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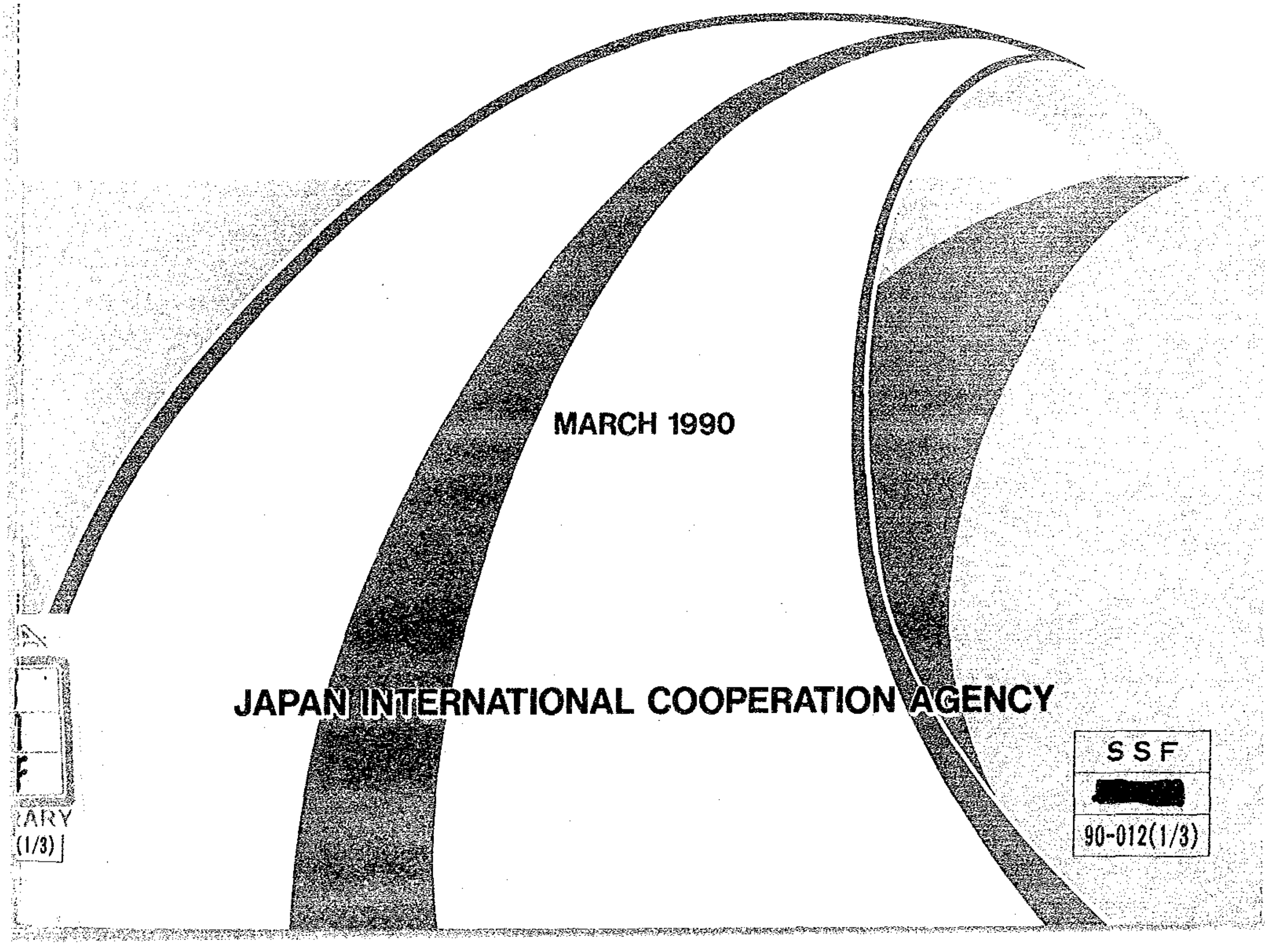
THE REPUBLIC OF INDONESIA
DIRECTORATE GENERAL OF HIGHWAYS
MINISTRY OF PUBLIC WORKS

FEASIBILITY STUDY ON THE CIKAMPEK-CIREBON TOLLWAY PROJECT

EXECUTIVE SUMMARY



MARCH 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of the Republic of Indonesia, the Japanese Government decided to conduct a feasibility study on Cikampek-Cirebon Tollway Project and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to Indonesia a survey team headed by Mr. Keikichi Yoshida, and composed of members from Pacific Consultants International, Yachiyo Engineering Co., Ltd. and Pasco International Inc. four times from September 1988 to December 1989.

The team held discussions with concerned officials of the Government of Indonesia, and conducted field surveys. 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 Indonesia for their close cooperation extended to the team.

March, 1990

Kensuke Yanagiya
President
Japan International Cooperation Agency

PROJECT LOCATION MAP

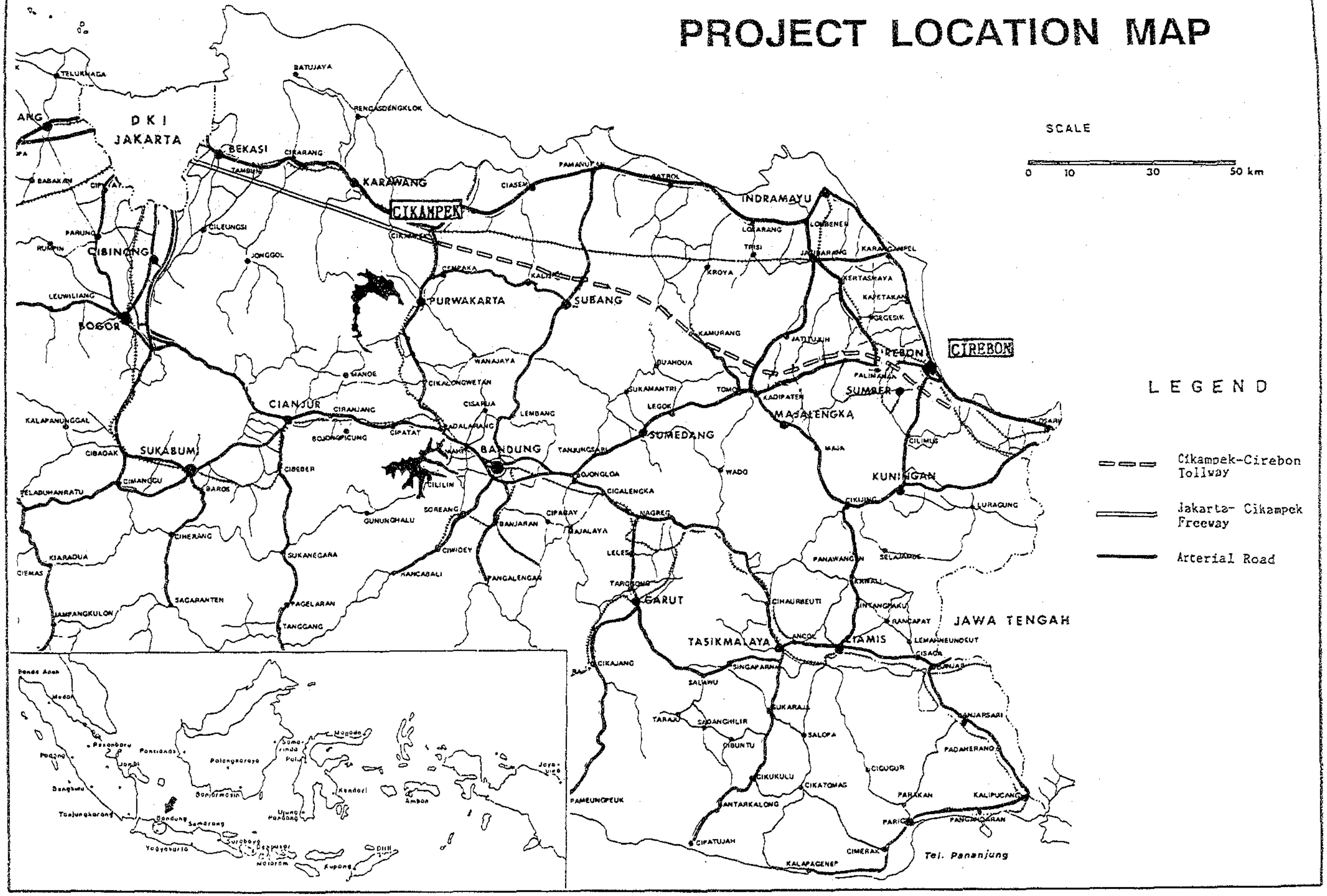


Table of Contents

1. INTRODUCTION

1.1 Study Background

Indonesia comprises more than 13,500 islands covering a land area of about 1,920,000 square kilometers with a population of around 164 million inhabitants.

