社会開発調査部報告書

No. 32

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
REPUBLIC OF THE PHILIPPINES

DETAILED ENGINEERING DESIGN STUDY

ON

PAN-PHILIPPINE HIGHWAY IMPROVEMENT PROJECT (MINDANAO SECTION)

FINAL REPORT
EXECUTIVE SUMMARY

MARCH 1997

KATAHIRA & ENGINEERS INTERNATIONAL
NIPPON ENGINEERING CONSULTANTS CO., LTD.

The exchange rates used in the Study are:

US$ 1.00 = Philippine Pesos 26.295

J. Yen 1.00 = Philippine Pesos 0.2308

₱1.00 = ¥4.33

(As of 16 December 1996)

Source: Central Bank of the Philippines

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PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct a detailed engineering design study on Pan-Philippine Highway Improvement Project (Mindanao Section) and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Philippines a study team headed by Mr. Kunihiko Sawano of Katahira & Engineers International, and composed of members from Katahira & Engineers International and Nippon Engineering Consultants Co., Ltd., twice between September 1995 to January 1997.

The team held discussions with the officials concerned of the Government of the Philippines, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

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 the Republic of the Philippines for their close cooperation extended to the team.

March 1997

Kimio Fujita
President
Japan International Cooperation Agency

March 1997

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Fujita,

Letter of Transmittal

We are pleased to submit to you the Final Report of the Detailed Engineering Design Study on Pan-Philippine Highway Improvement Project (Mindanao Section) in the Republic of the Philippines. The report contains the advice and suggestions of the authorities concerned of the Government of Japan and your Agency as well as the Department of Public Works and Highways and other authorities concerned of the Government of the Philippines.

This report presents the results of the detailed engineering design including the preparation of construction plan and tender documents, cost estimate and environmental impact assessment. The project aims to cope with the various problems that the road presently suffers from, and to make the road solid, reliable and comfortable.

In view of the urgency of improving the project road which is the only axis in the east Mindanao, and of the need for socio-economic development in Mindanao Island as a whole, we recommend that the Government of the Philippines implement this project as a top priority.

We wish to take this opportunity to express our sincere gratitude to your Agency and the Ministry of Foreign Affairs. We also wish to express our deep gratitude to the Department of Public Works and Highways and other authorities concerned of the Government of the Philippines for the close cooperation and assistance extended to us during our investigations and study.

Very truly yours,

Kunihiko Sawano
Team Leader,
Detailed Engineering Design Study
on Pan-Philippine Highway
Improvement Project (Mindanao Section)

SUMMARY

OBJECTIVES OF THE PROJECT

The Mindanao section of the Pan-Philippine Highway suffers from various problems such as progressive deterioration of pavement, structural and hydraulic problems in bridges, repeated slope failures in mountainous areas and frequent occurrence of floods, resulting in aggravation of riding quality, rise of transport cost and even traffic interruptions for a certain period. The Pan-Philippine Highway Improvement Project in Mindanao (the Project) aims to cope with such problems and make the road solid, reliable and comfortable.

PROJECT ROAD

The project road is the Pan-Philippine Highway from Lipata Ferry Terminal up to the end of Davao City Diversion Road with a length of 402.6 km.

PRESENT CONDITION OF THE ROAD

- **Topography:** Terrain of the road is as follows:
  - Flat : 67%
  - Rolling : 21%
  - Mountainous : 12%
- **Meteorology:** The study area is characterized by the abundant rainfall. Annual rainfall varies from 1,800mm to 3,700mm.
- **Population:** Population in the study area is 3.5 million.
- **Traffic Volume:** Traffic volume as of 1994 is 640-2,990 veh/day in Surigao-Tagum section and 4,910-8,070 veh/day in Tagum-Davao section. It is estimated to grow 2.9 times in 2010 and 4.6 times in 2020.
- **Road Condition:** Major problems are as follows:
  - Pavement distresses such as extensive block /alligator cracks, potholes, scaling, depression, etc.
  - Shoulder damages such as drop-off, heave, scour, etc.
  - Drainage problems such as side ditches being silted, culverts with insufficient capacity, etc.
  - Bridge problems such as insufficient load capacity, structural deterioration, problems in hydraulic regime, etc.
  - Slope disasters such as slope failure, debris flow, fall, landslide, etc.
  - Floods due to lack of drainage facilities, overflow from river, etc.

SCOPE OF WORK OF THE PROJECT

Type of Work	Quantity	Remarks
Pavement rehabilitation/improvement		
• PCC reconstruction	100.15 km	Type of work depends on degree and type of distress, drainage condition and subgrade strength.
• AC reconstruction *	7.34 km	
• AC overlay	133.84 km	
• Total	241.33 km	
Shoulder improvement		
• Graveling	587.84 km	Paving is proposed for steep sections and residential sections.
• PCC paving	86.43 km	
• AC paving	81.36 km	
• Total	755.63 km	
Drainage improvement		
• Concrete side ditch	160.44 km	Concrete side ditch is to replace earth ditch and to be additionally provided where necessary.
• Subsurface drainage	18.07 km	
• Pipe culvert replacement	322	
• Additional pipe culvert	89	
• Pipe culvert improvement	653	
• Box culvert replacement	99	
• Additional box culvert	23	
• Box culvert improvement	64	
Bridge rehabilitation/improvement		
• Total reconstruction	18 bridge	Bridges needing only minor repair works to be done as maintenance operation are not included.
• Partial reconstruction	29 bridge	
• Other rehabilitation	27 bridge	
• Total	74 bridge	
Slope protection		
• Cut slope failure	1 slope	Drainage improvement works are involved in most cases as a main or subsidiary measure.
• Embankment slope failure	71 slope	
• Landslide	1 slope	
• Total	73 slope	
Countermeasures against flood		
• Protection of road	1 section	Protection of road from damage by flood water is applied where flood depth is low, while other measure is applied where flood depth is high.
• Flood interception canal	3 section	
• Raise of road	7 section	
• Riverbed dredging	2 section	
• Flood protection dike	1 section	
• Cut-off channel	**	
• Bypass road	1 section	
• Total	15 section	

* Includes weak subgrade treatment.

** used as subsidiary measures to other main measures.

CONTRACT PACKAGING

Taking into consideration the construction period and cost, the project is divided into 19 contract packages. According to the priority based on the physical condition at present, contract packages are divided into four groups; Group A to D, as shown in the implementation schedule.

PROJECT COST AND IMPLEMENTATION SCHEDULE

(Unit: Million Pesos at 1996 price)

			1997	1998	1999	2000	2001	2002	2003	Total Cost	Cost Component		
											Foreign	Local	Tax
Implementation Schedule	Selection of Contractor	Group A Group B Group C Group D							ROW Cost ↓	Const. Cost ↓			
	ROW Acquisition ([ ]) and Construction ([ ])	Package 1 (D)							-	281.7	115.6	110.0	56.0
		Package 2 (D)							0.1	278.9	140.1	81.1	57.7
		Package 3 (D)							-	131.4	63.2	39.8	28.4
		Package 4 (C)							0.3	114.6	53.8	37.2	23.6
		Package 5 (A)							-	254.6	115.4	87.4	51.9
		Package 6 (A)							0.3	269.4	118.8	98.2	52.4
		Package 7 (A)							-	384.1	164.7	142.3	77.1
		Package 8 (A)							-	255.7	109.0	94.8	52.0
		Package 9 (B)							0.7	222.7	109.9	67.4	45.4
		Package10 (C)							-	323.0	158.3	96.4	68.3
		Package11 (B)							-	169.2	84.6	49.1	35.5
		Package12 (C)							-	149.3	62.9	56.8	29.6
		Package13 (A)							0.3	244.2	123.1	70.4	50.6
		Package14 (B)							7.4	149.3	63.6	59.3	26.4
		Package15 (B)							0.7	301.0	149.9	88.3	62.8
		Package16 (B)							-	348.4	184.1	89.2	75.0
		Package17 (A)							25.6	453.6	216.2	141.4	95.9
		Package18 (D)							-	208.5	91.6	76.7	40.2
		Package19 (D)							-	97.5	39.1	39.5	18.9
	Consultancy Services									440.5	277.5	149.8	13.2
Annual Fund Requirement	ROW Acquisition		26.2	8.8	0.3	0.1	-	-	-	35.4	-	35.4	-
	Construction		-	736.2	1,414.4	1,089.3	849.5	512.0	35.6	4,637.0	2,163.9	1,525.4	947.7
	Consultancy Services		11.0	74.0	131.9	104.1	72.6	43.8	3.1	440.5	277.5	149.8	13.2
	Total		37.2	819.0	1,546.6	1,193.5	922.1	555.8	38.7	5,112.9	2,441.4	1,710.6	960.9

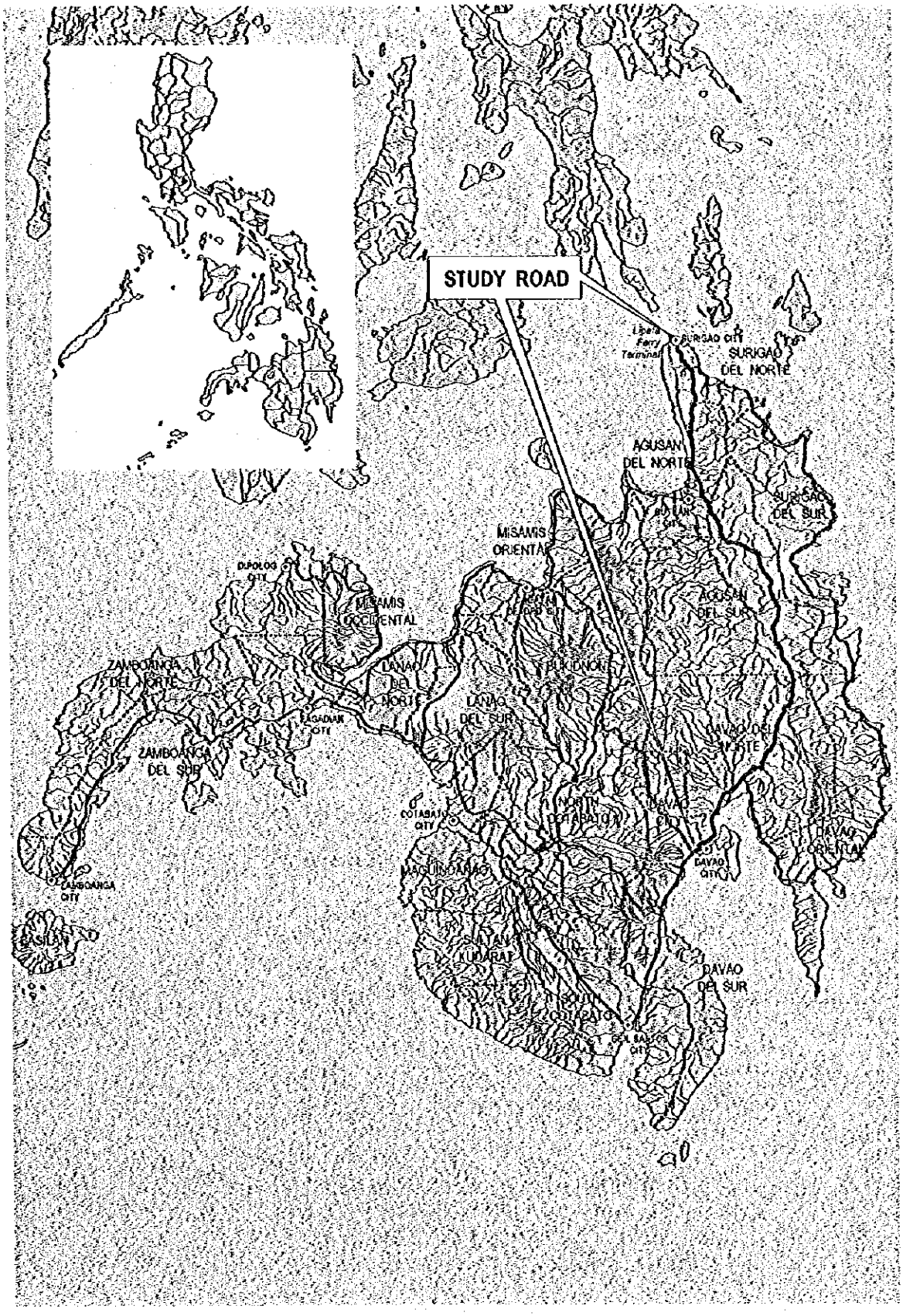
PROJECT EVALUATION

- **Technical Aspect:** All proposed works can be completed by usual construction methods commonly used in the Philippines and all necessary equipment and materials are easily obtained at sites. Thus, no technical problem is expected in the project implementation.
- **Economic Aspect:** Economic evaluation indicators are as follows:
  - IRR 29.6%,
  - NPV 4,156.3 million pesos
  - B/C 2.29

  Thus, the project is concluded to be highly feasible from the economic point of view.
- **Financial Aspect:** The project can be implemented within reasonable financial framework in accordance with the proposed schedule.
- **Environmental Aspect:** No adverse environmental impact is foreseen except resettlement of a few inhabitants and traffic interference du-ring construction, which will be easily solved / mitigated.
- **Social and Developmental Aspects:** The project will contribute to improvement of social environment and promote the regional development by providing reliable means of transport.

