	Discussion on the Minutes of Discussion w/DOTW ,and Site survey and data collection	Port Moresby/Lae
12	Aug.22	Fri	Signing of the Minutes of Discussion, and site survey / data collection	Port Moresby/Lae
13	Aug.23	Sat	Preparation of technical notes, and site survey	Port Moresby/Lae
14	Aug.24	Sun	Preparation of technical notes, and site survey	Port Moresby/Lae
15	Aug.25	Mon	Preparation of technical notes, and site survey	Port Moresby/Lae
16	Aug.26	Tue	Meeting on the technical notes w/DOTW and site survey	Port Moresby/Lae
17	Aug.27	Wed	Preparation of technical notes, and site survey	Port Moresby/Lae
18	Aug.28	Thu	Preparation of technical notes, and site survey	Port Moresby/Lae
19	Aug.29	Fri	Signing of technical notes, and site survey	Port Moresby/Lae
20	Aug.30	Sat	Data collection and site survey	Port Moresby/Lae
21	Aug.31	Sun	Preparation of field survey report	Port Moresby/Lae
22	Sept. 1	Mon	Preparation of field survey report	Port Moresby/Lae
23	Sept. 2	Tue	Preparation of field survey report	Port Moresby
24	Sept. 3	Wed	Preparation of field survey report	Port Moresby
25	Sept. 4	Thu	Preparation of field survey report	Port Moresby
26	Sept. 5	Fri	Return to Tokyo via Cairns	Cairns
27	Sept. 6	Sat	Transfer from Cairns to Tokyo	Tokyo

(2) The Second Field Survey (October 20-October 31, 1997)

Day	Date	Week	Activities	Stay
1	Oct. 20	Mon.	Transfer from TYO to Cairns	Cairns
2	Oct. 21	Tue	Meeting w/ Embassy of Japan, and w/ JICA Office in PNG	Port Moresby
3	Oct. 22	Wed	Explanation of draft final report for DNPI and DOTW	Port Moresby
4	Oct. 23	Thu	Explanation of draft final report for DNPI and DOTW	Port Moresby
5	Oct. 24	Fri	Explanation of draft final report for DNPI and DOTW	Port Moresby
6	Oct. 25	Sat	Transfer from Port Moresby to Lae and Site inspection	Lae
7	Oct. 26	Sun	Site inspection and transfer from Lae to Port Moresby	Port Moresby
8	Oct. 27	Mon	Discussion on the Minutes of Discussion w/DOTW	Port Moresby
9	Oct. 28	Tue	Discussion on the Minutes of Discussion w/DOTW and DNPI	Port Moresby
10	Oct. 29	Wed	Signing of the Minutes of Discussion	Port Moresby
11	Oct. 30	Thu	Return to Tokyo via Cairns	Cairns
12	Oct. 31	Fri	Transfer from Cairns to Tokyo	Tokyo

Appendix-3. List of Party Concerned in the Recipient Country

Name	Position	Agency
Mr. Kila Ai	Secretary	Department of National Planning & Implementation
Mr. Joe Kenken	Senior Adviser (Japan Desk) Foreign Aid Management Branch	Department of National Planning & Implementation
Ms. Nosing Zanggo	Senior Planner (Economic Infrastructure), Sectoral Planning Branch	Department of National Planning & Implementation
Mr. Greame Read	Adviser (Transport Planning) Sectoral Planning Branch	Department of National Planning & Implementation
Mr. Masayoshi Ono	JICA Adviser, Foreign Aid Management Branch	Department of National Planning & Implementation
Mr. Miria Ume	Secretary	Department of Transport & Works
Mr. Roy Mumu	Deputy Director Construction	Department of Transport & Works
Mr. Gabe Konio	First Assistant Director Technical. Service	Department of Transport & Works
Mr. Michael Sirabis	Assistant Director(Survey & Lands)	Department of Transport & Works
Mr. Rupa Kalamo	A/Assistant Director (Roads & Bridges)	Department of Transport & Works
Mr. Selvarajah S.	A/Assistant Director (Maintenance)	Department of Transport & Works
Mr. Bob Dalrymple	A/Principle Engineer(Bridges)	Department of Transport & Works
Mr. Jim Sloan	Supervising Surveyor (Land Acquisition Unit)	Department of Transport & Works
Mr. Peter Aisi	Senior Planner	Department of Transport & Works
Mr. Avoa Issou	A/Assistant Secretary (Monitoring & Evaluation)	Department of Transport & Works
Mr. John Wakma	Provincial Civil Engineer	Department of Works Lae

Appendix-4. Minutes of Discussion

Minutes of Discussions

Basic Design Study
on
the Project for Reconstruction of Umi Bridge Along the Highlands Highway
in
Papua New Guinea

In response to a request from the Government of Papua New Guinea, the Government of Japan has decided to conduct a Basic Design Study on the Project for Reconstruction of Umi Bridge along the Highlands Highway (hereinafter referred to as "the Project"), and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Papua New Guinea a Basic Study Team headed by Mr. Tetsuo YABE, Deputy Director, Grant Aid Project Study Department, JICA, which is scheduled to stay in the country from August 12 to September 5, 1997.