Java covers about 132,000 square kilometers and comprises only 7 percent of the whole Indonesian territories. The population of Java is around 100 million which is about 60 percent of the total Indonesian population. The island is the most densely populated area in Indonesia with metropolitan type cities namely DKI Jakarta, Surabaya, Bandung and Semarang.

DKI Jakarta is the capital city of Indonesia and Cirebon is a coastal city to the east and an important port in the Province of West Java. It is defined as a Primary Function City and Regional Development Center of West Java. Both cities have been developed in economic activities especially in the field of trade and industry and therefore have a rapidly growing demand for improved transport links.

The traffic volume between DKI Jakarta and Cirebon City has doubled in the past five years, causing frequent traffic congestion on many parts of the existing roads due to insufficient capacity. In recognition of this demand, the construction of a new expressway between DKI Jakarta and Cirebon city was considered by the Directorate General of Highway, Ministry of Public Works (hereinafter referred to as Bina Marga) as a portion of the Trans Java Highway Network. Construction of part of the Jakarta-Cirebon Expressway, the section between Jakarta and Cikampek, began in 1984 and was completed in September 1988.

As the next stage of implementation of the Jakarta-Cirebon Expressway, Bina Marga has decided to carry out a feasibility study for the implementation programme of the Cikampek-Cirebon section.

Due to a shortage of public funds for highway development, the West Java Tollway System was established more than a decade ago. The Jakarta-Cirebon expressway constitutes a part of this system and this project is intended to be designed as a tollway between Cikampek and Cirebon.

Upon the background mentioned above, the Government of the Republic of Indonesia requested a feasibility study on the Cikampek-Cirebon tollway project to the Government of Japan, which accepted it and entrusted the study to Japan International Cooperation Agency (JICA).

In March 1988, JICA dispatched a Preliminary Study Team headed by Mr. Yukihiko Sumiyoshi to Indonesia for a reconnaissance study as well as for discussion on the scope of work for the forthcoming study. The scope of work agreement was concluded on March 24, 1988 between Bina Marga and the JICA Preliminary Study Team.

1.2 Objective of the Study

The Objective of the Study is to determine the feasibility of constructing a tollway between Cikampek and Cirebon as a part of the Trans Java Tollway network to encourage inter-city transport between DKI Jakarta and Cirebon City in West Java Province.

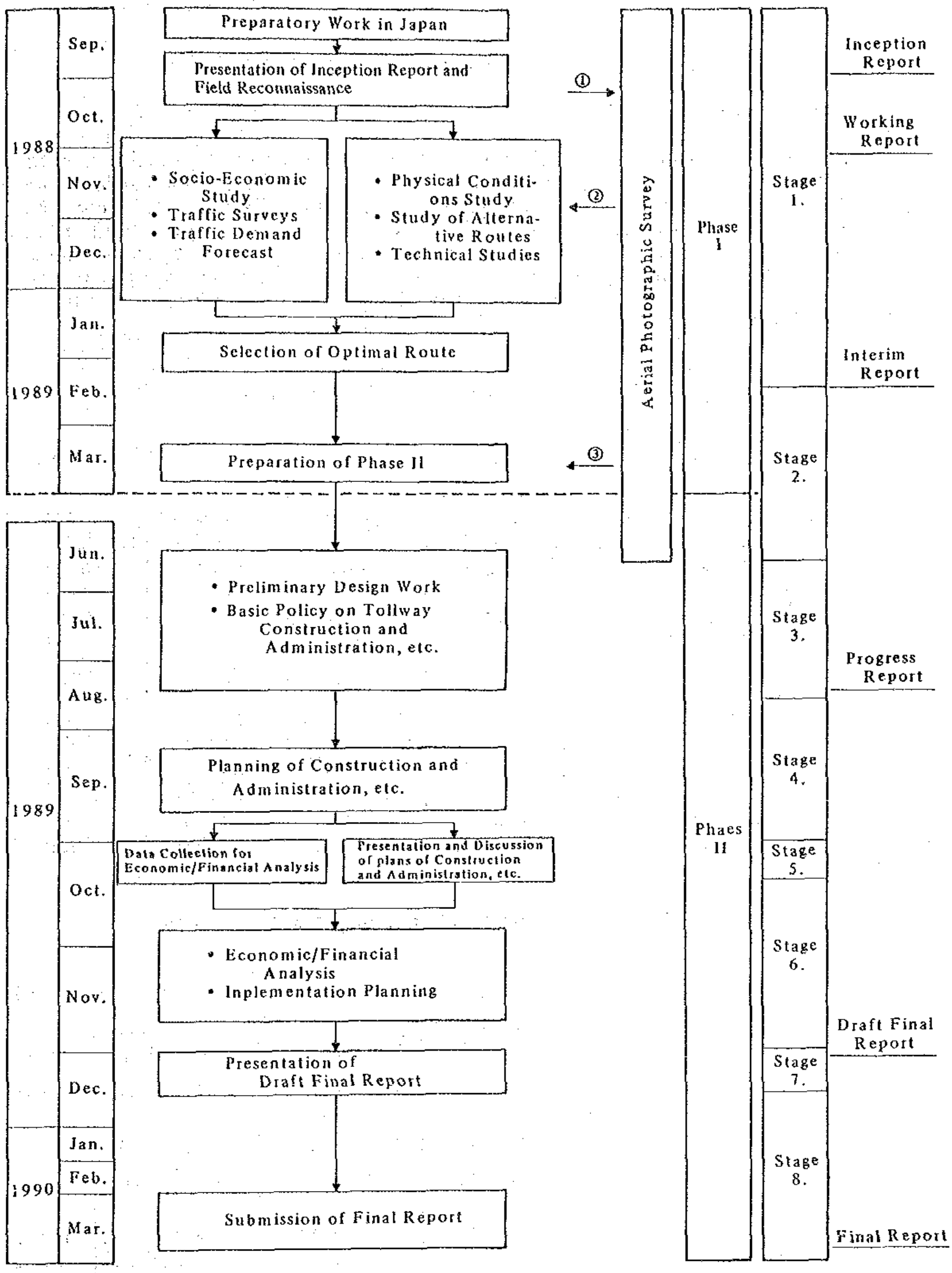
1.3 Scope of the Study

In order to achieve the study objective, the Study consist of two (2) phases with the following major study objectives.

Phase I : A major objective of this study is to select an optimal route for the Cikampek-Cirebon Tollway, based on traffic projections and preliminary economic and financial analysis for the comparison of various alternative routes.

Phase II : The selected route is further studied from more detailed field surveys, preliminary engineering and final economic and financial analysis to identify the viability of the proposed tollway project.

The work flow of the Study is shown in Fig. 1.1.



Note: ① Designation of aerial photographic area
② Delivering over the aerial photography
③ Delivering over topography

Fig. 1.1 Flow of the Study

2. FUTURE DEVELOPMENT FRAMEWORK

2.1 Population-Urban and Rural

Future population and employment frameworks for the major islands and the provinces in Java Island are based on the strategically planned projections by NUDS (National Urban Development Strategy). The project uses NUDS population projections as the main basis for economic and social planning aspects. However, because of differences in various statistical data sources and updating requirements, some modification and revision is carried out before the NUDS figures are applied to the project planning. The result is shown in Tables 2.1 through 2.4.