RECOMMENDATIONS

- **Early Implementation:** It is highly recommended to implement the project in the earliest possible time, even ahead of the proposed schedule if there is a fair prospect of increased fund for the project.
- **Mitigation Measures of Environmental Impacts:** Due considerations should be given to mitigate adverse impacts, viz.:
  - Resettlement of inhabitants;
    A proper relocation plan including provision of resettlement area in the vicinity.
  - Traffic interference during construction:
    Proper traffic control, provision of safety devices, etc.
- **Maintenance Requirements:** Future maintenance should be focused on:
  - Maintenance of the sections where no rehabilitation work is proposed.
  - Minor repair works of the bridges not covered by the project.
  - Cleaning of drainage facilities, especially in flood sections / mountainous sections.
  - Periodic dredging of riverbed sediments, especially for the bridges where dredging is proposed in the project.



LOCATION MAP

PROJECT COST AND IMPLEMENTATION SCHEDULE

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			1997	1998	1999	2000	2001	2002	2003	Total Cost	Cost Component: Foreign	Local	Tax
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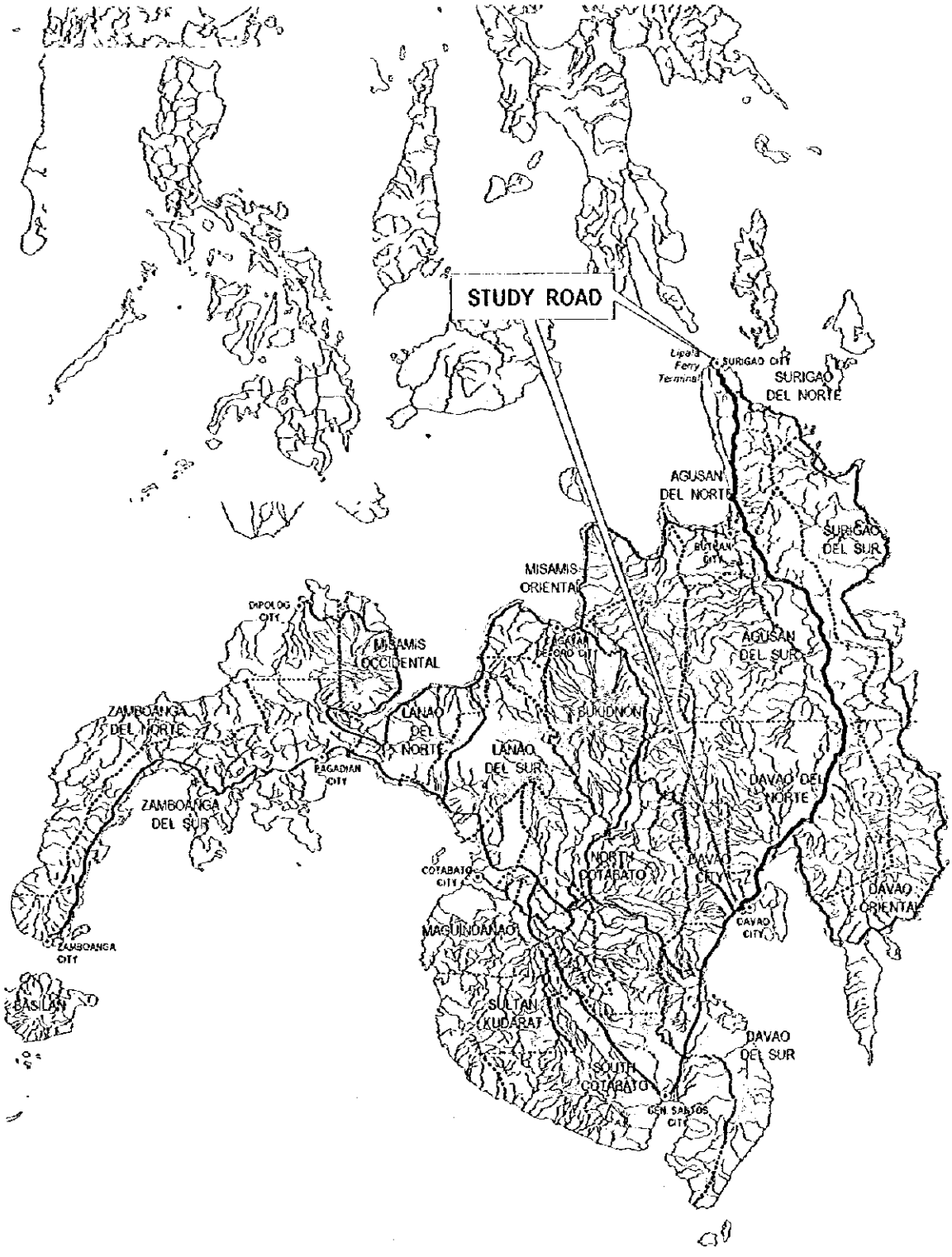

LOCATION MAP

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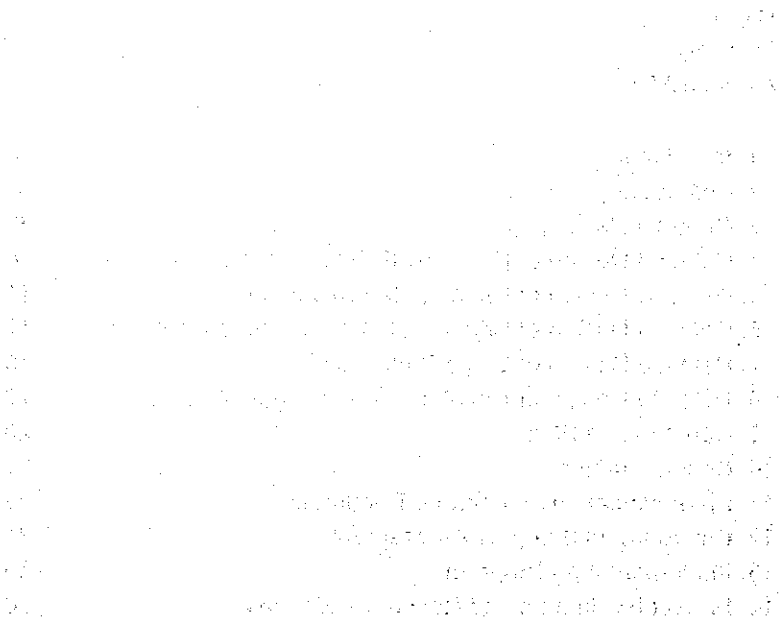


1. INTRODUCTION

1.1 BACKGROUND

The Pan-Philippine Highway is the most important trunkline in the country's road network running through the four major islands of Luzon, Samar, Leyte and Mindanao with a total length of 2,100 km. The construction of the Highway, which was then a long-cherished desire of the country to attain the national targets such as regional development, industrial growth, preservation of peace and order, national unification, etc., was started in 1969 and completed in 1979.

Now, in 18 to 27 years after opening to traffic, the Pan-Philippine Highway suffers various problems such as progress of pavement deterioration, repeated slope failures in the mountainous areas, damage of bridges and so on.

To cope with the said problems, the Government of the Philippines (GOP) conducted various feasibility studies with technical assistance provided by the Japan International Cooperation Agency (JICA). These studies cover the Luzon, Samar and Leyte sections of the Pan-Philippine Highway and the rehabilitation projects formulated therein are now being implemented.

Mainly for the reason of peace and order problem, rehabilitation of Mindanao section of the Highway has been left behind although it is of urgent necessity to promote the development of Mindanao. In the restoration of peace, GOP has decided to start the rehabilitation of the Mindanao section of the Highway and conducted the Feasibility Study on Pan-Philippine Highway Rehabilitation Project (Mindanao Section) from March 1994 to May 1995 with technical assistance provided by JICA.

In view of the priority and urgency of the project, GOP further sought a technical assistance from the Government of Japan (GOJ) for the conduct of the DETAILED ENGINEERING DESIGN STUDY ON PAN-PHILIPPINE HIGHWAY IMPROVEMENT PROJECT (MINDANAO SECTION) (the Study).

In response to the request of GOP, GOJ decided to conduct the Study. JICA, the official agency responsible for the implementation of the technical cooperation programs of GOJ, organized a study team to be engaged in the Study. The JICA Study Team, in close collaboration with the DPWH Counterpart Team, commenced the work in August 1995 and completed in March 1997.

1.2 OBJECTIVE OF THE STUDY

The objective of the Study is to prepare the detailed engineering design and tender documents for the Pan-Philippine Highway Improvement Project (Mindanao Section).

1.3 STUDY ROAD

The Study Road is the Pan-Philippine Highway from Lipata Ferry Terminal (Km. 1,113+402) up to the end of the Davao City Diversion Road (Km. 1,516+000) with a length of 402.6 km.

1.4 REPORTS

The final report is organized with the following:

- Executive Summary
- Drawings
- Tender and Contract Document
- Main Text
- Design Analysis Report
- Cost Analysis Report
- Appendix
- Prequalification Document
- Quantity Calculation Report

2. ENGINEERING SURVEY

2.1 EXISTING ROAD CONDITION SURVEY

- Pavement Condition Survey

Pavement condition survey was undertaken mainly on the pavement distresses such as:

- Cracks (open cracks and sealed cracks)
- Cracks with faulting
- Potholes
- Scaling
- Depression
- Pop-out
- Patching

Based on the data obtained, the following two indices were calculated for every 16 slabs (72m):

- Crack ratio = crack length (m)/1,000 sq.m.
- Number of slabs with depressions

- Shoulder and Side Ditch Survey

Following were surveyed for every 100m section:

- Shoulder : material, condition and proposed improvement
- Side ditch : cross-section type of road to judge the need of side ditch, side ditch material, dimension and condition, water flow direction, and proposed improvement.

- Pipe/Box Culvert Survey

Surveyed were the location, size and condition of all culverts including inlet facility, culvert itself, outlet facility, upstream, downstream and other related portions.

- Slope Survey

All damaged slopes were surveyed on the size of damage, geology, surface water condition, etc. The underlying causes of the damage were appraised and restoration measures were proposed.

- Bridge Survey

Conditions of each component of bridge, river bed/bank and approach road were surveyed. In addition, the following detailed surveys were conducted:

- Detailed dimension survey of structural members
- Crack survey of RC/PC beams

All bridges were re-assessed on their structural soundness.

2.2 TOPOGRAPHIC SURVEY

Following four kinds of topographic survey were undertaken:

- Route survey along the whole stretch of the project road
- Topographic survey at bridge sites, failed slopes and flood-prone areas
- River profile and cross-section survey
- Aerial photographic survey and mapping

• Route Survey

The route survey was undertaken in the following procedures:

- GPS survey at 52 GPS stations established at about 10 km interval.
- Traverse survey at the traverse points established at an interval of 200 to 1,000m.
- Establishment of temporary bench marks at about 500m interval.
- Centerline survey to determine the existing centerline alignment.
- Centerline stake-out at an interval of 20m and at points of beginning and end of each curve.
- Profile survey of centerline stakes.
- Cross-section survey at 20m interval and points of topographical changes, covering 30m, 50m and 60m either side from the centerline in flat, rolling and mountainous terrains, respectively.
- Topographic survey of all structures and facilities as well as topographic changes.
- Preparation of topographic maps (scale: 1/1,000, contour interval:1m), profiles (scale: H=1/1,000, V=1/100) and cross-sections (scale: 1/100).

• Topographic Survey at Bridge Sites, Failed Slopes and Flood-Prone Sections

Topographic survey for the following sections was undertaken:

- 10 failed slopes (scale: 1/500, contour interval: 1m)
- 71 bridge sites proposed to be rehabilitated/improved/reconstructed (scale: 1/200 for short bridges and 1/500 for long bridges, contour interval: 1m)
- 2 flood-prone sections (scale: 1/1,000, contour interval: 1m)

• River Profile and Cross-section Survey

River profile and cross-section survey was undertaken for 39 rivers which require detailed hydraulic analysis and/or dredging/rechanneling. The drawing scale is H = 1/1,000 and V = 1/100 for profile and 1/100 for cross-section.

• Aerial Photographic Survey and Mapping

For the purposes of detailed hydraulic analysis, route selection of a proposed bypass road, dike planning, etc., aerial photographic survey and mapping were undertaken for the following areas:

- Simulao River flood area (area covered: 10km x 3 km, scale: 1/5,000, contour interval: 1m)
- Monkayo bypass construction site (area covered: 2.5 km x 2.5 km, scale: 1/2,000, contour interval: 1m)
- Liboganon River flood area (area covered: 16 km x 4 km, scale: 1/5,000, contour interval: 1m)

2.3 SOIL/MATERIAL AND GEOTECHNICAL INVESTIGATION

The following investigations were undertaken:

- Geotechnical investigation for pavement rehabilitation design
- Geotechnical investigation for slope protection design
- Geotechnical investigation for bridge foundation design
- Soils investigation for soft ground sections
- Soils investigation for Sianib Section
- Soils investigation for Liboganon River dike design
- Material sources investigation

• Geotechnical Investigation for Pavement Rehabilitation Design

Following investigations were undertaken:

- Concrete pavement coring to examine PCC slab thickness and concrete strength at 197 locations.
- Test pitting to examine soil layer composition under PCC slab and characteristics of each layer including bearing capacity at 414 locations.
- Auger boring to examine soil layer composition under PCC slab and characteristics of each layer at 434 locations.