The team held a series of discussions with the concerned officials of the Government of Papua New Guinea and conducted a field survey at the study area.

In the course of discussions and field survey, both parties have confirmed the main items described in the attached sheets.

The team will proceed to further works and prepare the Draft Basic Design.

Port Moresby, August 22, 1997.

Mr. Tetsuo YABE
Leader
Basic Design Study Team
JICA

Mr. Miria UME
Secretary
Department of Transport and Works

Mr. Kila Al
Director
National Planning Office

ATTACHMENT

1. OBJECTIVE

The objective of the project is to reconstruct a new Umi Bridge in order to eliminate one of the traffic bottlenecks of the Highlands Highway due to inadequate load carrying capacity, insufficient traffic volume capacity of the existing bridge and the high risk of being washed out by flood. It is expected that the project will contribute to socio-economic development in not only the Project area but also the whole area along the Highlands Highway which is the most important in PNG .

2. PROJECT SITE

The Project site is shown in Annex-1.

3 PROJECT IMPLEMENTING AGENCY

The National Planning Office is responsible for the administration of the Project and the Department of Transport and Works is responsible for the implementation of the Project as described in Annex-2.

4. MAJOR ITEMS REQUESTED BY THE GOVERNMENT OF PNG

After discussion with the Basic Design Study team, the Government of PNG has finally requested as follows:

(1) Reconstruction of the new Umi bridge with 2 lanes and sidewalk, at the downstream side in parallel with the existing bridge.

(2) River protection and training works within a minimum extent to protect the new bridge.

(3) Construction of approach roads to connect the existing road with a minimum length.

However, the final components of the Project will be decided after further study.

5. JAPAN'S GRANT AID SYSTEM

(1) The Government of PNG has understood the system of Japan's Grant Aid explained by the Team, as described in Annex-3.

(2) The Government of PNG will take necessary measures, described in Annex-4 for smooth implementation of the Project on condition that the Grant Aid by the Government of Japan is extended to the Project.

6. SCHEDULE OF THE STUDY

(1) The consultants will proceed to further studies in PNG until September 5, 1997.

(2) JICA will prepare a Draft Basic Design Report in English and dispatch a mission around October 1997 in order to explain its contents.

(3) In case that the contents of the Report is accepted in principle by the Government of PNG, JICA will complete the Final Report and send it to the Government of PNG by January 1998.

7. CLARIFICATION OF LAND ACQUISITION AT THE PROJECT SITE

The Government of PNG has clarified that all the land required for the construction of the new Umi bridge and affected by the construction work has been completely procured and officially registered under the title of Government land as shown in Annex-5.

8. OTHER RELEVANT ITEMS

The following items have been confirmed by the both sides.

(1)Applicable Bridge Design Standard

Applicable bridge design code due to local conditions of thermal and seismic effects will be determined based on thorough discussion with DOTW and the team. For bridge design live load, the Japanese Bridge Specification shall be applied to the bridge design in the Study after comparison of live load between PNG and Japan indicates application of the latter to be reasonable and appropriate.

(2)Provision of Traffic Sign Boards of Load and Speed Limitation, and Installation of Gantry Barrier for Vehicular Clearance Limitation

DOTW will provide following incidental facilities at the existing bridge site just after the Exchange of Notes is signed by both sides.