Table 2.1 Future Population Framework

(Unit: million persons)

	1988	1995	2005	2015
Sumatra	35,700 (-)	44,728 (3.27)	57,707 (2.58)	69,578 (1.89)
DKI/West Java	41,876 (-)	46,792 (1.60)	53,020 (1.26)	58,088 (0.92)
Central Java and Yogyakarta	30,961 (-)	32,477 (0.69)	34,269 (0.54)	35,637 (0.39)
East Java	32,566 (-)	34,393 (0.78)	36,569 (0.62)	38,241 (0.45)
Java Total	105,403 (-)	113,662 (1.08)	123,662 (0.86)	131,966 (0.64)
Other Islands	34,267 (-)	40,550 (2.43)	49,028 (1.92)	56,344 (1.40)
Indonesia	175,370 (-)	198,940 (1.82)	230,593 (1.49)	257,888 (1.12)

Table 2.2 Framework of Urban and Rural Population

(Unit: million person)

	1988		1995		2005		2015	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Sumatra	7,575	22,515	10,233	34,495	14,317	43,390	18,526	51,052
DKI/W. Java	16,015	22,143	20,919	25,873	30,623	22,406	39,539	18,558
Central Java & Yogyakarta	6,413	22,754	8,531	23,946	14,636	19,633	19,871	15,766
East Java	6,266	23,449	8,518	25,875	16,584	19,985	23,595	14,646
Java Total	28,694	68,346	37,968	75,694	61,843	162,024	83,005	48,970
Other Islands	5,376	23,070	7,850	32,700	15,465	33,563	22,979	33,365
Indonesia	41,645	113,931	56,051	142,889	91,625	138,977	124,510	133,387

Table 2.3 Future Total Employment Framework

(Unit: million persons)

	1988	1995	2005	2015
Sumatra E.R. (%).	13,294 (37.2)	19,262 (43.1)	27,881 (48.3)	35,300 (50.7)
DKI/West Java E.R. (%)	14,526 (34.0)	17,885 (38.2)	21,569 (40.7)	26,250 (45.2)
Central Java & Yogyakarta E.R. (%)	13,756 (43.8)	14,502 (44.7)	15,743 (45.9)	17,016 (47.7)
East Java E.R. (%)	14,639 (45.0)	15,321 (44.5)	16,769 (45.9)	18,292 (47.8)
Java Total E.R. (%)	42,922 (40.7)	47,708 (42.0)	54,081 (43.7)	61,558 (46.6)
Other Islands E.R. (%)	13,713 (40.0)	16,624 (41.0)	21,989 (44.8)	26,960 (47.8)
Indonesia E.R. (%)	69,929 (39.8)	83,594 (42.0)	103,951 (45.1)	123,818 (48.0)

Note: * E.R. = Employment Rate (Employment/Population)

Table 2.4 Future Framework of Primary and Other Sector Employment

(x 1000 person)

	1988		1995		2005		2015	
	Primary	Other	Primary	Other	Primary	Other	Primary	Other
Sumatra	8,214	5,080	12,183	7,079	14,326	13,555	14,326	20,974
DKI/W. Java	4,593	9,932	4,593	13,292	4,593	16,976	4,593	21,657
Central Java & Yogyakarta	6,546	7,210	6,546	7,956	6,546	9,197	6,546	10,470
East Java	6,706	7,933	6,706	8,615	6,706	10,063	6,706	11,586
Java Total	17,845	25,075	17,845	29,863	17,845	36,236	17,845	43,713
Other Islands	7,132	6,583	9,340	7,284	9,058	12,931	9,058	17,902
Indonesia	33,191	36,738	39,368	44,226	41,229	62,722	41,229	82,589

2.2 Vehicle Ownership

In order to estimate future total traffic demand the future growth rate of vehicle ownership was employed, because the growth rate in vehicle ownership during 1982/1988 indicated nearly the same growth rate as the average traffic volumes during the same period.

The existing ownership level in Java is quite low compared to other countries. A regression analysis was made using such socio-economic variables as population, per capita income, GRDP (Gross Regional Domestic Product) as an explanatory variable, and the number of registered vehicles and ownership rates (registered vehicles per 1000 population) as an independent variable.

As a consequence, the following regression model was adopted and the future vehicle ownership in Java was estimated as shown in Table 2.5.

Curve Formula: $Y = a \cdot X + b$

where, Y = Vehicles per 1000 population
X = Per Capita GRDP

Vehicle Type	Parameters		Correlation Co-efficient (r)
	a	b	
Passenger Car	0.086474	-2.86885	0.993
Bus	0.020982	-0.96438	0.947
Truck	0.068185	-3.10717	0.996

Table 2.5 Estimated Future Vehicle Ownership in Java

Veh. Type	1988		1995		2005		2015
Passenger Car	927,800		1,363,900		2,399,000		4,117,300
(% p.a.)		(5.7)		(5.8)		(5.6)	
Bus	210,900		295,500		544,100		963,400
(% p.a.)		(4.9)		(6.3)		(5.9)	
Truck	643,100		977,500		1,793,100		3,140,800
(% p.a.)		(6.2)		(6.3)		(5.8)	
Total	1,781,800		2,636,900		4,736,200		8,221,500
(% p.a.)		(5.8)		(6.0)		(5.7)	
Ownership Rate (Veh./1000 pop.)	16.9		23.2		38.3		62.3

3. TRAFFIC DEMAND PROJECTION

3.1 Present Vehicle OD Matrix

The 1982 nation-wide traffic origin-destination (OD) survey results were employed in order to utilize the derived traffic distribution pattern that was unobtainable from the traffic surveys conducted in 1988 by the Study Team, which mainly covered the direct influence area of the project tollway.

The main procedure to estimate future traffic volume on the project tollway is shown in Fig. 3.1.

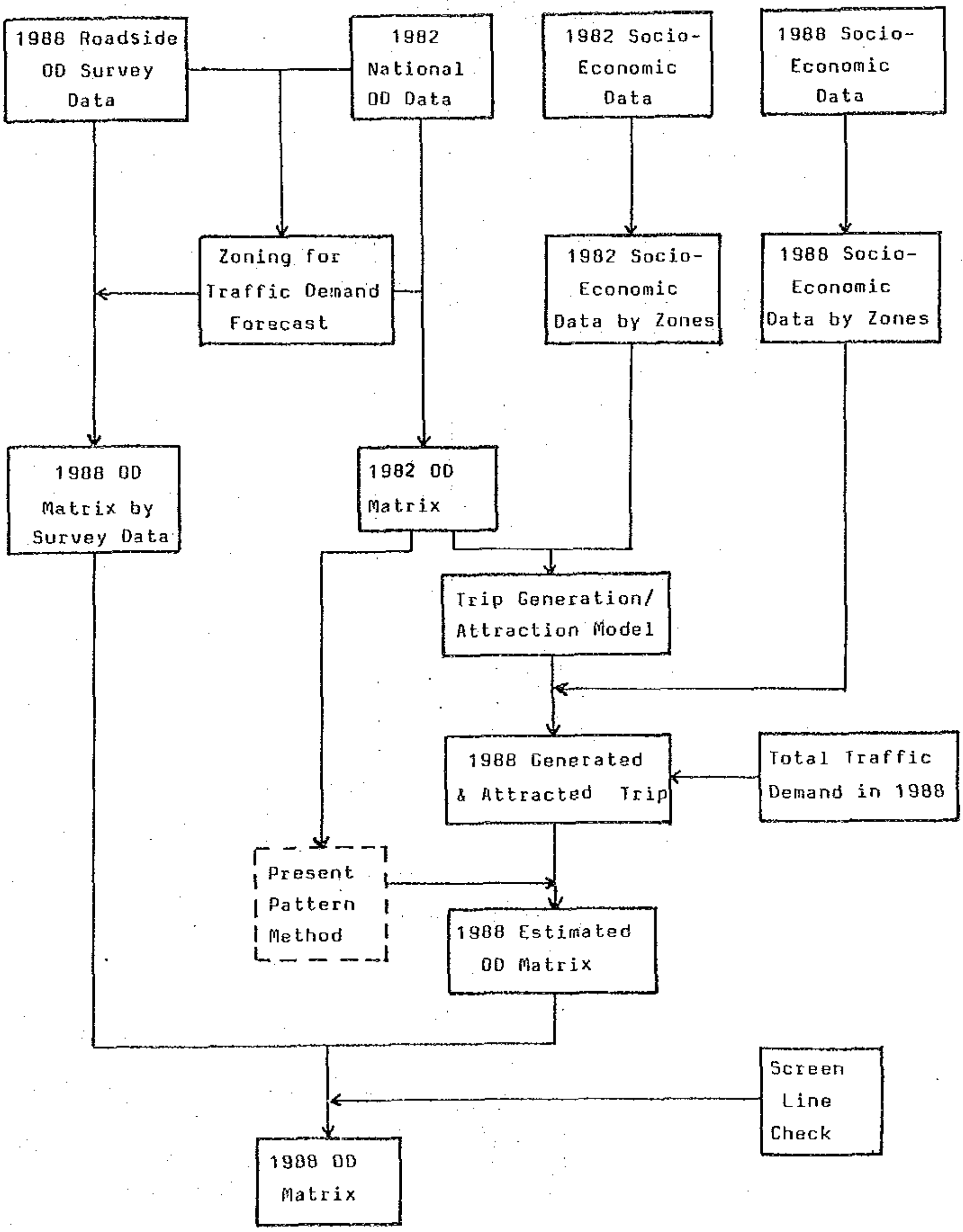


Fig. 3.1 Flow Chart to Estimate 1988 OD Matrix

3.2 Tollway Diversion Model

A diversion model to separate tollway users from the total road users is estimated based on the 1988 traffic survey result. The model analysis was conducted along with the flow chart diagram shown in Fig. 3.2.