• Geotechnical Investigation for Slope Protection Design

Two boring tests were undertaken at two embankment slopes which have slided, with a total drilling length of 20.9m.

• Geotechnical Investigation for Bridge Foundation Design

42 boring tests were undertaken at 19 bridge sites, with a total drilling length of 1,240.8m.

• Soil Investigation for Soft Ground Sections

Six boring tests were undertaken at six locations, with a total drilling length of 92.7m.

• Soils Investigation for Sianib Section

Three boring tests were undertaken at Sianib Section which has been suffering very fast pavement deterioration, with a total drilling length of 31.4m.

• Soils Investigation for Liboganon River Dike Design

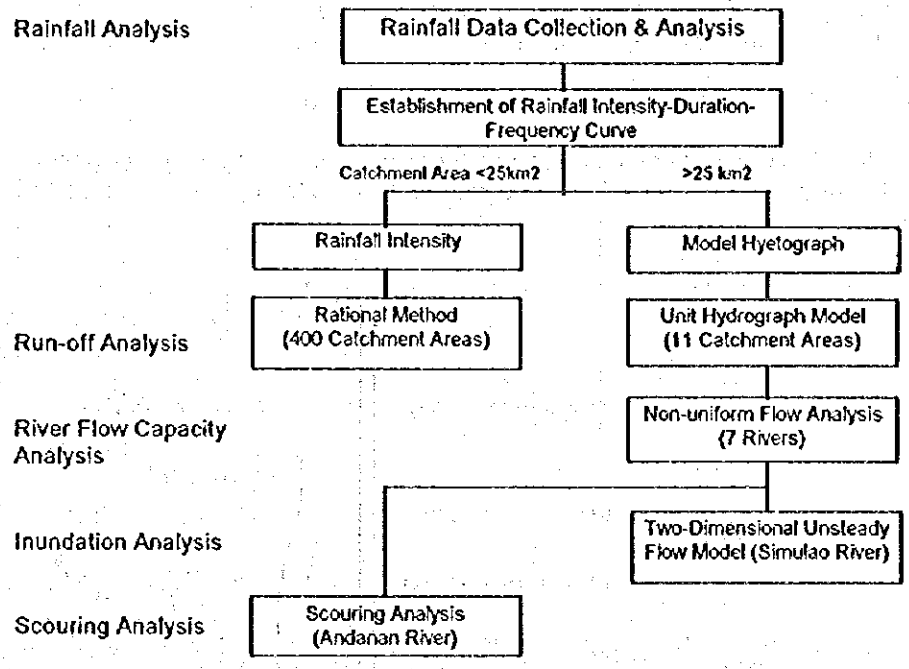
Two boring tests were undertaken at Liboganon River dike construction site, with a total length of 51.9m.

• Material Sources Investigation

- 19 test pittings at 19 borrow sources
- 38 test pittings at 19 base/subbase sources
- 38 test pittings at 19 concrete aggregate sources

2.4 HYDROLOGICAL INVESTIGATION

- Analysis Procedure



- Major Results of Analysis

  - Design Discharge

    Peak discharge at specific point of each catchment area to be used for design of bridge reconstruction and countermeasures against flood was determined.

  - Scouring at Andanan Bridge

    Based on the scouring analysis, future scouring depth is estimated to be 2.5m.

  - Simulao River Flood Area

    Based on the inundation analysis assuming 25-year return period, a recommended countermeasure for this flood area is to raise the road in two portions: 2.42 km section (Km 1355+200 to Km 1357+620) to EL26.0m and 1.12km section (Km 1360+100 to Km 1361+220) to EL28.0m.

  - Monkayo Flood Area

    Construction of a bypass road is proposed for this flood area to avoid the flood section. Based on the simulation of the 1994 flood by non-uniform flow analysis, the peak discharge is found to be Q=2,900 m³/s, resulting in the high water level to be EL51.0m at the new bridge point along the proposed bypass road and EL52.5m at Tina Bridge and Banlag Bridge.

  - Liboganon River Flood Area

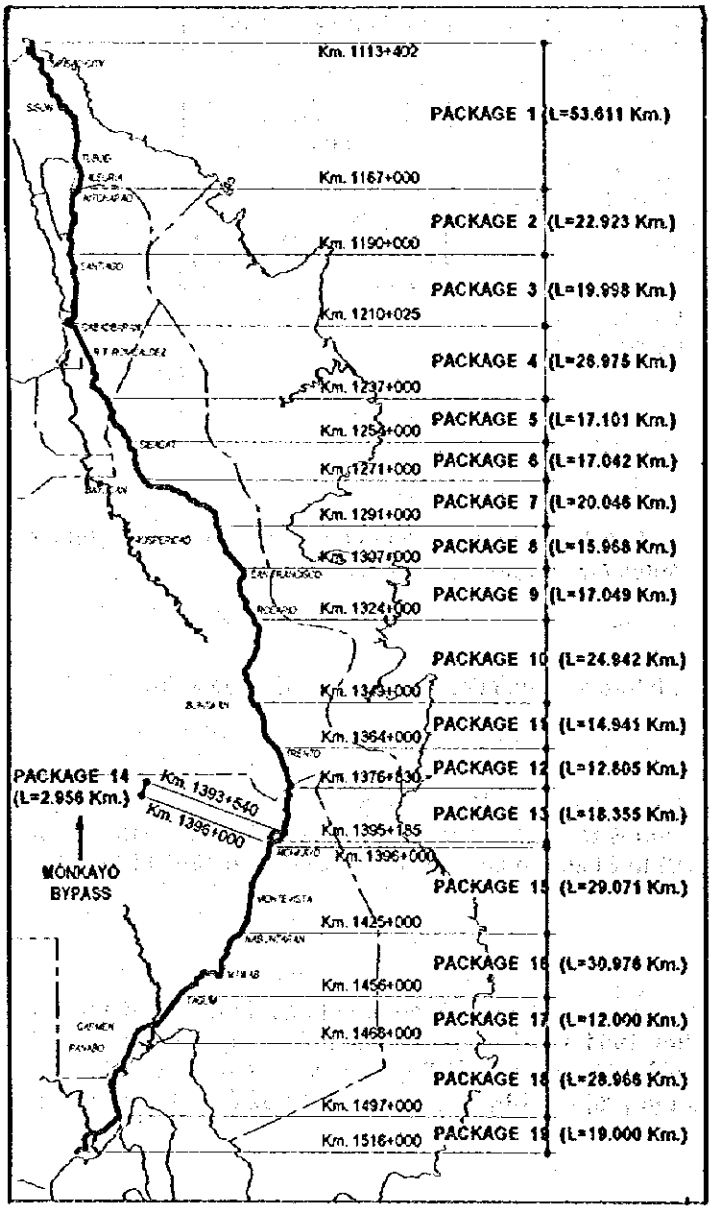
    Upstream side of the project road is protected by the dike except some 1.5km section on the left side of Liboganon River. Construction of dike at the missing section and a bridge between dikes is proposed. Based on the non-uniform flow analysis, the length of the new bridge is recommended to be 650m. In this case, the high water level is estimated to be EL5.0m.

3. CONTRACT PACKAGING

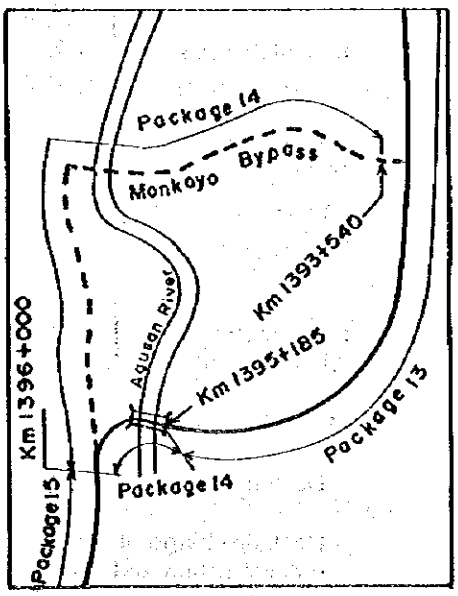
Basic consideration given in the division of the project into contract packages are as follows:

- Construction period of a package should not exceed three years.
- Construction cost of a package should be within the range between 100 to 500 million pesos.
- Maximum road length of a package should be about 50 km.

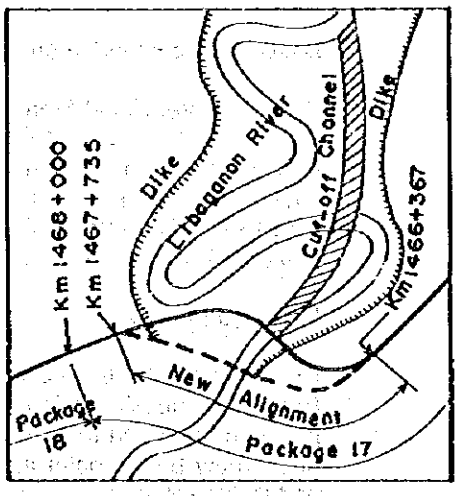
Based on the above considerations, the project is divided into 19 contract packages. KM posts and bridge ends are selected as the boundaries of contract packages so as to be easily identified.



CONTRACT PACKAGES



DETAILE OF BYPASS SECTION



DETAILE OF REALIGNMENT SECTION IN PACKAGE 17

4. DETAILED DESIGN OF ROADWAY REHABILITATION / IMPROVEMENT

4.1 GEOMETRIC DESIGN STANDARDS

terrain / Design Speed / Design Element	Flat	Rolling	Mountainous	
	80 km/hr.	60 km/hr.	50 km/hr.	40 km/hr.
Lane width	3.35 m	3.35 m	3.35 m	3.35 m
Pavement width	6.70 m	6.70 m	6.70 m	6.70 m
Shoulder width	2.50 m	2.50 m	2.50~1.00 m	2.50~0.50 m
Minimum Radius	220 m	120 m	80 m	50 m
Maximum Grade	4.0%	5.0%	7.0%	8.0%
Absolute Max.Grade & It's Max. Length	-	6% : 500 m 7% : 400 m	8% : 400 m	-

4.2 PAVEMENT DESIGN

- Rehabilitation Criteria

The rehabilitation requirement index (RRI) is employed as an indicator of evaluating necessity/urgency of rehabilitation. The RRI is expressed as follows:

$$RRI = 5.12 - 2.1 \log R - 0.087 \sqrt{D}$$
$$D = C + 0.63P + 0.18S + 6Dp + 2H$$

where;

R = International roughness index (m/km)
D = pavement distress factor
C = crack (m/1,000m²)
P = patching (m²/1,000m²)
S = scaling (m²/1,000m²)
Dp = depression (No./1,000m²)
H = pothole (No./1,000m²)

The scale for RRI ranges from 0 through 5, with the value of 5 representing the highest index. The terminal RRI is the lowest acceptable level before rehabilitation becomes necessary. An index of 2.5 is recommended for use as the terminal RRI in the rehabilitation design of major highways. In this Study, the pavement with RRI of 3.0 or less at present is selected for rehabilitation, considering the possible decrease of RRI until the time of implementation.

Crack ratio of 59.4m per 1,000m², which is more or less equivalent to RRI of 3.0, is used as the threshold of the rehabilitation section.

- Rehabilitation Method

Three types of rehabilitation methods are proposed; PCC reconstruction, AC reconstruction and AC overlay. The criteria for selecting the rehabilitation method is as follows:

- PCC reconstruction is applied to the sections where either of the following three conditions is satisfied: ① serious distress such as heavy depression or localized settlement, pumping and/or water bleeding, block or alligator crack with depression, or crack with fault is observed, ② drainage condition is assessed to be bad, and ③ RRI is less than 1.5.
- AC reconstruction is applied to weak subgrade sections where existing pavement settles.
- AC overlay is applied to all other sections.

• Design Standard

The AASHTO Guide for Design of Pavement Structures, 1993 is applied.