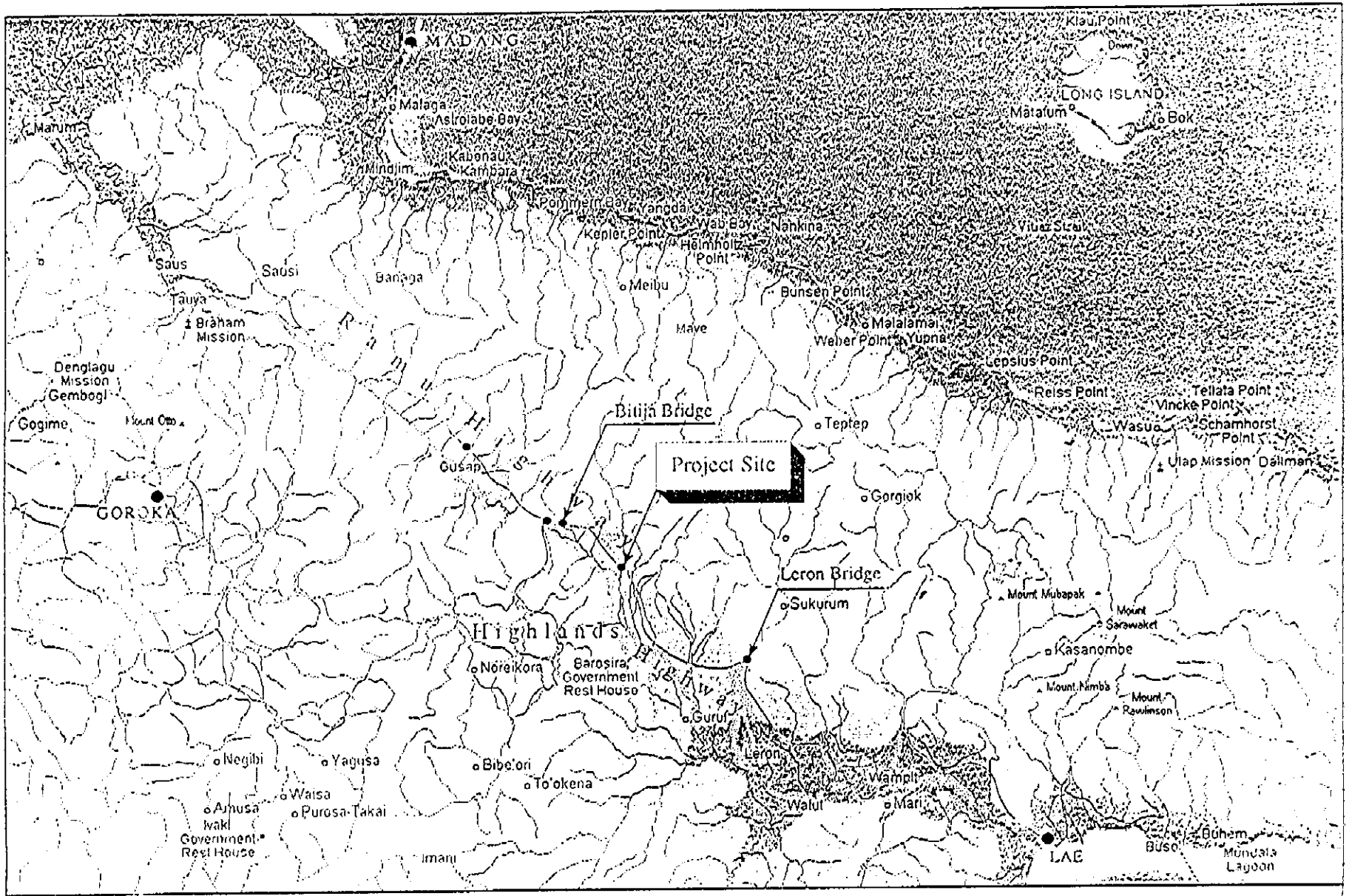
- Two traffic sign boards with speed limitation in order to reduce impact stresses.
- Two traffic sign boards with load limitation in order to eliminate overload condition.
- Two gantry barriers for clear vehicular clearance limitation in order to prevent vehicle collision to the structural members.

(3)Removal of Existing Umi Bridge and Collapsed Steel Truss Bridge

The construction of the new Umi Bridge will be affected by the collapsed bridge in the downstream, and the safety after the completion will be also affected by the existing bridge due to possible washout or collapse. Hence, the Government of PNG should completely remove the whole collapsed bridge members deposited in the river bed before the commencement of the construction, and should remove the existing bridge including the piers immediately after the completion of the new bridge with PNG's own expense in accordance with JICA's official request.

(4) Counterpart Agency of the Project

The counterpart agency responsible for the Basic Design Study and implementation of the Project is the Department of Transport and Works. In case that the Department is divided into two i.e. the Department of Transport for the policy making and planning of infrastructures in the country and the Department of Works for the implementation, the Department of Works is the counterpart agency of the Project.