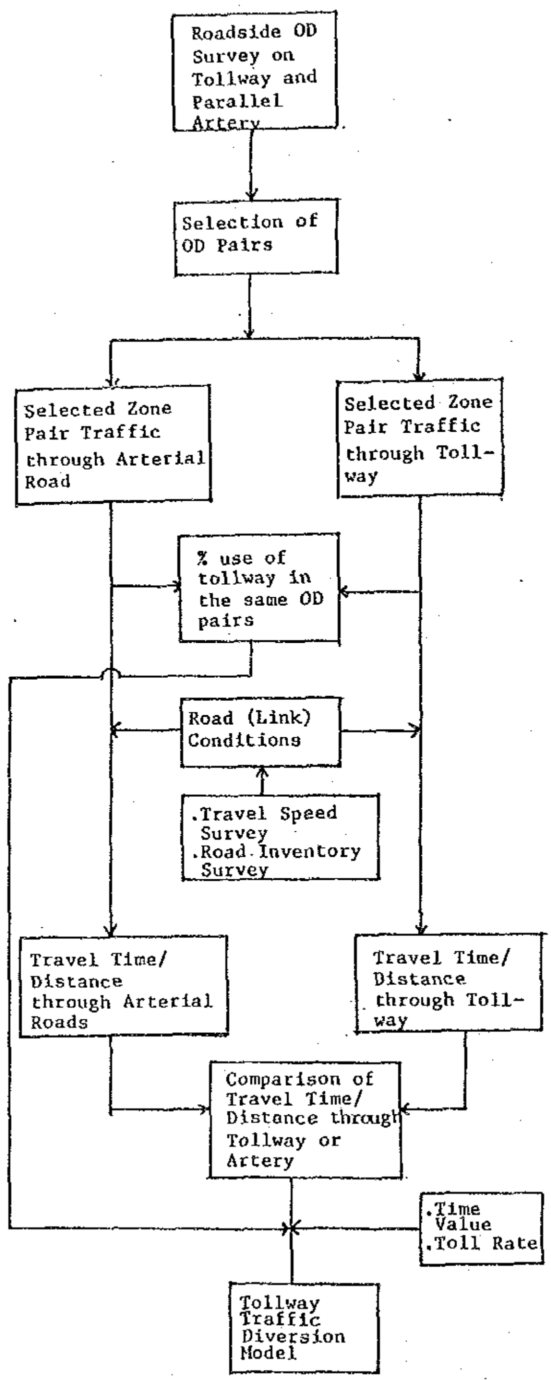


Fig. 3.2 Flow Chart for Tollway Diversion Model

The model takes into account the factor derived from a toll rate divided by the corresponding travel time difference, i.e. the derived diversion curve implies a distribution for time values of vehicles.

In this model, a shift factor is introduced in order to reflect an increasing willingness to pay for a toll in accordance with a rise in income level.

The model formula was calibrated from the data samples used for the model formula-1, and were derived as follows:

Passenger car : $$P = \frac{100}{1 + 2.77992 \times 10^{-5} \times (T/S)^{2.080629}} \quad (r^2 : 0.8767)$$

Pick-up : $$P = \frac{90}{1 + 2.20822 \times 10^{-4} \times (T/S)^{1.803121}} \quad (r^2 : 0.8460)$$

Truck : $$P = \frac{80}{1 + 2.07866 \times 10^{-5} \times (T/S)^{2.276770}} \quad (r^2 : 0.8839)$$

where,
- P : Diversion rate (%)
- T : Toll rate/Travel time difference (Rp./min.)
- S : Shift factor (ratio of per capita GDP/Income of the year in question to that of 1988)
- r : Cor. Coefficient

3.3 Future Vehicle Traffic Demand

1) Methodology

A future traffic demand was forecast as diagrammatically shown in the methodological flow chart of Fig. 3.3.

2) Future Origin-Destination Matrix

A future OD matrix was based on the analytical results of future socio-economic parameters, trip generation/attraction model, future road network and trip distribution model.

In order to determine a 'control total' figure of future traffic demand a correlation analysis was made between the growth of traffic volumes and that of vehicle ownership.

As a result, it was found that these factors are directly correlated, so the future growth rate of vehicle ownership was adopted to forecast a future total traffic demand. The estimated growth rates obtained for respective vehicle types are as shown in Table 3.1.

Table 3.1 Growth Rates of Future Total Traffic Demand

Vehicle Type		1988		1995		2005		2015
Passenger Car & Pick-up	Growth Index	100		147		256		447
	Growth Rate (% p.a.)		5.7		5.8		5.6	
Truck	Growth Index	100		152		279		488
	Growth Rate (% p.a.)		6.2		6.3		5.8	
Bus	Growth Index	100		140		258		457
	Growth Rate (% p.a.)		4.9		6.3		5.9	
Total	Growth Index	100		148		266		461
	Growth Rate (% p.a.)		5.8		6.0		5.7	