The initial performance period which is defined as "the performance period of the initially rehabilitated or reconstructed pavement before next rehabilitation is required" is assumed as follows:

- PCC reconstruction : 12-20 years depending on traffic loading
- AC reconstruction : 10 years
- AC overlay : 10 years

• Work Quantity

Rehabilitation Method	Thickness of PCC Slab/ AC Surface Course	Total Length
PCC Reconstruction	23 cm	12.31 km
	25 cm	81.32 km
	28 cm	6.52 km
AC Reconstruction	10 cm	7.34 km
AC Overlay	8 cm	86.05 km
	10 cm	34.61 km
	12 cm	13.18 km
Total		241.33 km

4.3 SHOULDER DESIGN

• Rehabilitation/Improvement Criteria

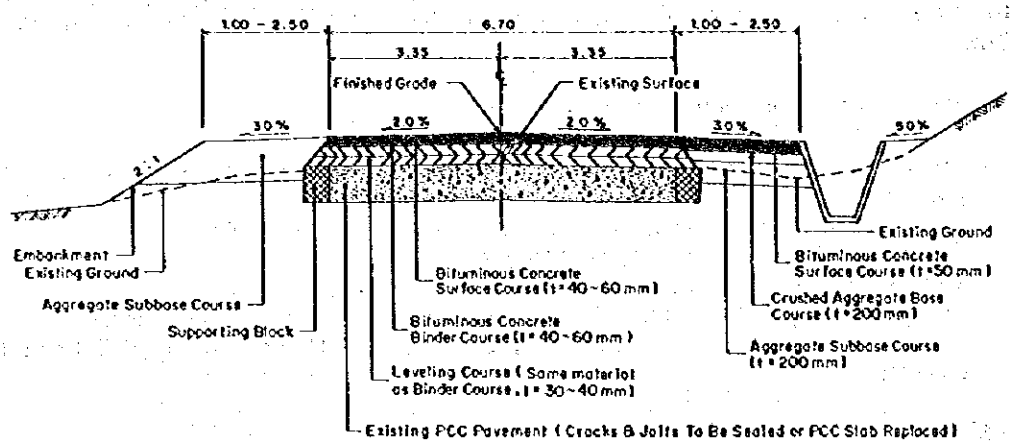
① Earth shoulder shall be gravelled.
② Shoulder with distress such as drop-off, heave or score shall be restored.
③ Shoulder with vertical gradient of 5% or more shall be paved to prevent from being scoured.
④ Shoulder in a dense residential area shall be paved to provide the space for pedestrians/pedicabs/tricycles.

The sections which need only shoulder rehabilitation/improvement under criteria ① or ② and no other work such as pavement rehabilitation or drainage improvement are not included in this project, expecting the work to be undertaken as a maintenance work.

• Work Quantity

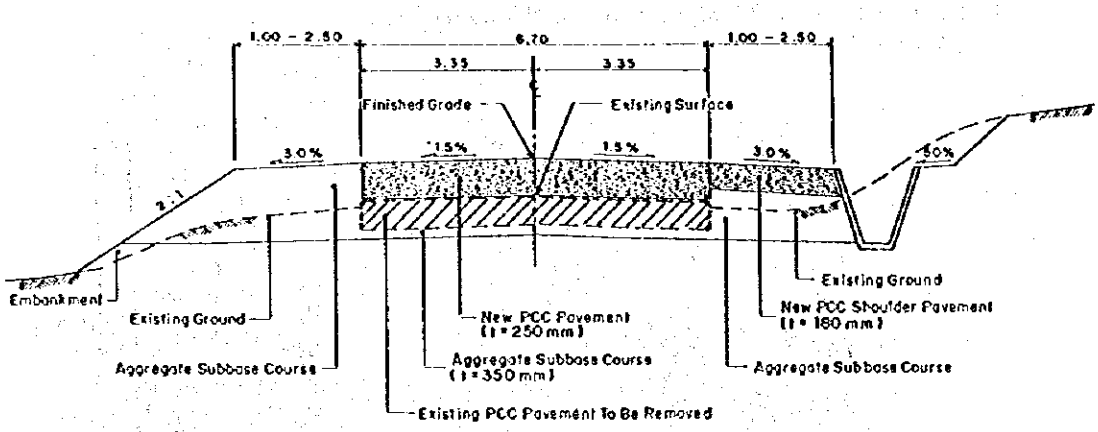
Type	Pavement Thickness	Application	Total Length
Gravel	-	Where paving is not required	587.84 km
AC pavement	5 cm	Where AC overlay or AC reconstruction is applied to the roadway.	81.36 km
PCC pavement	23 cm	From Tagum to the end of the project road, expecting frequent utilization of heavy vehicles.	3.13 km
	18 cm	Other than the above	83.30 km
Total			755.63 km

TYPICAL ROADWAY CROSS-SECTIONS



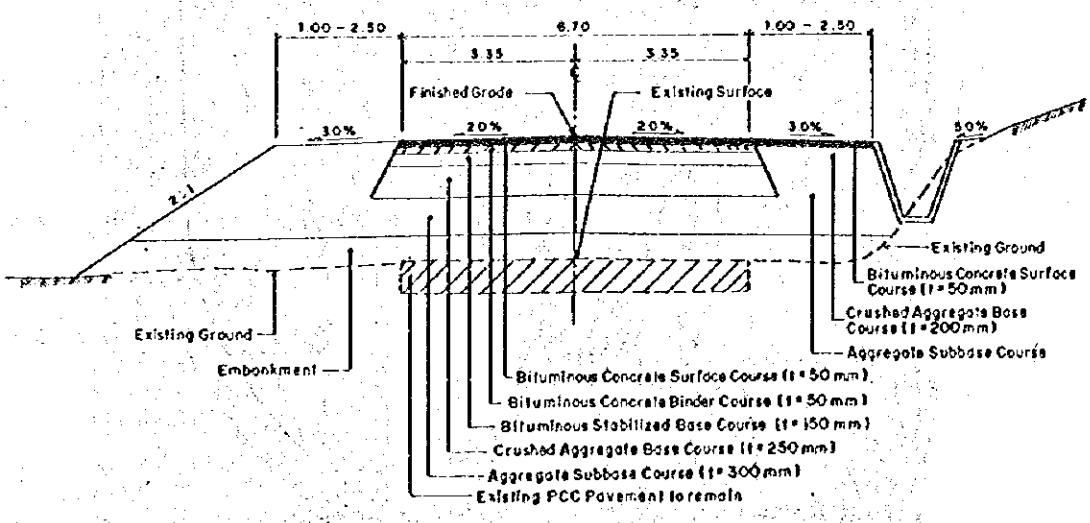
AC OVERLAY

AC OVERLAY WITH AC SHOULDER



PCC RECONSTRUCTION

PCC, RECONSTRUCTION WITH PCC SHOULDER



AC RECONSTRUCTION

AC RECONSTRUCTION WITH AC SHOULDER

4.4 DESIGN OF MONKAYO BYPASS

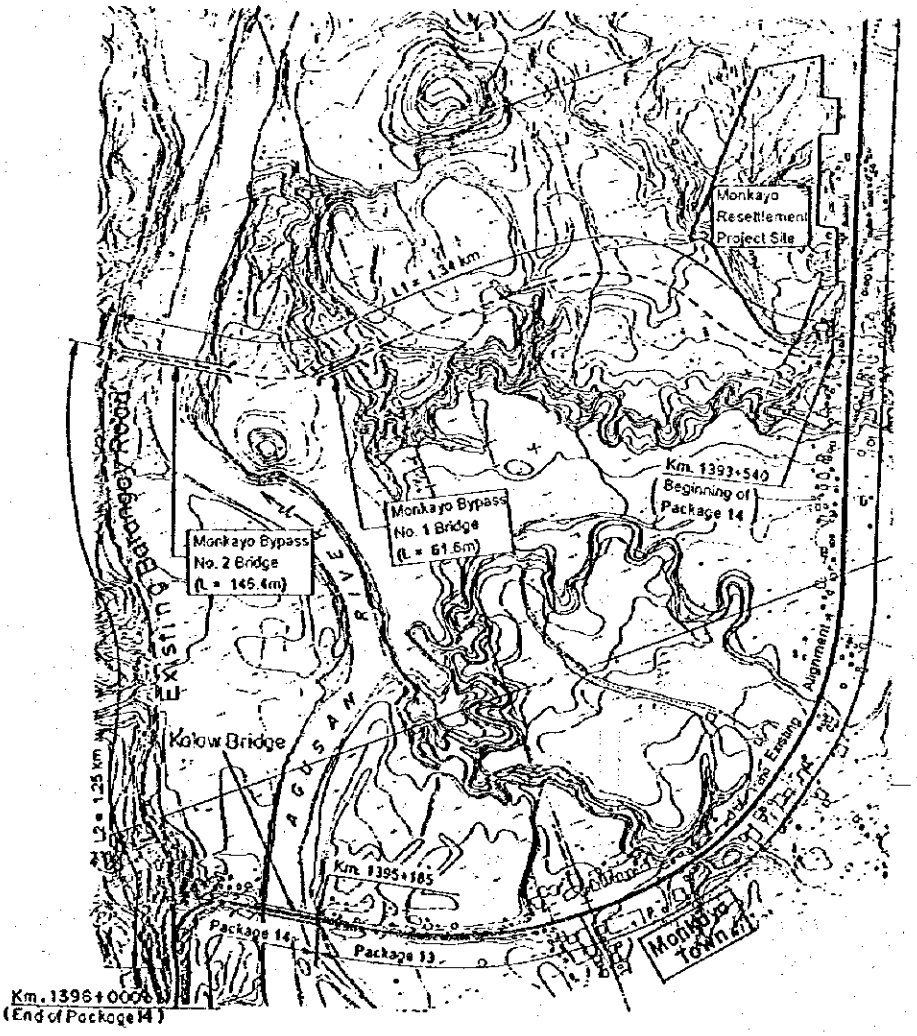
Monkayo Bypass is proposed to avoid the flood section in Monkayo, Davao del Norte, where the high water level of Agusan River for a return period of 50 years is estimated to be EL51.0m, submerging 2.4 km section of the highway including Kalaw Bridge and Monkayo Town.

- Basic Considerations in the Route Selection

  - To utilize the existing barangay road on the left side of Agusan River as much as possible.
  - To cross Agusan River at the location where river course is stable.
  - To consider Monkayo Resettlement Project.
  - To consider the possibility of future roadside development.
  - To minimize right-of-way acquisition and dislocation of houses and residents.
  - To avoid the cutting of steep mountain slope adjacent to the barangay road as much as possible.

- Major Works

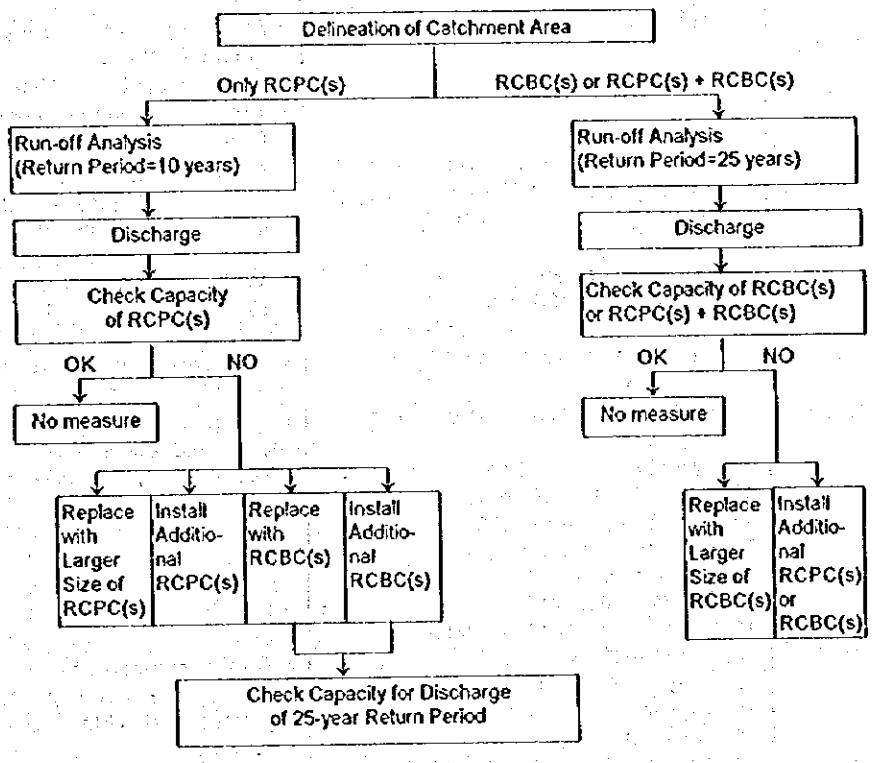
  - Road construction: 2.59 km
  - Bridge construction: 2 bridges with a total length of 208m
  - Slope protection



5. DETAILED DESIGN OF DRAINAGE IMPROVEMENT

5.1 CULVERTS

- Procedure for Capacity Analysis and Improvement Measures



- Other Related Works
  - Extension of existing culverts
  - Installation of headwalls and catch basins
  - Provision of scour prevention measures and slope protection measures

5.2 SIDE DITCH

- Design Discharge
  5-year return period rainfall is used to determine the design discharge.
- Material
  Concrete side ditches are proposed for easier maintenance.
- Longitudinal Slope
  Maximum slope is 4% and minimum slope is 0.5% in rural areas and 0.35% in urban areas.

5.3 SUBSURFACE DRAINAGE

Subsurface drainage is proposed for sections where underground water level is high.