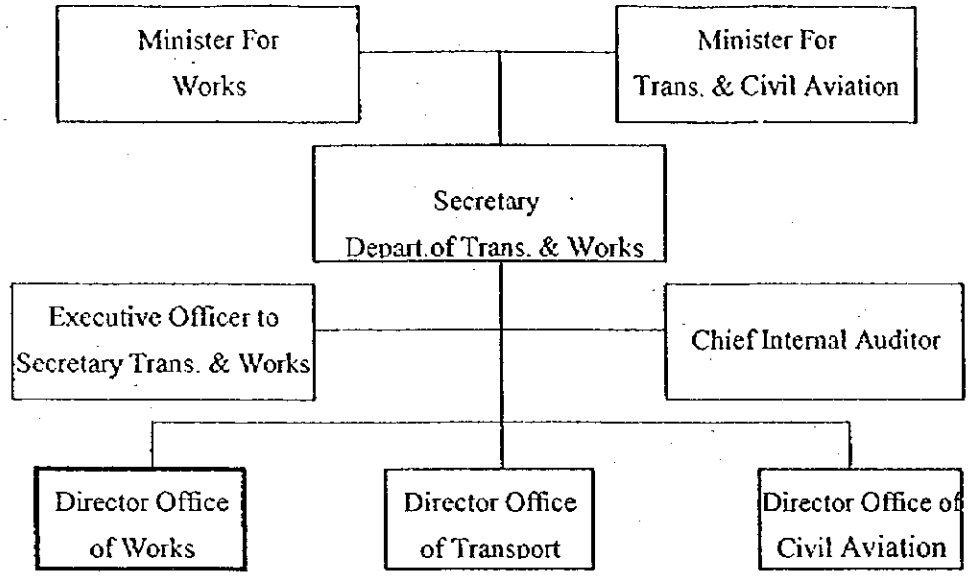


Annex - 1 Proposed Site

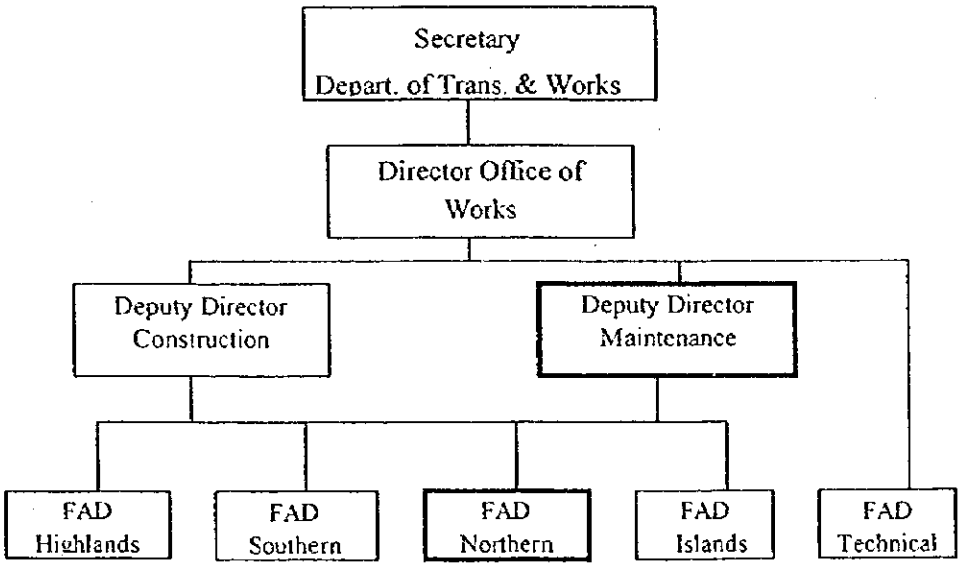
Annex-2 Project Implementing Organization of the Government of PNG

1. The operational organization of the Government of PNG is as shown in the following chart while the construction works of this Project is implemented.

Department of Transport and Works



2. The maintenance organization is confirmed as follows:



Annex-3 Japan's Grant Aid Scheme

1. Grant Aid Procedures

1) Japan's Aid Program is executed through the following procedures.

Application	(Request made by a recipient country)
Study	(Basic Design Study conducted by JICA)
Appraisal & Approval	(Appraisal by the Government of Japan and Approval by Cabinet)
Determination of Implementation	(The Notes exchanged between the Government of Japan and recipient country)

2) Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study), using (a) Japanese consulting firm(s).

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Program, based on the Basic Design Study report prepared by JICA, and the result are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes signed by the Governments of Japan and the recipient country.

Finally, for the implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

2. Basic Design Study

1) Contents of the Study

The aim of the Basic Design Study (hereinafter referred to as "the Study"), conducted by JICA on a requested project (hereinafter referred to as "the Project") is to provide a basic document necessary for the appraisal of the Project by the Japanese Government. The contents of the Study are as follows:

a) Confirmation of the background, objectives, and benefits of the requested project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation.

b) Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view.

c) Confirmation of items agreed on by both parties concerning the basic concept of the Project.

d) Preparation of a basic design of the Project.

e) Estimation of costs of the Project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guideline of Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whether measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

2) Selection of Consultants

For smooth implementation of the Study, JICA uses (a) registered consultant firm(s). JICA selects (a) firms (s) based on proposals submitted by interested firms. The Firm(s) selected carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference set by JICA.