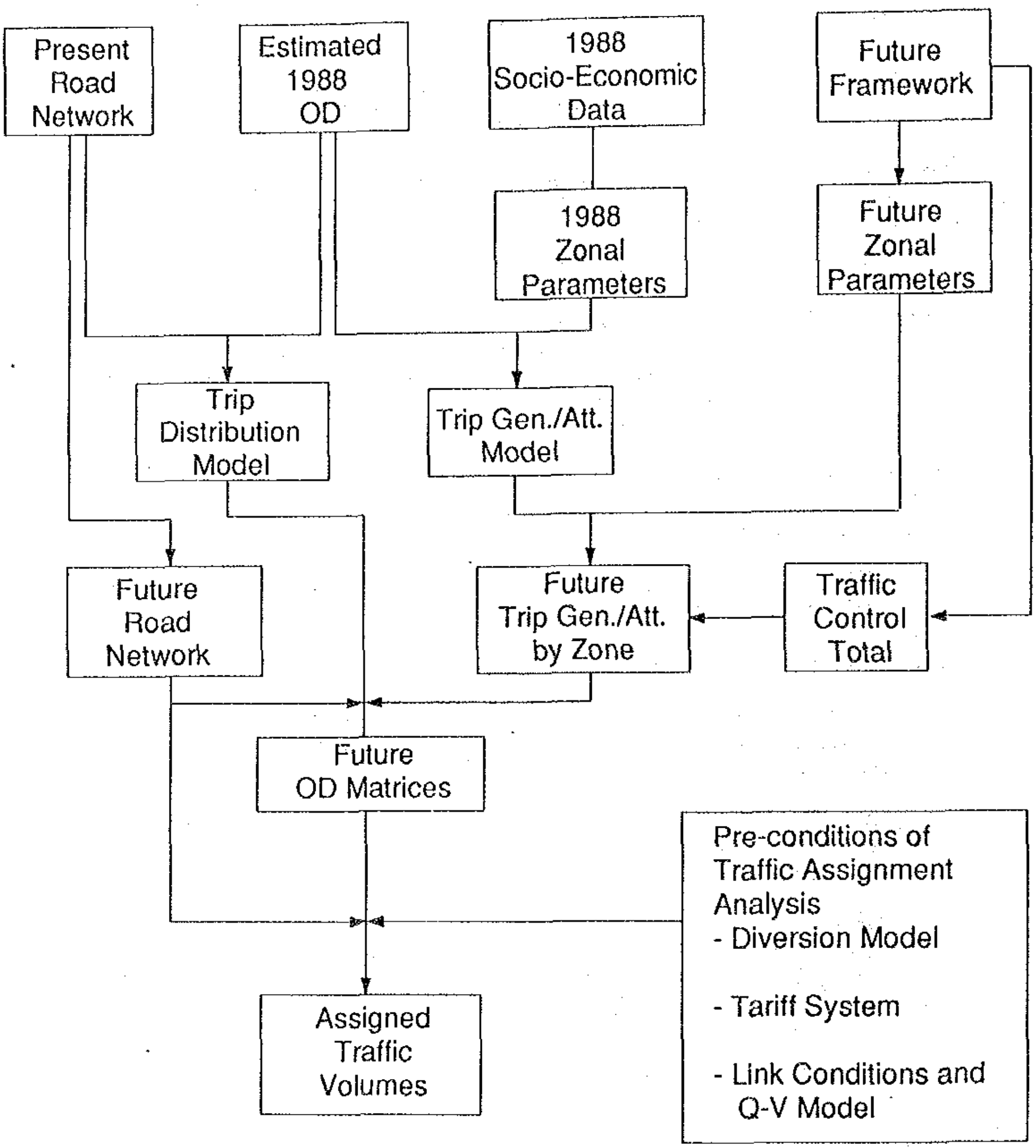


Fig. 3.3 Flow Chart of Traffic Demand Forecast

3) Trip Generation and Attraction Model

A trip generation/attraction model was derived from the 1988 vehicle OD Matrix for the respective vehicle types. To examine zonal parameters which are most suited to explaining zonal trip generation/attraction a correlation analysis was made. Consequently the following zonal parameters were adopted; urban population and secondary plus tertiary sector employment.

The model formulae derived from the above analysis are shown in Table 3.2.

Table 3.2 Model Formulae for Trip Generation/Attraction

Vehicle Type	Model Formulae	Correlation Coefficient
Passenger Car	Ti = 0.005929 x UP + 537.8939	0.9317
Pick-up	Ti = 0.002057 x UP + 738.4111	0.9177
Truck	Ti = 0.002358 x UP + 0.002948 x STE + 817.4718	0.9572
Bus	Ti = 0.000929 x UP + 0.000418 x STE - 55.56639	0.9637

Ti : Trip Generation/Attraction (Tripends/day)
UP : Urban Population
STE : Secondary and Tertiary Sector Employment

4) Trip Distribution Model

The construction of the project tollway will have significant impact upon the region and enhance the development potential. Therefore, a gravity model that reflects such impacts as shorter travel distance, higher travel speed and less traffic congestion on the project region was selected from which to estimate future trip distribution.

The model formula is derived for each type of vehicle as presented in Table 3.3.

Gravity Model: $$Tij = K \bullet \frac{Gi^{\alpha} \bullet Aj^{\beta}}{Dij^{t}}$$

where,
Tij : OD pair traffic volumes
Gi : Generated trips
Aj : Attracted trips
Dij : OD pair distance
K, α, β, t : Regression parameters
r : Correlation Coefficient

Table 3.3 Regression Parameters by Vehicle Type

Vehicle Type	K	α	β	t	r
Passenger Car	4.25641	0.51243	0.76010	1.67397	0.7641
Pick-up	13.89817	0.52069	0.67355	1.76047	0.7229
Truck	6.03465	0.61015	0.65379	1.72214	0.7362
Bus	1.98011	0.57713	0.70926	1.14382	0.7296

The gravity model, however, was only applied to DKI Jakarta and West Java Province where the project tollway will most probably influence their regional development.

5) Future Road Network

A future road network is required for estimation of the future traffic volumes on the road links to the tollway. Accordingly it was assembled with the following network components:

a) The existing tollways and their access roads; national and provincial roads were assumed to remain as they are for the future.

b) Such established projects as the Tangerang-Merak Tollway, Cikampek-Padalarang Tollway and Bandung By-pass were incorporated into the network.

c) Alternative routes being studied in this report were incorporated into the network.

d) Proposed interchanges of Cikampek-Cirebon Tollway are all considered in the network.

e) In Central Java and East Java the major arterial roads are all considered to constitute the network.

Based on the above network components, the networks used for study analysis were assumed as shown in Figs. 3.4 and 3.5.

6) Tariff System

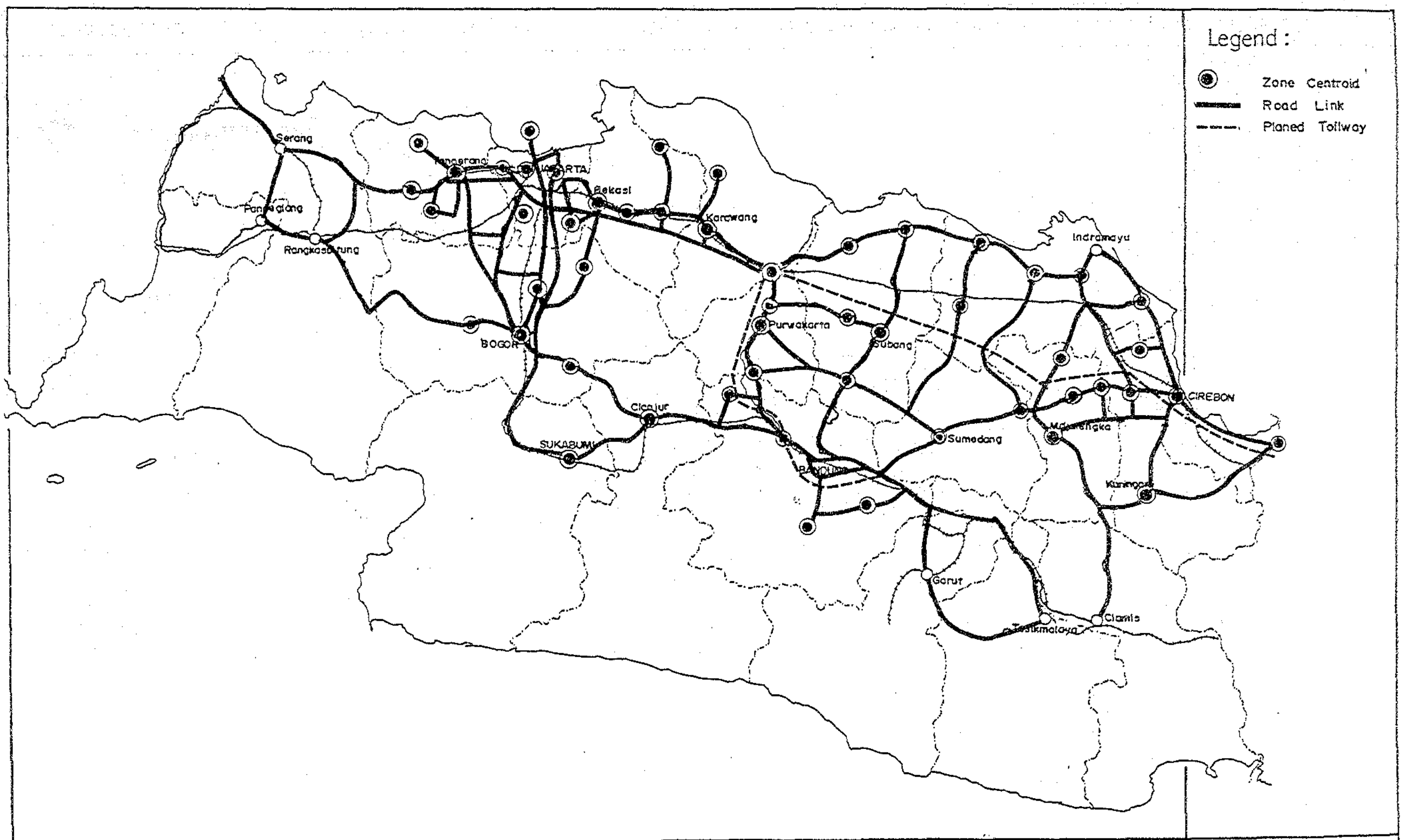
A toll per user kilometer which was assumed to decline as the user traveled longer distances, and which was based on the present actual toll levy system was adopted.

7) Traffic Assignment

The future road traffic volume has been estimated by assigning the future OD traffic (Matrix) to the future road network.