5.4 WORK QUANTITIES

Replacement of culverts	RCPC to bigger size of RCPC	322
	RCPC to RCBC	98
	RCBC to bigger size of RCBC	1
Additional Culverts	RCPC	89
	RCBC	23
Improvement of Culverts	RCPC	644
	RCBC	36
Scour & Slope Protection Only	RCPC	9
	RCBC	28
Concrete Side Ditch		160.44 km
Subsurface Drainage		18.07 km

6. DETAILED DESIGN OF BRIDGE REHABILITATION/IMPROVEMENT

6.1 REHABILITATION/IMPROVEMENT METHODS AND APPLICATION CRITERIA

Category	Rehabilitation/Improvement Method	Application Criteria
A. Total Reconstruction	1. Total Reconstruction of Bridge	• All substructures are inadequate in structural capacity. • Load limit is below 15 tons. • Freeboard is insufficient causing flood.
B. Partial Reconstruction	2. Reconstruction of Entire Slab of Span 3. Reconstruction of All Girders of Span 4. Reconstruction of Substructure	• Main structures are deteriorated to the degree of being inadequate in bearing/structural capacity.
C. Widening	5. Widening of Carriageway or Construction of Additional Bridge 6. Widening of Sidewalk	• Width of carriageway and/or sidewalk is inadequate.
D. Extension	7. Construction of Additional Span	• Approach road encroaches on waterway.
E. Major Repair	8. Partial or Total Reconstruction of Railing 9. Partial Reconstruction of Slab 10. Reconstruction of Concrete Girder 11. Replacement of Steel Girder/Member 12. Replacement of Bearing 13. Repair of Bridge Seat 14. Reinforcement of Pier 15. Reinforcement of Foundation	• Bridge components are seriously damaged but still repairable or economically reinforceable/replaceable.
F. Minor Repair	16. Repair of Slab 17. Repair of Concrete Girder 18. Repainting of Steel Girder/Member 19. Repair of Substructure 20. Provision/Reconstruction of Slab Overlay	• Bridge components are slightly deteriorated needing repair to prolong usable life.
G. Protection from Scour	21. Repair of Abutment Slope Protection 22. Provision/Reconstruction of Abutment Slope Protection 23. Provision/Reconstruction of Pier Foundation Protection 24. Provision/Reconstruction of River Bank Protection	• Abutment slope, pier foundation and/or river bank are scoured.
H. Approach Road Protection	25. Provision/Reconstruction of Approach Road Embankment Slope Protection 26. Provision of Approach Slab	• Approach road embankment is eroded or sinks by 20cm or more.
I. River Control	27. Provision of Spurdike 28. Dredging	• Control of river flow direction is needed to protect river bank or riverbed rises due to sedimentation.
J. Aseismatic Protection	29. Widening of Bridge Seat 30. Provision of Shear Key and/or Slab Connection	• Bridge length is 35m or more.

Note: The bridges needing only minor works (Methods 16 to 21) are not included in this project, expecting those works to be undertaken as a maintenance work.

6.2 DESIGN STANDARD

The AASHTO Standard Specifications for Highway Bridges, 1992 with Interim Specifications 1993, 1994 and 1995 is applied.

6.3 NUMBER OF BRIDGES FOR REHABILITATION/IMPROVEMENT

Rehabilitation/Improvement Method	To be implemented under this project	Already implemented or being implemented by DPWH	To be implemented under DPWH maintenance program	Total
Total Reconstruction	18*	4	-	22
Partial Reconstruction				
Slab	5	-	-	5
Girders	24	-	-	24
Widening				
Carriageway	-	2	-	2
Other Rehabiliation	27	-	-	27
Minor Works Only	-	-	47	47
Total	74	6	47	127

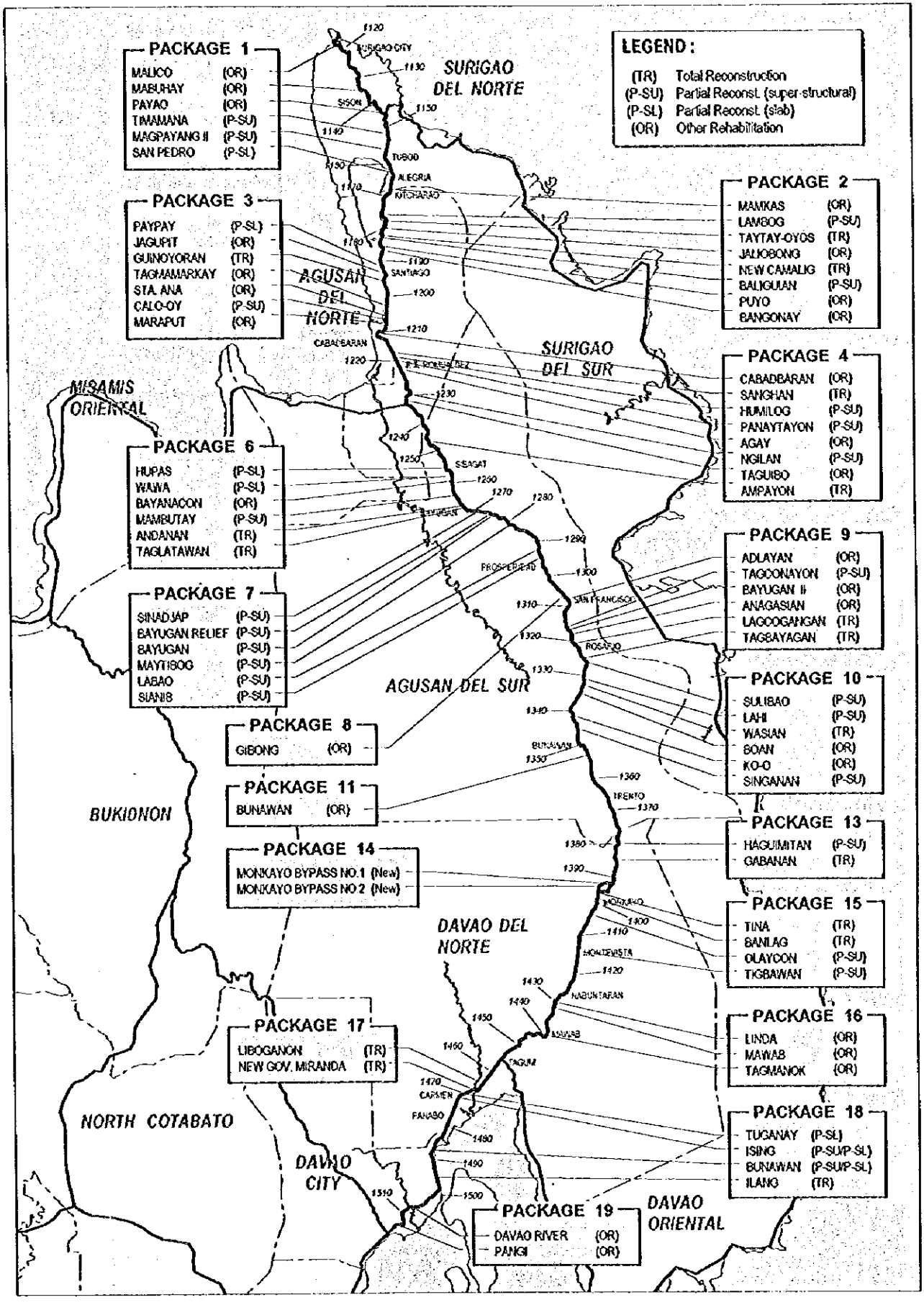
* including widening and extension

6.4 OUTLINE OF TOTAL RECONSTRUCTION BRIDGES

Bridge No. & Name	Existing Bridge	Justification of Reconstruction	New Bridge
2-03 Taytay-Oyos	1-span RCDG * (L=3.4+14.0+3.4=20.8m)	• Wide shear cracks at girders. • Needs to widen.	2-barrel RCBC (L=2x6.5=13.0m)
2-05 New Camalig	3-span RCDG (L=3x14.0=42.0m)	• Severe spalling at girders. • Needs to widen.	3-span RCDG (L=3x16.0=48.0m)
2-12 Guinoyoran	1-span RCDG * (L=3.5+14.0+3.5=21.0m)	• Wide shear cracks at girders. • Needs to extend.	2-span PCDG (L=2x22.25=44.5m)
2-21 Sanghan	2-span RCDG (L=2x12.0=24.0m)	• Wide shear cracks at girders. • Wide cracks at bridge seat.	1-span PCDG (L=26.1m)
3-07 Ampayon	2-span Precast Slab (L=2x6.0=12.0m)	• Precast slab seriously deteriorated. • Needs to widen sidewalks.	1-span PCDG (L=22.0m)
4-06 Andanan	12-span RCDG (L=12x15.0=180.0m)	• Wide shear cracks at girders. • Deep scouring at piers.	7-span PCDG (L=7x25.7=179.9m)
4-07 Taglatawan	3-span RCDG (L=8.0+10.0+8.0=26.0m)	• Wide shear cracks at girders. • Needs to widen to 4-lane.	1-span PCDG ** (L=22.1m)
4-24 Lagcogangan	2-span RC Slab, 1-span RCDG (L=6.0+10.0+6.0=22.0m)	• Abutments settled due to soft ground. • Piers settled & tilted.	1-span PCDG (L=21.3m)
4-25 Tagbayagan	3-span RCDG (L=3x10.0=30.0m)	• Uneven settlement of substructures due to soft ground.	1-span PCDG (L=25.3m)
4-29 Wasian	2-span RC Slab, 1-span RCDG (L= 6.0+10.0+6.0=22.0m)	• Abutments settled due to soft ground.	1-span PCDG (L=25.3m)
5-04 Gabanan	3-span RCDG (L=3x15.0=45.0m)	• Wide shear cracks at girders. • Deep scouring at piers.	2-span PCDG (L=2x26.5=53.0m)
Monkayo Bypass, No.1	-	• New alignment.	3-span PCDG (L=3x20.5=61.5m)
Monkayo Bypass, No.2	-	• New alignment.	4-span PCDG (L=4x36.6=146.4m)
5-08 Tina	3-span RCDG (L=9.7+11.9+9.7=31.3m)	• Submerged during heavy rain.	1-span PCDG (L=31.3m)
5-09 Banlag	3-span RCDG (L=6.0+15.0+6.0=27.0m)	• Submerged during heavy rain.	1-span PCDG (L=31.3m)
5-20 Liboganon	3-span RCDG (L=10.0+12.0+10.0=32.0m)	• 10-ton load limit.	1-span PCDG (L=31.3m)
5-21 Gov. Miranda	2-span RC Box Girder, 2-span Through Truss (L=23.15+2x49.6+23.15=145.5m)	• Planned as a part of countermeasures for Liboganon River flood area.	18-span PCDG (L=18x36.1=649.8m)
6-02 Ilang	2-span RCDG (L=12.0+6.0=18.0m)	• Needs to widen to 4-lane.	1-span PCDG ** (L=22.3m)

* with cantilever spans on both sides

** 4-lane bridge



BRIDGES TO BE REHABILITATED / IMPROVED UNDER THIS PROJECT

7. DETAILED DESIGN OF SLOPE PROTECTION

7.1 DESIGN CRITERIA

- Basic Policies
  - Protection works shall be selected in due analysis of causes of failue.
  - Emphasis shall be placed on drainage works.
  - Due consideration shall be given to environmental preservation.
  - Locally available materials shall be used as much as possible.

- Design Standard
  The following guidelines are referred to:
  - Design Guidelines, Criteria and Standards, BOD, DPWH
  - Guidelines for Slope Protection and Stability Works, Japan Road Association

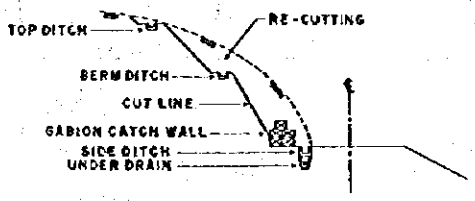
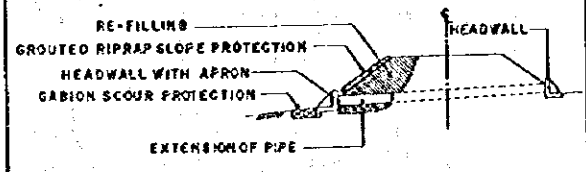
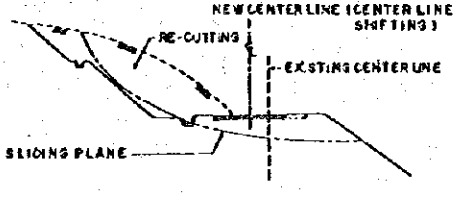
7.2 NUMBER OF DISASTER SLOPES