The consulting firm(s) used for the Study is (are) recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency and also to avoid any undue delay in implementation should the selection process be repeated.

3. Japan's Grant Aid Scheme

1) What is Grant Aid

The Grant Aid Program provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. Grant Aid is not supplied through the donation of materials as such.

2) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Government concerned, in which the objectives of the Project, period of execution, conditions and amount of the Grant Aid. etc., are confirmed.

3) "The period of the Grant Aid" means the one fiscal year which the Cabinet approves the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with (a) consultant firm(s) and (a) contractor(s) and final payment to them must be completed.

However in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Government.

4) Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of the third country.

However the prime contractors, namely, consulting, contracting and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons or Japanese nationality.)

5) Necessity of "Verification"

The Government of recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan.

This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

6) Undertaking required of the Government of the Recipient Country

In the implementation of the Grant Aid project, the recipient country is required to undertake such necessary measures as the following:

(1) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.

(2) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites.

(3) To secure buildings prior to the procurement in case the installation of the equipment.

(4) To ensure all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid.

(5) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.

(6) To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified Contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

7) "Proper Use"

The recipient country is required to maintain and use the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

8) "Re-export"

The products purchased under the Grant Aid not be re-exported from the recipient country.

9) Banking Arrangements(B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank of the Government of Japan under an authorization to pay issued by the Government of the recipient country or its designated authority.

Annex-4 Necessary Measures to be undertaken by the Government of PNG

The following necessary measures should be undertaken by the Government of PNG on condition that the Grant Aid by the Government of Japan is extended to the Project:

1. To provide data and information necessary for the Project.
2. To secure the land for the execution of the Project, such as land for approach road, bridge construction, working areas, storage yard, etc.
3. To clear the sites prior to the commencement of the construction.
4. To bear commissions to the Japanese foreign exchange bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commission.
5. To ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation in PNG and prompt internal transportation therein of the materials and equipment for the Project purchased under the Grant Aid.
6. To exempt Japanese juridical and physical nationals engaged in the Project from customs duties, internal taxes and other fiscal levies which may be imposed in PNG with respect to the supply of the products and services under the verified contracts.
7. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into PNG and stay therein for the performance of their work.
8. To provide necessary permissions, licenses and other authorizations for implementing the Project, if necessary.
9. To maintain and use properly and effectively the facilities constructed under the Project.
10. To bear all the expenses other than those to be borne by the Japan's Grant Aid within the scope of the Project.
11. To coordinate and solve any issues related to the Project which may be raised from third parties or inhabitants in the Project area during the implementation of the Project.
12. To secure the safety of Japanese nationals engaged in the Project and to provide tight security against riot, insurrection, civil commotion, rebellion, and usurped power.

Annex- 5

Department of Transport and Works
Office of Works

Date: 20 August, 1997
Our Reference: LAU-106-42-08
Action Officer: J.Sloan
Designation: a/Principal Surveyor

P.O.Box 1108, Boroko
Papua New Guinea
Phone 3241 265
Fax 3241 170

Japan International Cooperation Agency (JICA)

Attention: **The Team Leader (Umi Bridge Investigation)**

SUBJECT: LAND CLEARANCE - UMI BRIDGE, MOROBE PROVINCE

Our Land Acquisition Unit have investigated the status of the land at the Umi bridge site in Morobe Province. Their findings are as follows:

The existing bridge site, including the approach roads on either side, have been purchased to a width of 60.35 metres. This is evidenced by the following two documents, copies of which are attached.

- Native Land Dealing (NLD) 4194 - this document refers to the purchase of the land on the eastern (Lae) side of the river.
- Unregistered Administration Lands (UAL) 996 - this document refers to the purchase of the land on the western (highlands) side of the river.

Assuming the new bridge and approach roads are contained within the 60.35 metre reserve no further action is required; that is you have full land clearance.

If, after the new design is completed, it becomes evident extra land is required the Office of Works will arrange road widening survey. The subsequent transfer of any extra land would not be a problem or hindrance to the project as it is already state land.

With regard to a campsite and storage area there are large tracts of state land in the vicinity of the bridge site. Office of Works will identify and mark out a site suitable to your requirements.

I trust this letter serves to allay any concerns you may have over land on this project.