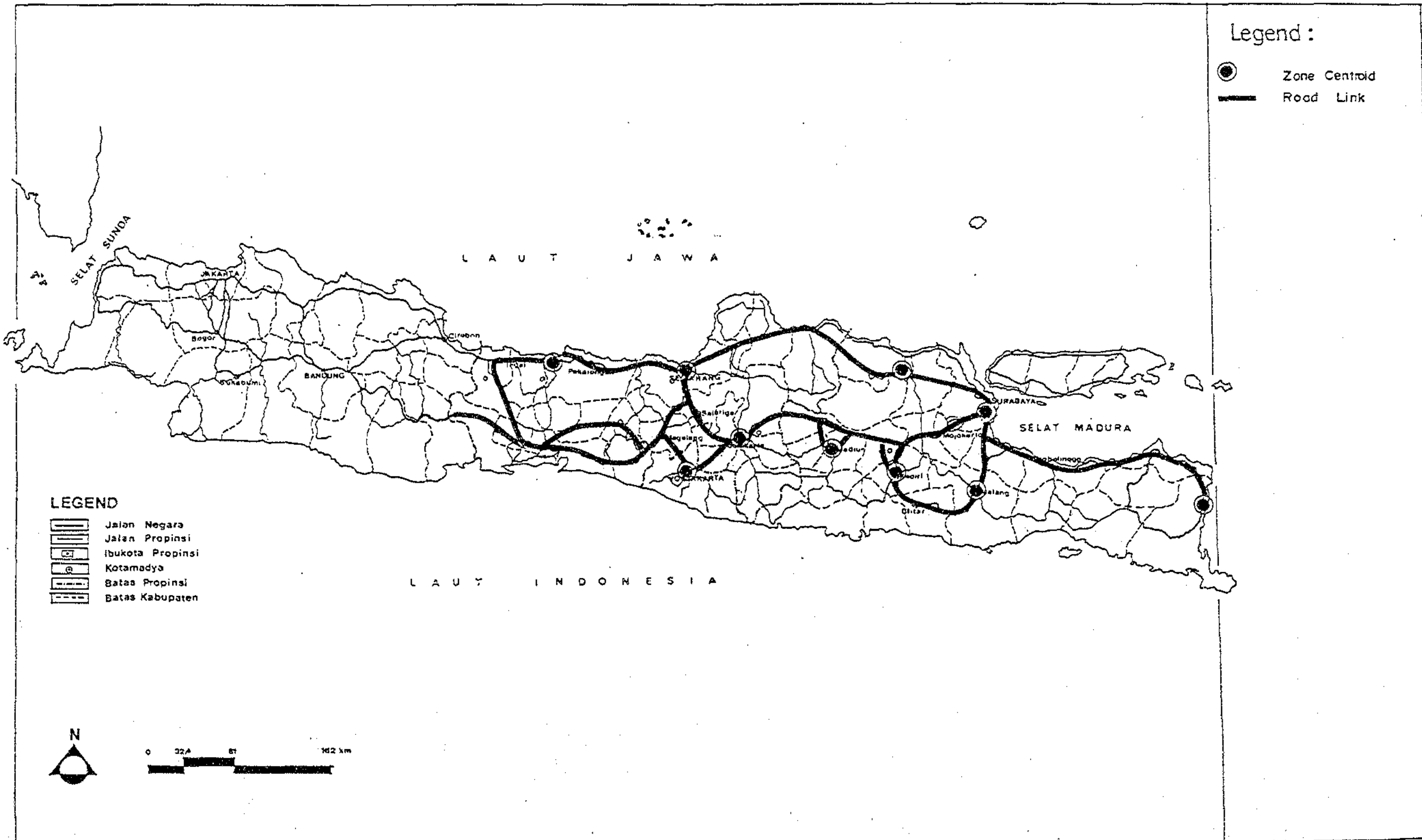
A minimum travel time was adopted as a criterion when selecting possible alternative routes or an optimal one for a particular OD pair traffic.

The estimated traffic volume on the project tollway is presented in Section 7.1.



Feasibility Study on Cikampek - Cirebon Tollway Project

Fig. 3.4 Road Network in West Java for Traffic Demand Analysis



Feasibility Study on Cikampek - Cirebon Tollway Project | **Fig. 3.5 Road Network in Java for Traffic Demand Analysis**

4. ALTERNATIVE ROUTE STUDY

4.1 Identification of Alternative Routes

At the preliminary study stage, some alternative possibilities were eliminated primarily because of engineering consideration as well as conflicting with planning concepts. Three possible routes were chosen as likely suitable alternatives. The three alternative routes are shown in Figs. 4.1 through 4.4.

4.2 Comparative Study of Alternative Routes

The comparative study of the alternative routes has been conducted on such evaluation factors as an environmental and socio-economic impacts, economic and financial features.

A summary of the study results is shown in Tables 4.1 and 4.2.

Table 4.1 Environmental and Social Impacts

Environmental and Social Factors	Environmental Preferability		
	Route A	Route B1	Route B2
1) Traffic Demand	Poor	Good	Fair
2) Pollution	Fair	Fair	Good
3) Land Use and Human Life Impacts:			
- Irrigated and built-up area	Poor	Poor	Good
- Recreation and open space	Fair	Fair	Fair
4) Nature Aspect	Good	Good	Fair
5) Accessibility to Road Network	Good	Good	Fair
6) Compatibility with Urban Development Plans	Fair	Good	Fair
7) Driver Amenity	Poor	Good	Fair
Overall Rating	Fair	Good	Fair

To assess the environmental and social preferability of the three routes each assessment category is rated as being either good, fair or poor. The overall rating is presented in Table 4.1 which results in the preferability of Route B1.

Table 4.2 Economic and Financial Comparison of Alternative Routes

Efficiency Measures	Route A	Route B1	Route B2
Economic Internal Rate of Return (EIRR)	22.8%	28.6%	27.9%
Financial Internal Rate of Return (FIRR)	17.3%	21.6%	20.9%

In terms of the above economic comparison, Route B1 showed the highest efficiency to the project investment out of the alternative Routes.

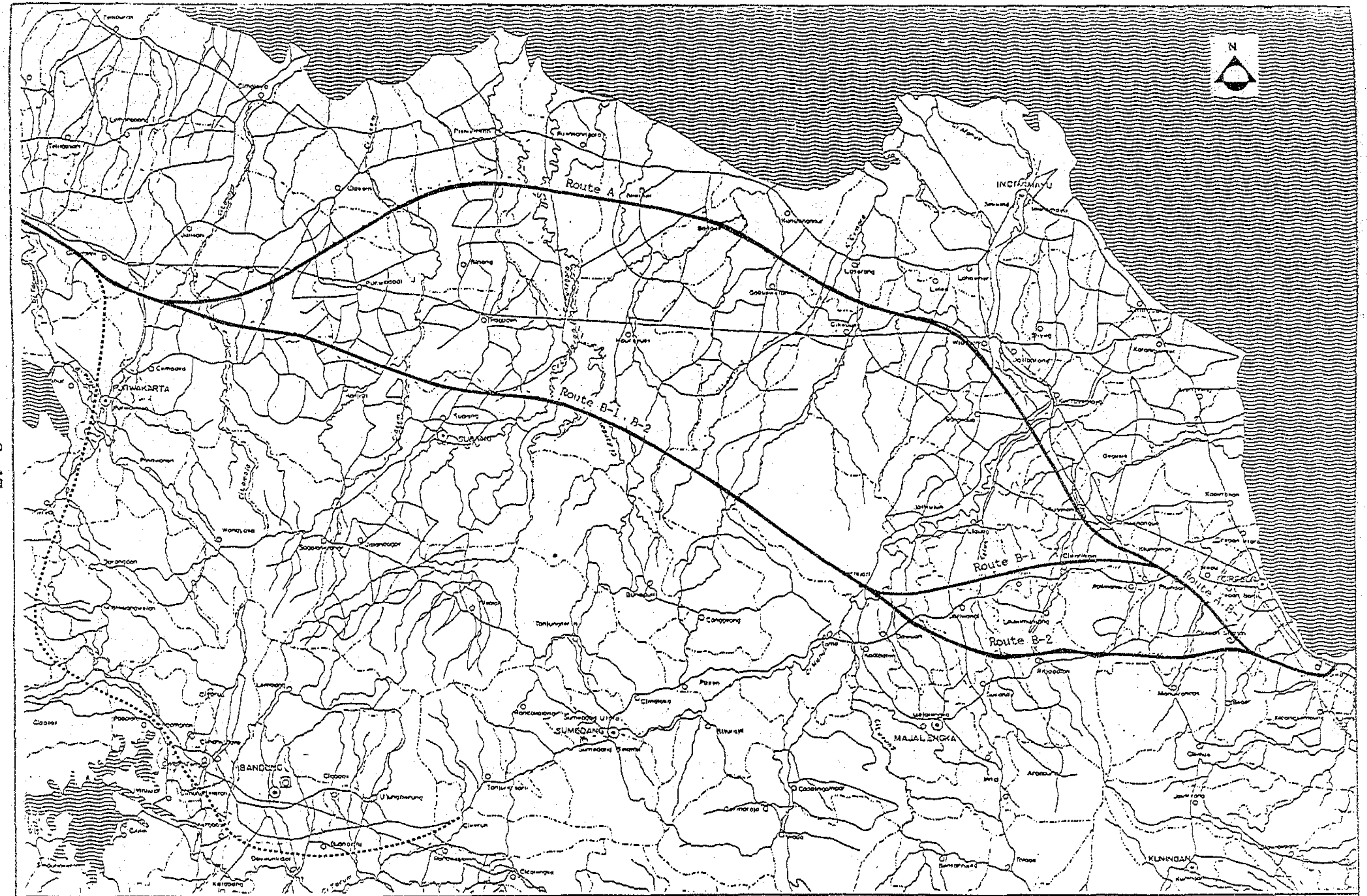
In terms of the above financial comparison, Route B1 also showed the highest efficiency to the project investment out of the alternative Routes.