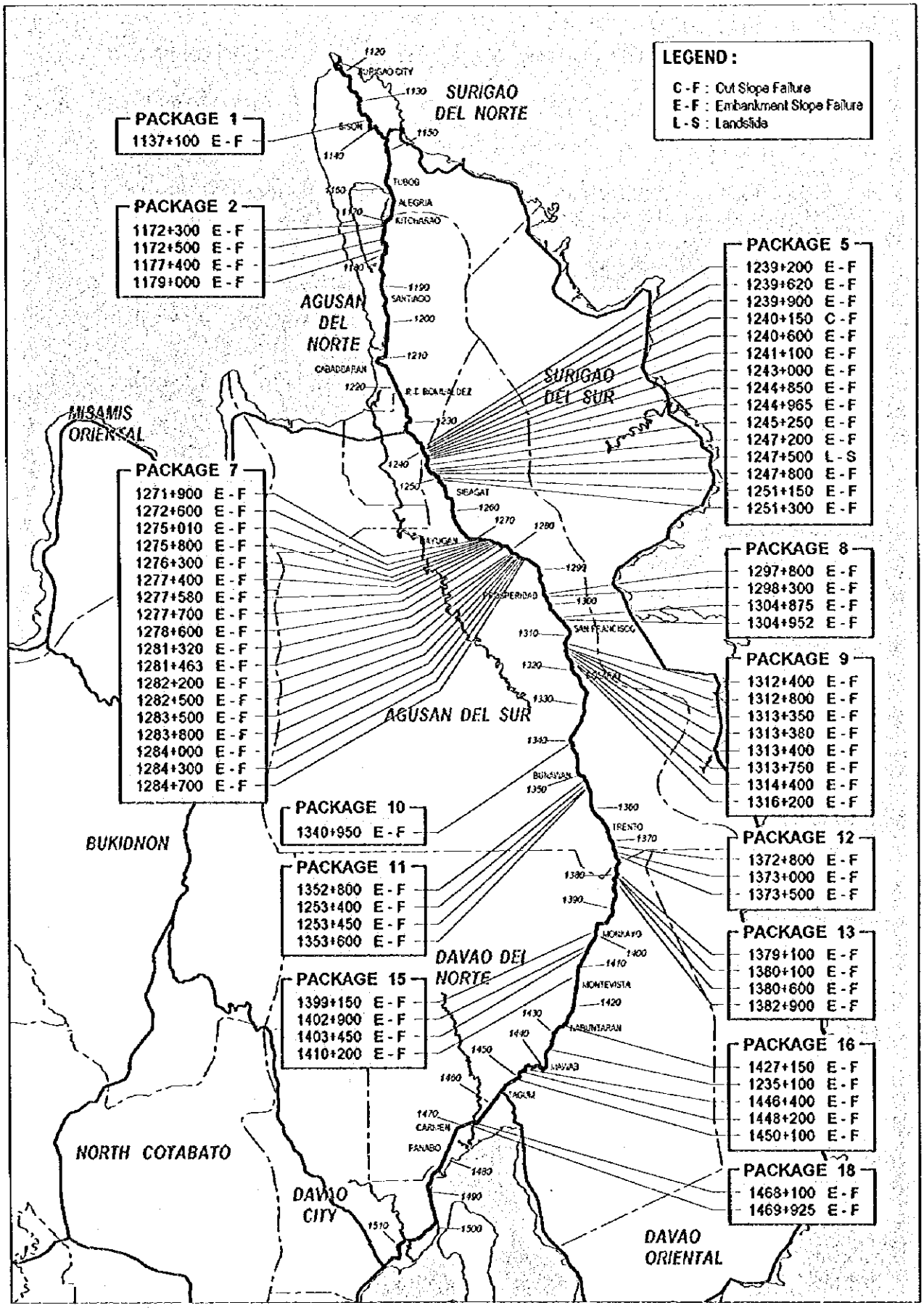
Road slope disasters found in the project road are classified into:
①cut slope failure, ②embankment slope failure, ③debris flow, and ④landslide.

Number of disaster slopes is as follows:

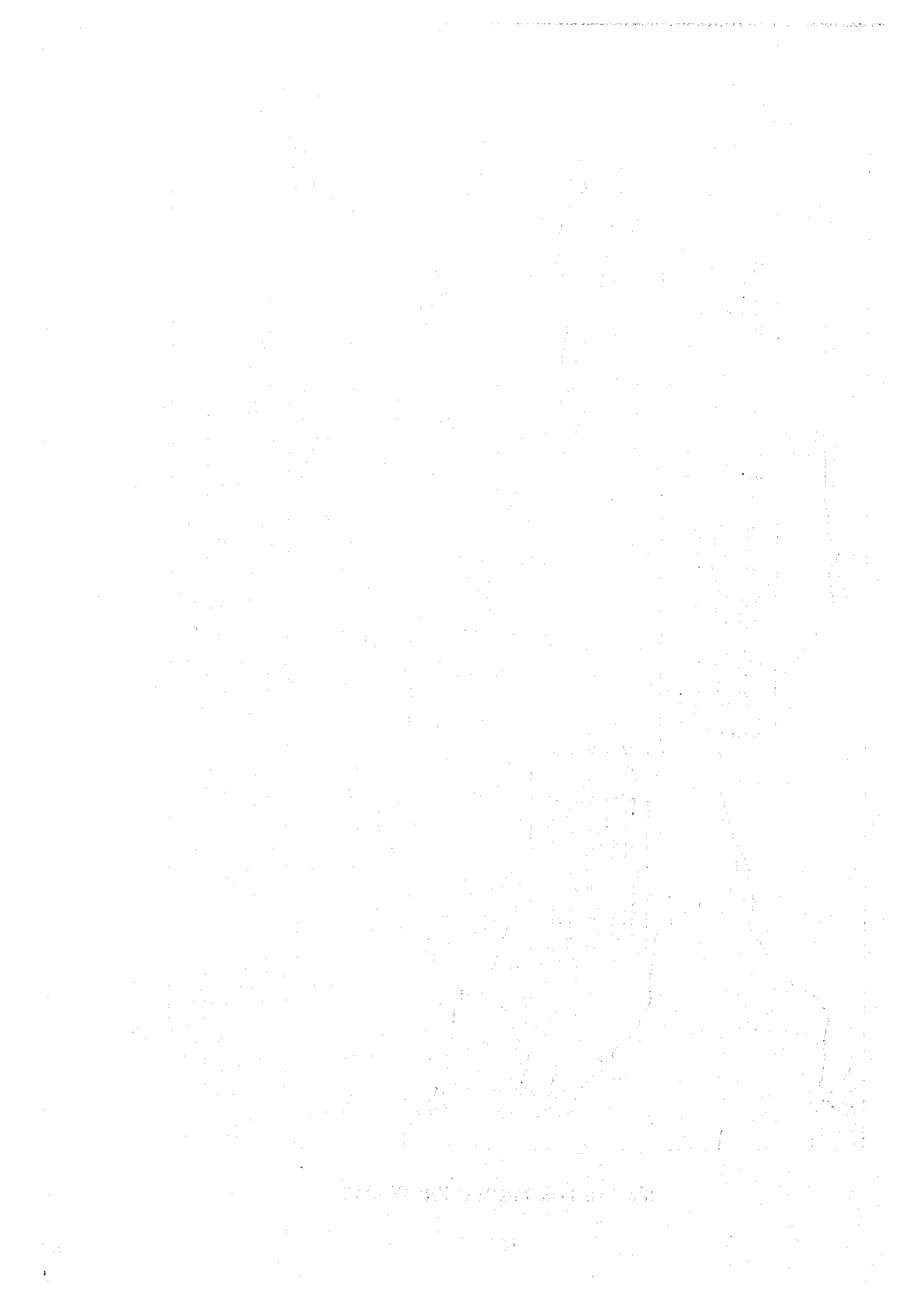
Type of disaster	To be restored under this project	Already restored by DPWH	Total
Cut slope failure	1	1	2
Embankment slope failure	71	13	84
Debris flow	-	2	2
Landslide	1	-	1
Total	73	16	89

7.3 TYPICAL DESIGNS

Type of Disaser	Illustration	Major Works
Cut Slope Failure		• Recutting with stable gradient. • Gabion catch wall.
Embankment Slope Failure		• Extension, replacement or provision of culvert. • Improvement of inlet and outlet facilities. • Improvement/provision of side ditch. • Slope protection by grouted riprap.
Landslide		• Cutting of mountain side slope. • Vegetation on re-cut slope.



SLOPES FOR PROTECTION WORKS



8. DETAILED DESIGN OF COUNTERMEASURES AGAINST FLOOD

8.1 DESIGN CRITERIA

- Severity of Flood

Severity of flood is dependent on flood depth, duration and frequency. For the purpose of selection of coutermeasures, severity of flood is assessed based on the following criteria:

Average Depth	Duration	Return Period (years) <2	2-5	5-10	10-15	>15
Less than 15cm (Passable to all types of vehicles with care)	Any	B	C	D	D	D
15-30cm (Passable to bus & truck only)	< 5 hrs	B	B	C	D	D
	> 5 hrs	A	B	B	C	D
30 cm or more (Impassable to all types of vehicles)	< 5 hrs	A	A	B	B	B
	> 5 hrs	A	A	A	B	B

A = High
B = Medium
C = Low
D = Negligible

- Type of Countermeasures

Location of Countermeasure	Type of Countermeasure	Purpose
Countermeasure along the road	1. Protection of road from damage by flood water	Road protection
	2. Installation of flood interception canal on the side of road	Flood prevention
	3. Raise of road above expected high water level	
Countermeasure along the river	4. Riverbed dredging to increase discharge capacity of river	
	5. Construction of flood protection dike	
	6. Provision of cut-off channel to increase discharge capacity of river	
Special Measure	7. Construction of bypass	Avoiding flood section

- Selection Criteria of Countermeasures

  - Countermeasures along the road (Countermeasures 1-3) are preferentially selected. The basic criteria for selection of type of countermeasure is as follows:

Severity of Flood	Roadside Development	Countermeasure to be Selected
A or B	high	2
A or B	low	3
C	irrespective of high or low	1
D	irrespective of high or low	Do nothing

  - Countermeasures along the river (Countermeasures 4-6) are selected where flood damage other than the road is also serious and it is economically worth to protect vicinity area as well as road itself, and/or where it is obvious that countermeasures along the river is technically and economically superior to countermeasures along the road.

  - Special measure (Countermeasure 7) is adopted when other measure is costly and its effect is not very sure.

- Design Return Period

50 years for bridges, 25 years for box culverts, 10 years for pipe culverts, 10 years for embankment (except for Simulao River flood area where 25 years is used), and 50 years for Liboganon River bank.

8.2 DESIGN OF EACH FLOOD SECTION

Package	Flood Section No.	Location (Km)	Flood Section Length (m)	Severity of Flood	Counter-measures Adopted *
1	1	1160+700~1161+700	1,000	A	3
1	2	1163+600~1164+100	500	B	3
1	3	1164+750~1165+100	350	A	3
1	4	1166+600~1167+900	1,300	A	2
2	5	1182+100~1182+590	490	B	2
2	6	1183+100~1183+260	160	C	1
2	7	1184+250~1185+200	950	A	[3]
2	8	1187+600~1189+200	1,600	A	3
3	9	1192+000~1193+800	1,800	A	2
3	10	1196+400~1196+720	320	B	[1] + 4
3	11	1199+600~1203+870	4,270	A	3
4	12	1219+700~1220+100	400	C	3
4	13	1224+200~1224+640	440	B	[3] + 4
11	14	1355+200~1357+620	2,420	A	3
		1360+100~1361+220	1,120		
14	15	1393+400~1398+300	2,400	A	3 + 7
17	16	1460+500~1468+000	7,500	A	5 + 6

* [ ] : already implemented or being implemented by DPWH.

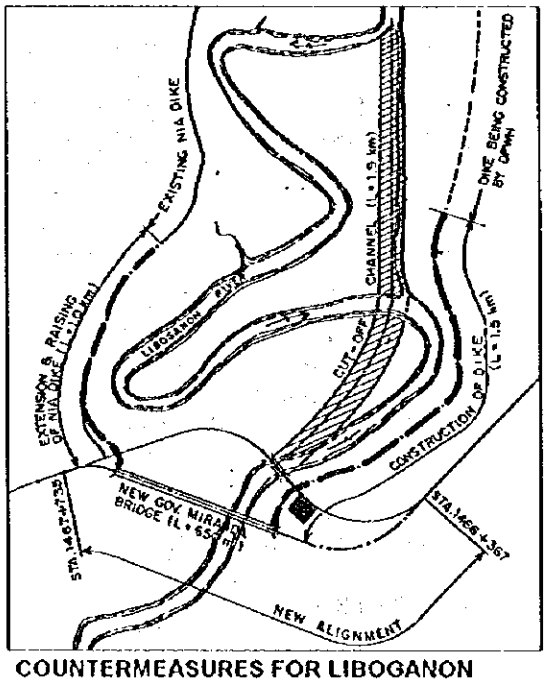
8.3 OUTLINE OF LARGE-SCALE MEASURES

- Monkayo Flood Area (Flood Section 15)