MICHAEL SIRABIS
Assistant Director (Lands & Survey)

for: JOHN SIOLA
a/Director (Works)

PARTICIPANTS LIST

PNG SIDE

National Planning Office

Mr. Joe Kenken	Senior Adviser (Japan Desk) Foreign Aid Management Branch	National Planning Office
Ms. Nosing Zanggo	Senior Planner (Economic Infrastructure), Sectoral Planning Branch	National Planning Office
Mr. Greame Read	Adviser (Transport Planning) Sectoral Planning Branch	National Planning Office
Mr. Masayoshi Ono	JICA Adviser, Foreign Aid Management Branch	National Planning Office

Department of Transport and Works

Mr. Roy Mumu	Deputy Director Construction	Department of Works
Mr. Gabe Konio	First Assistant Director Technical. Service	Department of Works
Mr. Michael Sirabis	Assistant Director(Survey & Lands)	Department of Works
Mr. Rupa Kalamo	A/Assistant Director (Roads & Bridges)	Department of Works
Mr. Selvarajah S.	A/Assistant Director (Maintenance)	Department of Works
Mr. Bob Dalrymple	A/Principle Engineer(Bridges)	Department of Works
Mr. Jim Sloan	Supervising Surveyor (Land Acquisition Unit)	Department of Works
Mr. Peter Aisi	Senior Planner	Department of Transport
Mr. Avoa Issou	A/Assistant Secretary (Monitoring & Evaluation)	Department of Transport
Mr. John Wakma	Provincial Civil Engineer	Department of Works Lae

JAPANESE SIDE

Basic Design Study Team

Mr. Tetsuo Yabe	Team Leader	Japan International Cooperation Agency Grant Aid Project Study Department
Mr. Tadashi Kageyama	Coordinator	Japan International Cooperation Agency Training Affairs Department
Mr. Hisashi Ohshima	Chief Consultant	Nippon Koei Co., Ltd.
Mr. Tetsu Nakagawa	Bridge Designer	Nippon Koei Co., Ltd.

Minutes of Discussions

Basic Design Study
on
the Project for Reconstruction of Umi Bridge Along the Highlands Highway
in
Papua New Guinea

In August 1997, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Basic Design Study Team on the Project for Reconstruction of Umi Bridge along the Highlands Highway (hereinafter referred to as "the Project'). After the assessment of the data and information obtained through the study, JICA has prepared the Draft Basic Design on the Project.

In order to explain and consult the Government of PNG on the components of the Draft Basic Design, JICA sent to PNG a Study Team (hereinafter refer to as "the Study Team) headed by Mr. Akira Hara , Development Specialist of JICA, which is scheduled to stay in the country from October 21 to 30, 1997.

As a result of discussions, both parties have confirmed the main items described on the attached sheets.

Port Moresby, October 29, 1997.

Mr. Akira HARA
Leader
D.B/D Explanation Team
JICA

Mr. Miria UME
Secretary
Department of Transport and Works

Mr. Kila Ai
Secretary
Department of National Planning &Implementation

ATTACHMENT

1. OBJECTIVE

The objective of the project is to reconstruct a new Umi Bridge in order to eliminate one of the traffic bottlenecks of the Highlands Highway due to inadequate load carrying capacity, insufficient traffic volume capacity of the existing bridge and the high risk of being washed out by flood. It is expected that the project will contribute to socio-economic development in not only the Project area but also the whole area along the Highlands Highway which is the most important road in PNG .

2. PROJECT SITE

The Project site is shown in Annex-1.

3 PROJECT IMPLEMENTING AGENCY

The Department of National Planning & Implementation (formerly the National Planning Office) is responsible for the administration of the Project and the Department of Transport and Works is responsible for the implementation of the Project.

4. DRAFT DESIGN

The Government of PNG has in principle agreed to the components of the Draft Basic Design Report dated on October 1997 prepared by the Team.

5. JAPAN'S GRANT AID SYSTEM

The Government of PNG has understood the system of Japan's Grant Aid as described in the Minutes of Discussions signed on August 22, 1997.

6. NECESSARY MEASURES TO BE TAKEN BY THE GOVERNMENT OF PNG

The Government of PNG will take necessary measures described in Annex-4 of the Minutes of Discussions signed on August 22, 1997 for smooth implementation of the Project on condition that the Grant Aid by the Government of Japan is extended to the Project.

7. FURTHER SCHEDULE OF THE STUDY

JICA will complete the Final Report and send it to the Government of PNG by January 1998.

8. OTHER RELEVANT ITEMS

The following items have been confirmed by the both sides.