A summary of the result of the above comparative analysis is given as shown in Table 4.3.

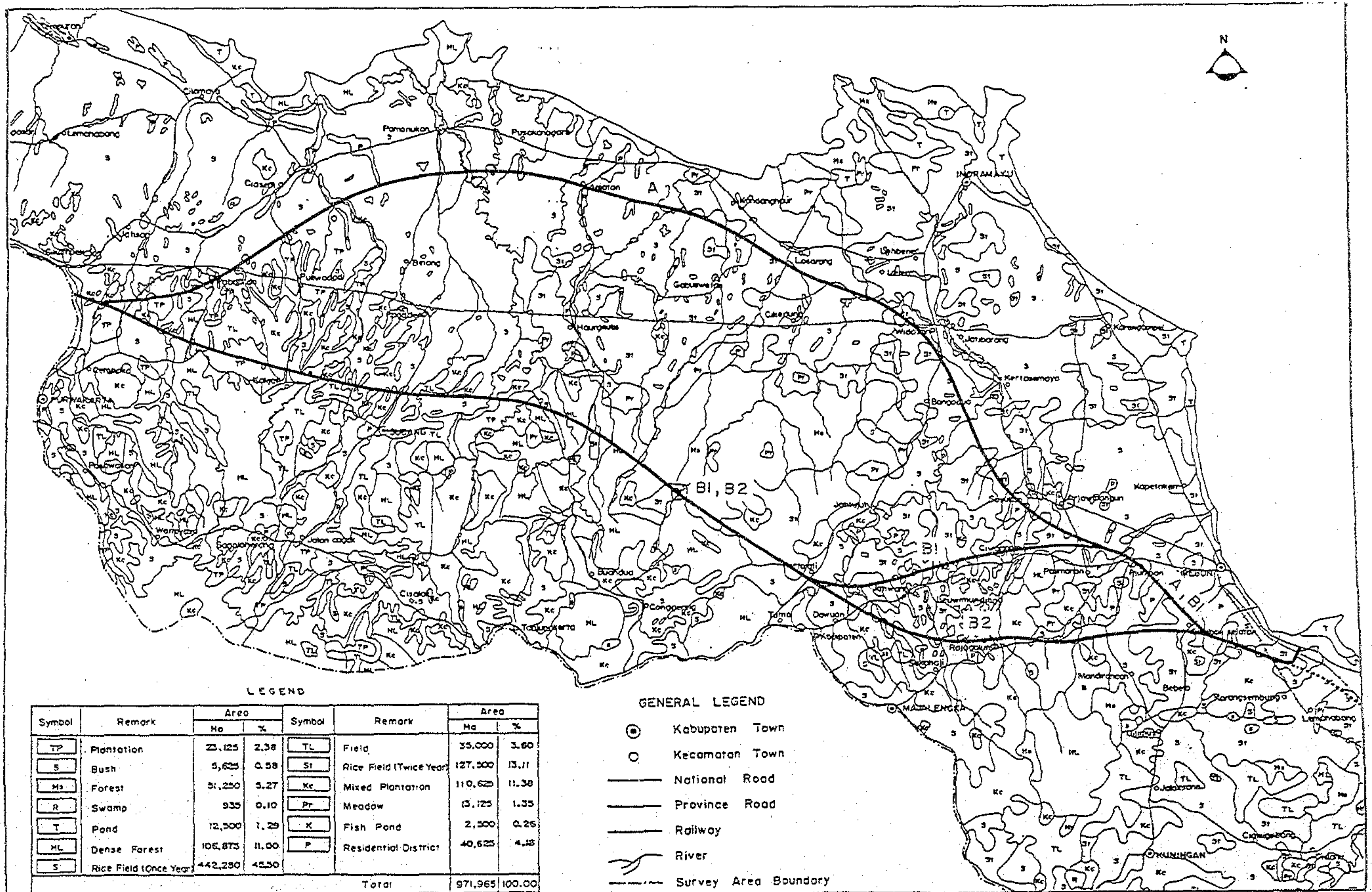
Table 4.3 Overall Comparison of Alternative Routes

Comparative Elements		Route A	Route B1	Route B2
a)	Environmental and Socio-economic Impacts	Fair	Good	Fair
b)	Economic Efficiency	Poor	Good	Fair
c)	Financial Efficiency	Poor	Good	Fair

Finally alternative Route B1 was approved by the Government of Indonesia to be the optimal route for Cikampek-Cirebon Tollway Project and the route to be utilized in the subsequent preliminary design work.



Feasibility Study on Cikampek - Cirebon Tollway Project | Fig. 4.1 Alternative Route Map



LEGEND

Symbol	Remark	Area Ha	Area %	Symbol	Remark	Area Ha	Area %
TP	Plantation	23,125	2.38	TL	Field	35,000	3.60
S	Bush	5,625	0.58	St	Rice Field (Twice Year)	127,500	13.11
Ms	Forest	51,250	5.27	Kc	Mixed Plantation	110,625	11.38
R	Swamp	935	0.10	Pr	Meadow	13,125	1.35
T	Pond	12,500	1.29	K	Fish Pond	2,500	0.26
HL	Dense Forest	106,875	11.00	P	Residential District	40,625	4.18
S	Rice Field (Once Year)	442,250	45.50				
					Total	971,965	100.00