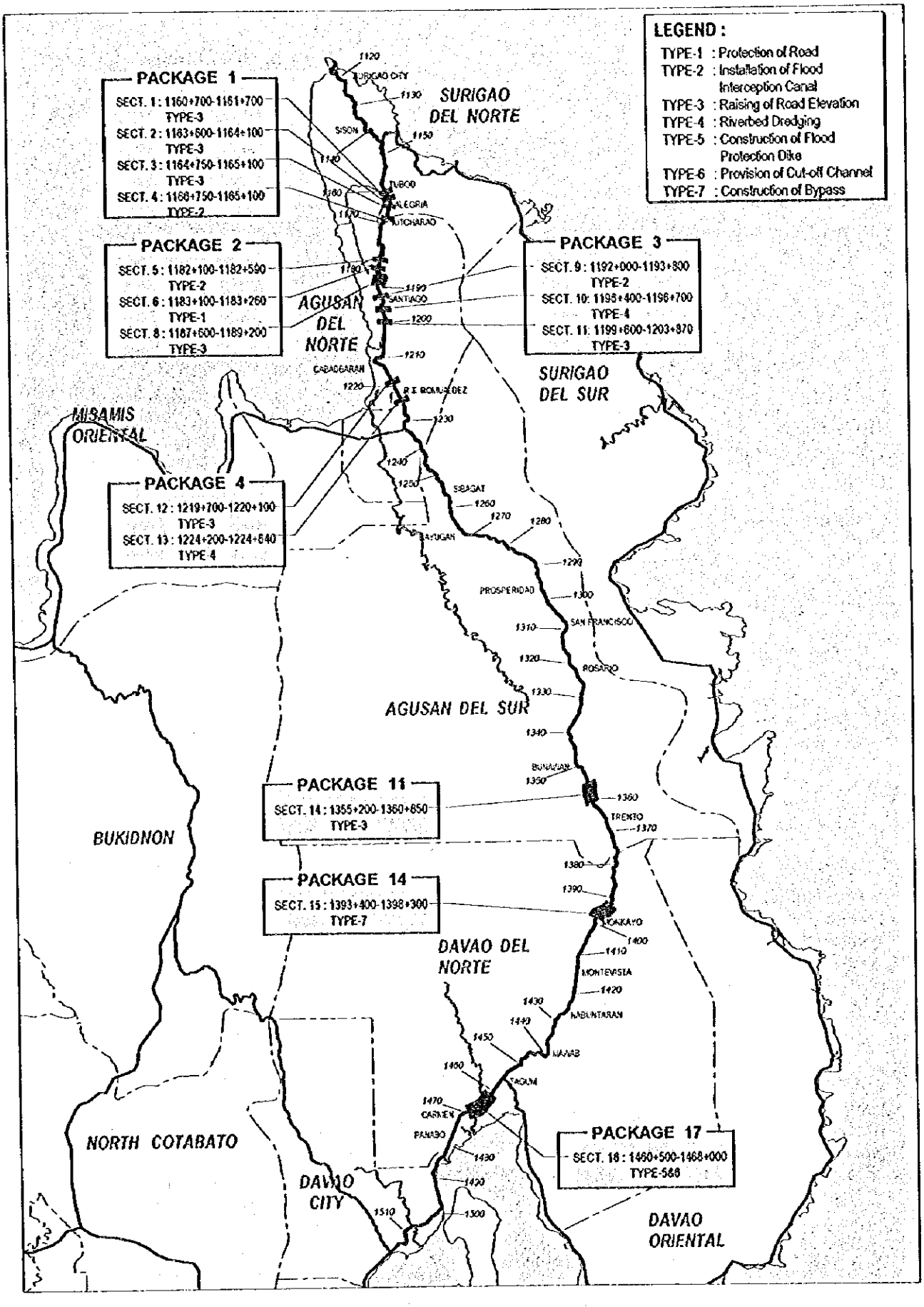
Proposed countermeasures are:
- Construction of Monkayo Bypass (See Chapter 4.4).
- Raise of road for 300m section including Tina Bridge and its approaches by 1.0m at the bridge location and reconstruction of Tina Bridge.
- Raise of road for 410m section including Banlag Bridge and its approaches by 4.0m at the bridge location and reconstruction of Banlag Bridge.

- Liboganon River Flood Area (Flood Section 16)

Proposed countermeasures are:
- Construction of incompleted portion of dike on the left side of Liboganon River (1.5km)
- Extension and raising of dike on the right side (1.0km)
- Construction of cut-off channel (1.9km)
- Construction of New Gov.Miranda Bridge (l = 650m)



COUNTERMEASURES FOR LIBOGANON RIVER FLOOD AREA



FLOOD SECTIONS NEEDING COUNTERMEASURES

9. CONSTRUCTION PLAN

9.1 BASIC PRINCIPLES

Major requirements in construction are as follows:

- In principle, construction works shall be done in accordance with the "DPWH Standard Specifications for Public Works and Highways, 1988".
- Road traffic shall be maintained during construction within the existing road width except in case of constructing detours for reconstruction of bridges.

9.2 MAINTENANCE OF TRAFFIC

- Road Work (Pavement, Shoulder, Drainage, Slope Protection)
  In principle, road works are planned to be executed side by side. During the construction of one side, the other side is open to traffic in one-way operation.
- Total Reconstruction of Bridge
  There are two cases depending on the site conditions: ①construction of a detour road including a temporary bridge, and ②construction of a new bridge adjacent to the original bridge and re-alignment of road after completion of the new bridge.
- Partial Reconstruction of Bridge
  There are also two cases: ①detour road construction, and ②side-by-side construction maintaining traffic on one side.

9.3 CONSTRUCTION METHOD

- Roadway Rehabilitation/Improvement Works
  Major works are: ①removal of existing pavement, ②embankment, ③subgrade preparation, ④subbase / base course, and ⑤ surface course.
- Bridge Construction
  The method and sequence of bridge construction are: ①construction of temporary jetty, ② piling, ③cofferdam and footing, ④substructure, ⑤fabrication of precast girders at yard, ⑥hauling and erection of girders by track crane, and ⑦cross beam and slab.

All works will be done by usual methods commonly used in the Philippines.

9.4 CONSTRUCTION MATERIALS

Construction materials required for the project are classified into two: goods on the market and materials to be obtained from sources/quarries near the project sites. Goods on market include portland cement, bituminous materials, structural steel, reinforcing steel, prestressing steel, fuel, lumber, steel mesh of gabion, etc. All goods are procurable within the country. Material from sources/quarries include borrow materials, aggregates for subbase course, base course, asphalt concrete, portland cement concrete pavement and structural concrete, and boulders for riprap and gabion. Material sources have been identified for each package.

9.5 CONSTRUCTION EQUIPMENT AND PLANTS

Major equipment and plants required for the project are tractor crawler with dozer, wheel loader, backhoe crawler, dumptruck, grader, roller, asphalt sprayer, asphalt paver, water truck, vibrating hammer, reverse circulation drill, crawler crane, truck crane, crushing plant, batching plant, asphalt plant, etc. All equipment and plants are procurable within the country.

9.6 WORK PROGRAM AND CONSTRUCTION PERIOD

Construction period of each contract package is estimated as shown in Chapter 13, based on the work program prepared taking into account the volumes of work, workable days, capacity of equipment, number of equipment fleets, etc.

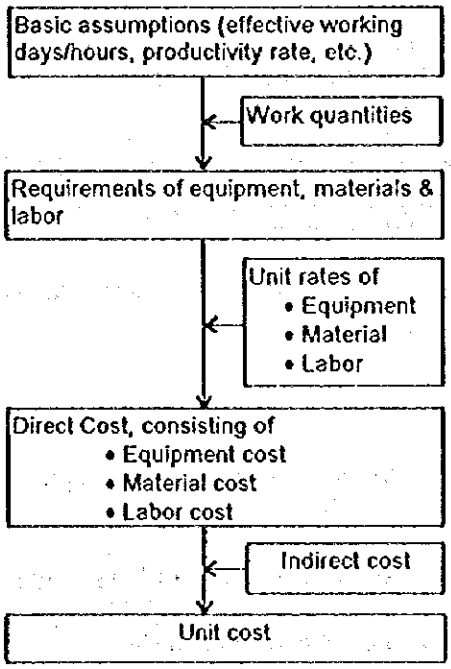
10. COST ESTIMATES

The project cost consists of the following:
- Construction cost
- Right-of-way acquisition and compensation cost
- Consultancy services cost for construction supervision

10.1 CONSTRUCTION COST

- Unit Cost Analysis

The procedure for unit cost analysis is as follows:



Unit rates are estimated as follows:

- Equipment: Associated Construction Equipment Lessors, Inc. (ACEL) rental rates are adopted.
- Materials to be purchased: Current market prices are adopted.
- Materials to be procured at site: Unit cost is estimated including processing, crushing, stockpiling, loading, royalties on quarries, local taxes, hauling, wastage/losses, etc.
- Labors: Salaries and wages authorized by the Department of Labor and Employment are adopted. Labor cost includes all fringe benefits.

Indirect cost is estimated in accordance with DPWH Department Order No. 30, as follows:

- Value added tax: 10% of direct equipment and labor costs
- Overhead, contingencies and miscellaneous expenses: maximum 10% of direct cost
- Contractor's profit: 10% of direct cost
- Mobilization and demolization costs: 7% of direct cost

- Construction Cost

The quantity of each pay item is multiplied by respective unit cost and their sum gives the construction cost.

10.2 RIGHT-OF-WAY ACQUISITION AND COMPENSATION COST

Right-of-way acquisition is required in the following areas:

Location	Contract Package No.	Land Area to be acquired (m^2)	No. of houses affected
Bridge reconstruction site			
New Camalig Bridge	2	1,000	-
Sanghan Bridge	4	1,000	4
Andanan Bridge	6	1,000	4
Lagcogangan Bridge	9	1,000	5
Tagbayagan Bridge	9	1,000	5
Gabanan Bridge	13	1,000	4
Tina Bridge	15	1,000	5
Banlag Bridge	15	1,000	5
Liboganon Bridge	17	4,000	-
Monkayo Bypass	14	66,000	32
Liboganon River Bank	17	124,000	-
Total		202,000	64

The right-of-way acquisition and compensation cost is estimated based on the current price in the project site.

10.3 CONSULTANCY SERVICES COST FOR CONSTRUCTION SUPERVISION

The consultancy services cost is estimated assuming 9.5% of the construction cost.

10.4 PROJECT COST

The project cost is summarized as follows:

(Unit: Million pesos at 1996 price)

Contract Package	Construction Cost Total	Foreign	Local	Tax	ROW Cost	Consultancy Cost	Total
1	281.7	115.6	110.0	56.0	-		
2	278.9	140.1	81.1	57.7	0.1		
3	131.4	63.2	39.8	28.4	-		
4	114.6	53.8	37.2	23.6	0.3		
5	254.6	115.4	87.4	51.9	-		
6	269.4	118.8	98.2	52.4	0.3		
7	384.1	164.7	142.3	77.1	-		
8	255.7	109.0	94.8	52.0	-		
9	222.7	109.9	67.4	45.4	0.7		
10	323.0	158.3	96.4	68.3	-		
11	169.2	84.6	49.1	35.5	-		
12	149.3	62.9	56.8	29.6	-		
13	244.2	123.1	70.4	50.6	0.3		
14	149.3	63.6	59.3	26.4	7.4		
15	301.0	149.9	88.3	62.8	0.7		
16	348.4	184.1	89.2	75.0	-		
17	453.6	216.2	141.4	95.9	25.6		
18	208.5	91.6	76.7	40.2	-		
19	97.5	39.1	39.5	18.9	-		
Total	4,637.0				35.4	440.5	5,112.9
Cost Component							
Foreign	2,163.9				-	277.5	2,441.4
Local	1,525.4				35.4	149.8	1,710.6
Tax	947.7				-	13.2	960.9

11. PREQUALIFICATION AND TENDER DOCUMENTS

11.1 PREQUALIFICATION DOCUMENTS

The prequalification documents are organized with the following:

- INVITATION TO PREQUALIFY AND TO BID states that the Government of the Philippines invites interested contractors to apply for prequalification and, if prequalified, to bid for the project.
- SECTION I INTRODUCTION presents the project background, objective of prequalification, and definitions of terms and abbreviations.
- SECTION II GENERAL PROJECT DESCRIPTION summarizes the project description and scope of work.
- SECTION III GENERAL INFORMATION ON CONTRACT prescribes the type of contract, financial conditions, duties and taxes, and bond and guarantee.
- SECTION IV GENERAL INSTRUCTIONS AND CONDITIONS FOR PREQUALIFICATION provides for prequalification time schedule, eligibility of applicants, clause on consortium, joint venture and sub-contractors, clause on subsequent change of partner-company or subcontractor, clarification and addendum, matters relevant to documents, and selection and notification of tenderers.
- SECTION V INSTRUCTIONS TO APPLICANTS FOR PREQUALIFICATION includes the instructions as to submittals and exchange rate to be adopted.
- SECTION VI PREQUALIFICATION FORMS shows all forms of the documents.

11.2 TENDER DOCUMENTS

The tender documents consist of the following five volumes:

- **VOLUME I** **PROPOSAL BOOK**
  - Invitation to Bid
  - Instruction to Bidders
  - Bid Form and Appendices to the Bid
  - Bill of Quantities
  - Draft Contract Agreement and Sample Forms
- **VOLUME II** **CONDITIONS OF CONTRACT**
  - Part I Conditions of Contract for Works of Civil Engineering Construction, FIDIC, Fourth Edition 1987; Part 1-General Conditions
  - Part II Conditions of Particular Application
- **VOLUME III** **TECHNICAL SPECIFICATIONS**
  - Part I DPWH Standard Specifications for Public Works and Highways 1988, Volume II
  - Part II Special Provisions
- **VOLUME IV** **CONTRACT DRAWINGS**
- **VOLUME V** **SUPPLEMENTAL NOTICES/ADDENDA TO THE BIDDING DOCUMENTS**

The bidders are required to obtain copies of FIDIC (to be used as VOLUME II, Part I) and DPWH Standard Specifications (to be used as VOLUME III, Part I) and VOLUME V will be prepared in the course of bidding. Therefore, issued to the bidders in the beginning are VOLUME I, Part II of VOLUME II, Part II of VOLUME III and VOLUME IV.