(1)Provision of Traffic Sign Boards of Load and Speed Limitation, and Installation of

Gantry Barrier for Vehicular Limitation

DOTW will provide the necessary incidental facilities at the existing bridge site as described Article 8, (2) of the Attachment in the Minutes of Discussions signed on August 22, 1997.

(2) Removal of Existing Umi Bridge and Collapsed Steel Truss Bridge

Both parties have confirmed the following items:

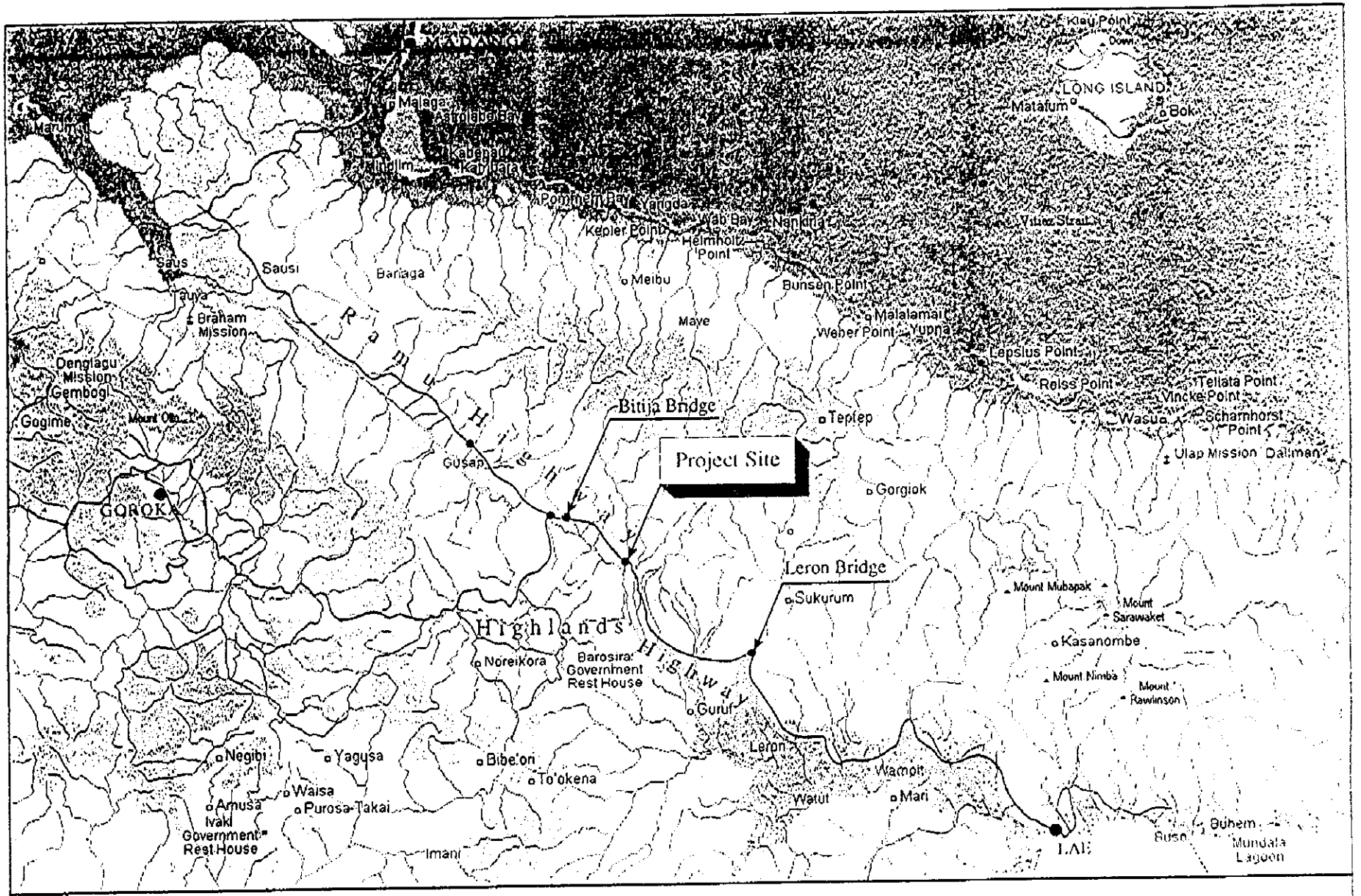
1)It was confirmed that the Government of PNG would remove the whole collapsed bridge members deposited in the river bed and the existing bridge including the piers with PNG's own expense in the Minutes of Discussions signed on August 22, 1997.

2)The Government of PNG however since then has requested by their letter (Annex-2) to consider the total removal cost to be born by the Japanese Government due to the forecast financial constraints caused by drought and frost.