12. ENVIRONMENTAL IMPACT ASSESSMENT

12.1 GENERAL

As the project will not significantly affect the quality of the environment, the project is exempted from the preparation and examination of the Environmental Impact Statement (EIS) except for Monkayo Bypass Construction.

According to the initial environmental examination, slight negative impacts are expected on three factors: resettlement of a few inhabitants, traffic interference during construction and generation of construction waste. For these factors, proper mitigation measures should be taken. Proposed measures are as follows:

- Resettlement
  Preparation of proper relocation plan including provision of resettlement area in the vicinity.
- Traffic Interference
  Opening of at least one lane to traffic and maintenance thereof in comfort and safety.
- Construction Waste
  Proper treatment in accordance with DPWH Standard Specifications.

12.2 ENVIRONMENTAL IMPACT ASSESSMENT FOR MONKAYO BYPASS CONSTRUCTION

Possible negative impacts are as follows (impact level is small on any factor):

Factor	Duration	Remarks
Surface water	short	Increase in suspended solid and decrease in water flow.
Sedimentation	short	Increase in sediment load.
Air quality	short	Exhaust gas emission from heavy equipment.
Noise	short	Noise generation from heavy equipment.
Topography	long	Alteration of topography by cut and embankment.
Erosion	short	Increase in erosion rate due to removal of vegetation.
Landuse	long	Change in landuse from natural vegetation to built-up area.
Aesthetics	short	Aesthetic disfigurement due to earth work.
Resettlement	long	Dislocation of 32 families.
Water supply	short	Decrease in quality and quantity of water flow.
Sanitation	short	Improper waste disposal.
Health	short	Introduction of diseases from outsiders.
Traffic interference	short	Inconvenience for residents along existing road.
Traffic accidents	long	Increase in traffic accidents at intersection with existing highway.

Mitigation measures are as follows:

- Factors with impacts in short term: proper construction work with care to mitigate environmental pollution.
- Topography : Proper landscaping
- Landuse : Proper landscaping
- Resettlement : Preparation of proper relocation plan
- Traffic accidents : Installation of traffic safety devices

13. IMPLEMENTATION PROGRAM

13.1 IMPLEMENTING AGENCY

The Department of Public Works and Highways (DPWH) is the implementing agency for this project. PMO-PJHL of DPWH will be the executing office.

13.2 IMPLEMENTATION ORGANIZATION

- Bidding Stage

  Bidding of all contract packages will be conducted by the DPWH Central Office Prequalification, Bids and Awards Committee (PBAC) with the initiation of PMO-PJHL and assistance of Consultant.

- Construction Stage

  PMO-PJHL will be responsible for overall project management, administrative matters, and monitoring. Consultant will provide construction supervision services under the control of PMO-PJHL.

13.3 PRIORITY OF CONTRACT PACKAGES

According to the priority based on the physical condition at present, contract packages are divided into four groups: Group A to D, as shown in the implementation schedule.

13.4 IMPLEMENTATION SCHEDULE AND ANNUAL FUND REQUIREMENT

Based on the fund availability and priority of contract packages, the implementation schedule is prepared as follows:

(Unit: Million Pesos at 1996 price)

			1997	1998	1999	2000	2001	2002	2003	Total Cost	Cost Component		
											Foreign	Local	Tax
Implementation Schedule	Selection of Contractor	Group A Group B Group C Group D							ROW Cost ↓	Const. Cost ↓			
	ROW Acquisition ( ) and Construction ( )	Package 1 (D)							-	281.7	115.6	110.0	56.0
		Package 2 (D)							0.1	278.9	140.1	81.1	57.7
		Package 3 (D)							-	131.4	63.2	39.8	28.4
		Package 4 (C)							0.3	114.6	53.8	37.2	23.6
		Package 5 (A)							-	254.6	115.4	87.4	51.9
		Package 6 (A)							0.3	269.4	118.8	98.2	52.4
		Package 7 (A)							-	384.1	164.7	142.3	77.1
		Package 8 (A)							-	255.7	109.0	94.8	52.0
		Package 9 (B)							0.7	222.7	109.9	67.4	45.4
		Package10 (C)							-	323.0	158.3	96.4	68.3
		Package11 (B)							-	169.2	84.6	49.1	35.5
		Package12 (C)							-	149.3	62.9	56.8	29.6
		Package13 (A)							0.3	244.2	123.1	70.4	50.6
		Package14 (B)							7.4	149.3	63.6	59.3	26.4
		Package15 (B)							0.7	301.0	149.9	88.3	62.8
		Package16 (B)							-	348.4	184.1	89.2	75.0
		Package17 (A)							25.6	453.6	216.2	141.4	95.9
		Package18 (D)							-	208.5	91.6	76.7	40.2
		Package19 (D)							-	97.5	39.1	39.5	18.9
	Consultancy Services									440.5	277.5	149.8	13.2
Annual Fund Requirement	ROW Acquisition		26.2	8.8	0.3	0.1	-	-	-	35.4	-	35.4	-
	Construction		-	736.2	1,414.4	1,089.3	849.5	512.0	35.6	4,637.0	2,163.9	1,525.4	947.7
	Consultancy Services		11.0	74.0	131.9	104.1	72.6	43.8	3.1	440.5	277.5	149.8	13.2
	Total		37.2	819.0	1,546.6	1,193.5	922.1	555.8	38.7	5,112.9	2,441.4	1,710.6	960.9

14. PROJECT EVALUATION AND RECOMMENDATIONS

14.1 PROJECT EVALUATION

The project is feasible from every aspect as summarized below:

- Technical Aspect

All proposed works can be completed by usual construction methods commonly used in the Philippines and all necessary equipment and materials are easily obtained at sites. Thus, no technical problem is expected in the project implementation.

- Economical Aspect

Economic evaluation indicators are as follows:
- Internal rate of return (IRR) : 29.6%
- Net present value (NPV) : 4,156.3 million pesos
- Benefit/cost ratio (B/C) : 2.29

Thus, the Project is concluded to be highly feasible from the economic point of view.

- Financial Aspect

The project can be implemented within reasonable financial framework in accordance with the proposed schedule.

- Environmental Aspect

Because of the nature of the project which is to rehabilitate/improve the existing road, positive impacts are expected to be significantly big, while negative impacts are negligibly small except resettlement of a few inhabitants and traffic interference during construction. These negative impacts will, however, be easily solved/mitigated.

- Social and Developmental Aspects

The project will contribute to improvement of social environment and promote the regional development by providing reliable means of transport.

14.2 RECOMMENDATIONS

- Early Implementation

It is highly recommended to implement the project in the earliest possible time. The proposed implementation schedule is prepared taking into account the reasonably estimated fund availability for each year. The implementation should, however, be hastened if there is a fair prospect of increased fund for the project.

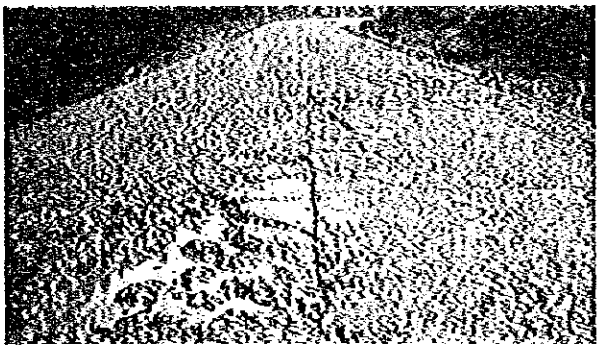
- Mitigation Measures of Environmental Impact

Due considerations should be given to mitigate adverse environmental impacts. Possible adverse impacts and their mitigation measures are as follows:
- Resettlement of Inhabitants
  A proper relocation plan should be prepared including provision of resettlement area in the vicinity.
- Traffic interference during construction
  Mitigation measures such as opening of at least one lane to traffic and maintenance thereof in comfort and safety, proper traffic control, provision of safety devices, etc. should be taken.

- Maintenance Requirements

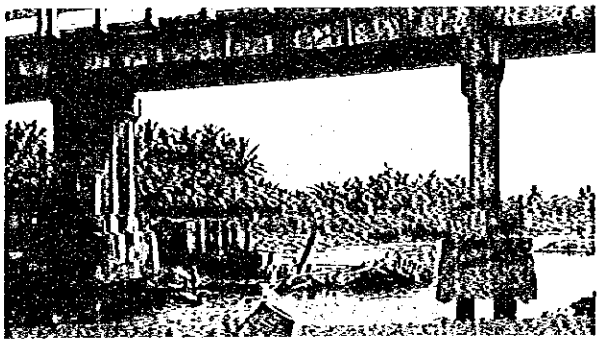
The future maintenance should focus on:
- Maintenance of the sections where no rehabilitation work is proposed.
- Minor repair works of the bridges not covered by the project.
- Cleaning of drainage facilities, especially side ditches and cross drainages in flood sections and mountainous sections.
- Periodic dredging of riverbed sediments, especially for the bridges where dredging is proposed in the project.

TYPICAL SITE CONDITION AND IMPROVEMENT WORKS

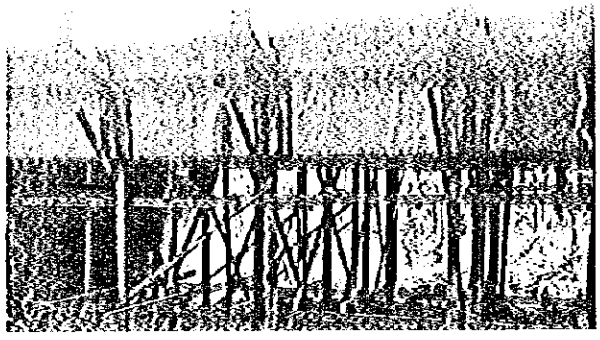


CONCRETE PAVEMENT IN VERY BAD CONDITION. TOTAL RECONSTRUCTION WITH CONCRETE PAVEMENT.

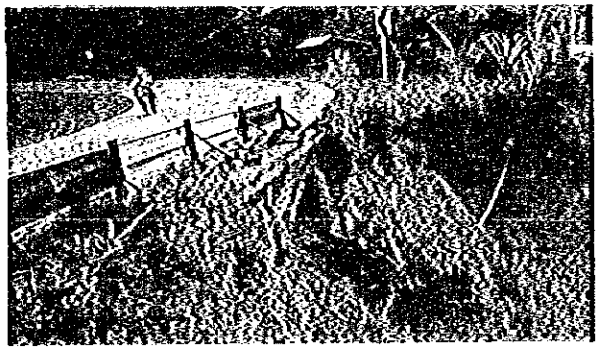
CONCRETE PAVEMENT IN BAD CONDITION WITH PARTIALLY BROKEN SLABS. REPLACEMENT OF BROKEN SLABS WITH CONCRETE PAVEMENT AND AC OVERLAY.



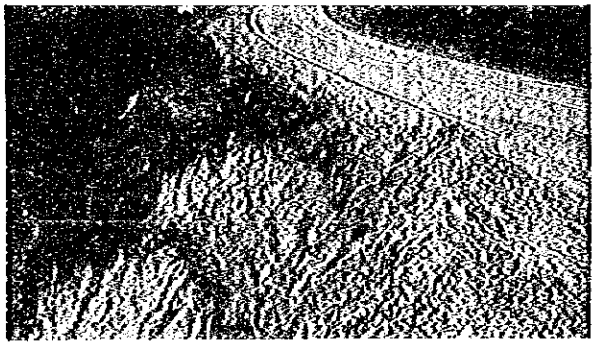
ANDANAN BRIDGE. SERIOUSLY DETERIORATED SUPERSTRUCTURE WITH DEEP LOCAL SCOURING AT PIERS. TOTAL RECONSTRUCTION.



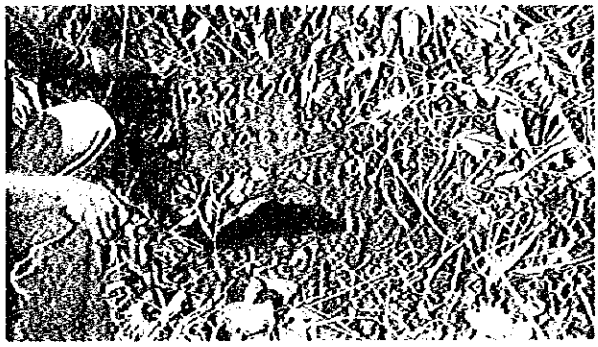
BAYUGAN BRIDGE. SERIOUSLY DETERIORATED SUPERSTRUCTURE. REPLACEMENT OF SUPERSTRUCTURE.



EMBANKMENT SLOPE FAILURE. ONE LANE AFFECTED. SLOPE PROTECTION WITH SURFACE AND SUBSURFACE WATER CONTROL.



EMBANKMENT SLOPE FAILURE. SHOULDER AFFECTED. SLOPE PROTECTION.



BURIED PIPE CULVERT WITHOUT INLET FACILITY. REPLACEMENT WITH NEW PIPE CULVERT.

GRAVEL SECTION AT SOFT GROUND AREA. AC PAVEMENT AFTER PRE-LOADING.