3)The study team has conveyed a message that the Government of Japan would positively consider the PNG's request as an exceptional case taking into account the PNG current situation.

(3) Counterpart Training in Japan

JICA will accept one counterpart from DOTW for training in Japan over two month period during the Japanese 1999 fiscal year. DOTW has accepted this offer and assured to take necessary measure to process the application.



Annex - I Proposed Site

Annex-2

DEPARTMENT OF NATIONAL PLANNING & IMPLEMENTATION

TELEPHONE: (675) 328 8502
FACSIMILE: (675) 323 3147

VULUPINDI HAUS
P O BOX 710 WAIGANI NCD
PAPUA NEW GUINEA

23 October 1997
JPN.14.049/KOL

Mr. Akira Hara
JICA Mission Leader
The Project for Reconstruction of Umi Bridge
along the Highlands Highway
c/o JICA PNG Office
P.O Box 6639 Boroko
N.C.D

Dear Sir,

SUBJECT: **REQUEST FOR EXTRA FUNDING BY THE GOVERNMENT OF JAPAN FOR THE PROJECT FOR RECONSTRUCTION OF UMI BRIDGE ALONG THE HIGHLANDS HIGHWAY**

I am pleased to know that the Government of Japan has dispatched the JICA mission headed by yourself to present draft of Basic Design Study Report to the Government of Papua New Guinea in order to expedite the implementation of the project which is hoped to be funded by the Government of Japan under Japanese General Grant Aid Scheme as a priority project of the Government of Papua New Guinea.

During the discussions with the JICA Basic Design Study Mission headed by Mr. Tetsuo Yabe in August 1997, the Government of Papua New Guinea agreed with the JICA Mission that the Government of Papua New Guinea would completely remove the whole collapsed bridge members deposited in the river bed before the commencement of the construction, and would remove the existing bridge including the piers immediately after the completion of construction of the new bridge with appropriate funding by the Government of Papua New Guinea.

However, I, on behalf of the Government of Papua New Guinea, would like to request the Government of Japan to consider to extend it assistance to allocate extra fund for removal of the collapsed bridge before construction of the new bridge as well as for removal of the existing bridge after the completion of construction of the new bridge.

Our request for additional funding by the Government of Japan is based on the expected budget constraints due to the current drought across the country as well as frost in the

Highlands Region. The Government of Papua New Guinea decided to allocate PNG K 30 million to meet urgent relief needs of people affected throughout the country. Rapid Assessment Team comprised of officials from the National Government and specialist from AusAID recently reported that more than 150,000 people will be facing a life-threatening situation with no food available other than bush food by the end of this month and more than 400,000 people will face similar situation by the end of this year.

The Government of Papua New Guinea has determined to make every best efforts with assistance of donor community to provide all necessary relief support until the end of drought.

The effects of drought and frost is costing the Government of Papua New Guinea PNGK 7 million (US$ 5 million) every month and is expected to run to over PNGK 100 million (US$ 70 million) if it continues into next year.

We are preparing the 1998 budget at moment and Department of Finance has already instructed that 1998 Development Budget needs to be cut from the original PNGK 684.0 million to PNGK 476.4 million. This is due to the expected huge decline in the Government Revenues for 1998 and for next couple of years because of loss of revenues from most of agricultural crops represented by coffee, copra and palm oils as well as revenues from mining.

Reconstruction of Umi Bridge is an important project to provide better and safe infrastructure along the Highlands Highway which support the stability of the people's livelihood and the improvement of the economic activities in the Highlands Region.

I hope the Government of Japan will favourably consider our request and expedite the implementation of the project smoothly.

On behalf of the Government of Papua New Guinea, I wish to take this opportunity to sincerely thank the Government of Japan for its continuos support to Papua New Guinea.

Yours sincerely

KILA AI
Secretary

cc. Mr. Miria Ume
Secretary
Department of Transport and Works
P.O Box 1108 Boroko, N.C.D

cc. Mr. Yukiharu Kobayashi
Second Secretary
Embassy of Japan
P.O Box 1040 Port Moresby
N.C.D

cc. Mr. Masahiro Kobayashi
Resident Representative
JICA PNG Office
P.O Box 6639 Boroko
N.C.D

cc. Mr. John Siola
Director
Office of Works
Department of Transport and Works
P.O Box 1108 Boroko
N.C.D

cc. Mr Leo Bualia
a/First Assistant Secretary
Sectoral Planning Division
Department of National Planning & Implementation

cc. Mr Ora Ila
a/First Assistant Secretary
Resource Programming and Monitoring Division
Department of National Planning & Implementation