Feasibility Study on Cikampek – Cirebon Tollway Project

Fig. 4.2 Landuse Map

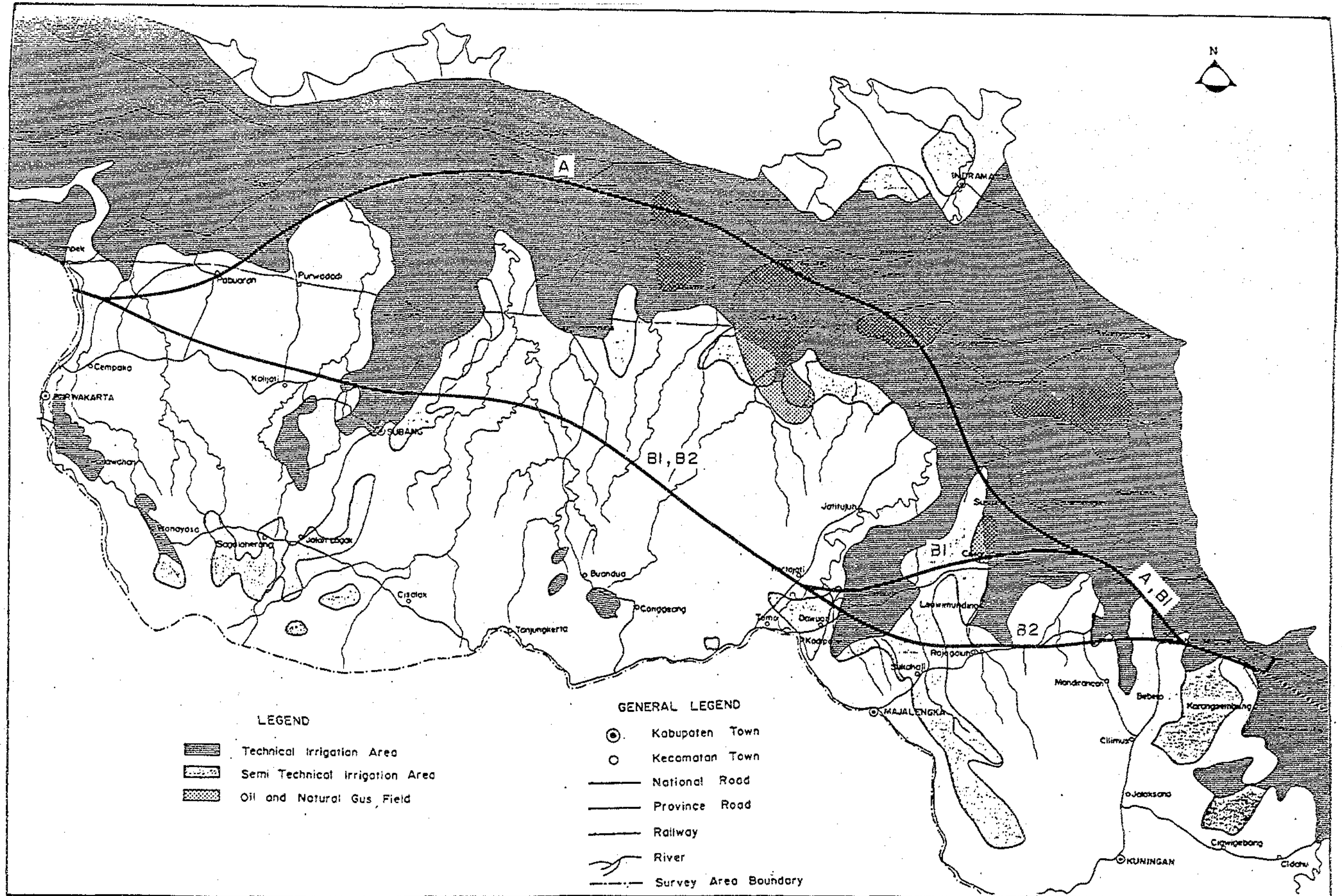
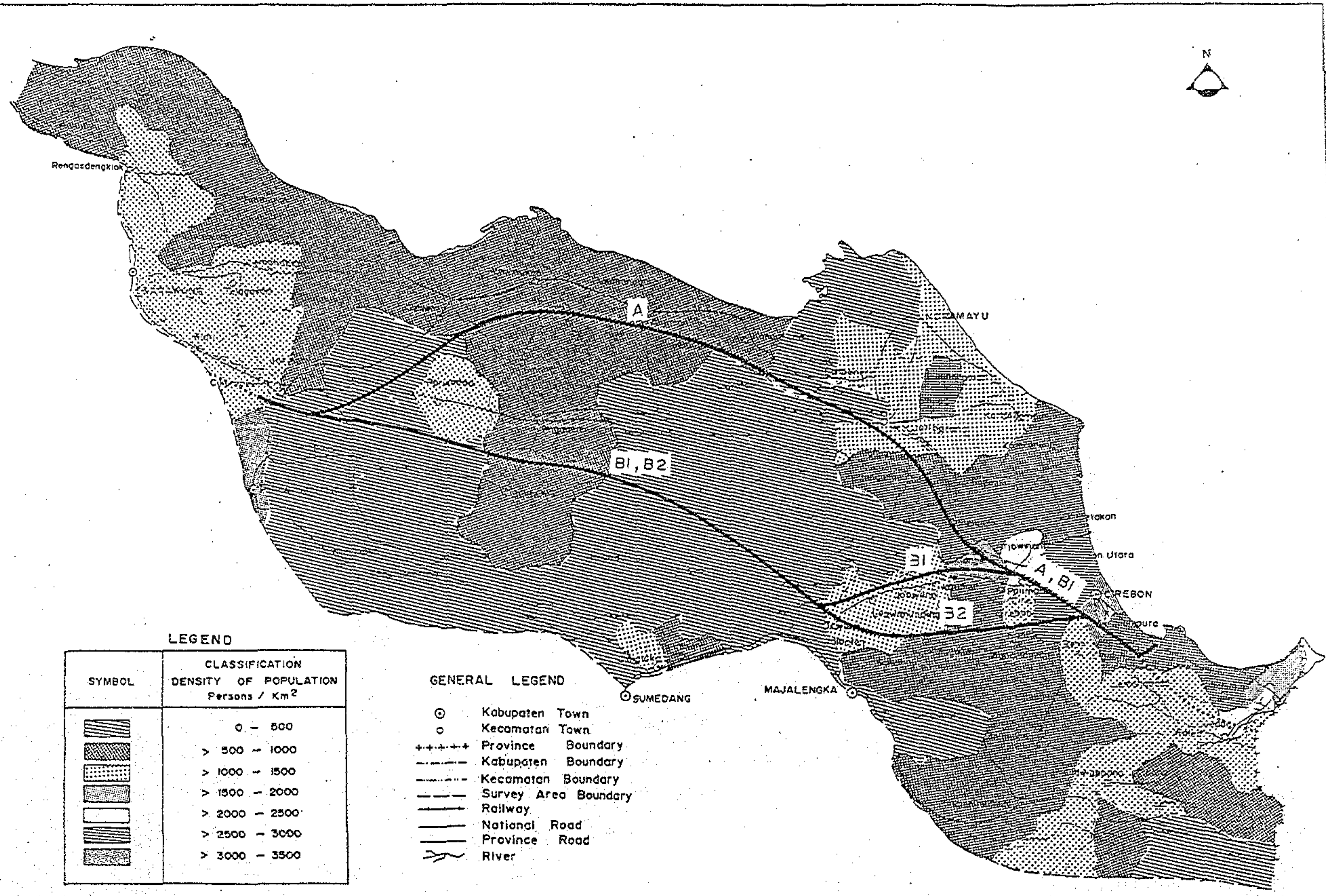


Fig. 4.3 Irrigation Area and Oil Field Map



Feasibility Study on Cikampek – Cirebon Tollway Project | Fig. 4.4 Population Density Map

5. TOLLWAY OPERATION AND MAINTENANCE PLANNING

5.1 Tollway Operation

It is government policy at present to utilize the private sector for tollway construction and operation. A selected investor(s) is authorized to operate a tollway within a contracted concessionary period, and thereafter he has to transfer the tollway property to the government.

5.2 Toll Collection System

1) Tariff System

A distance proportional tariff is proposed and has been adopted.

2) Toll Collection and Management System

A magnetic card system is proposed for the project tollway. Users stop at on-ramps and off-ramps, a transit card is handed on entry and a toll is paid on exit.

In order to clearly identify the jurisdiction of toll revenue of different tollway operators it is proposed to build throughway barrier gates at the east terminus of Jakarta-Cikampek Tollway and the west terminus of Cikampek-Cirebon Tollway.

A barrier gate will also be required at the east terminus of the project tollway when it is extended further east and operated by a different operator.

5.3 Operational Organization

Assuming that the project tollway is operated by a private investor separately from Jasa Marga, the operational organization must be self-sufficient.

However, since it is required that high standards of service and safety should be maintained, Jasa Marga should be authorized to dictate the technical standards and to supervise the operator to ensure that these standards are being maintained.

5.4 Tollway Maintenance

"Tollway Maintenance" is defined as the function of preserving, repairing, and restoring a tollway and keeping it in condition for safe, convenient, and economical use. "Maintenance" includes both physical maintenance activities, such as patching, filling joints, mowing, and so forth, and traffic service activities including remarking and removing litter.

Maintenance budgets are based on the estimated costs to accomplish specific work programs to stated tollway levels of service and performance standards.

5.5 Traffic Control and Information System

Traffic control and information service is vital in monitoring safe and smooth traffic flow regardless of weather or traffic conditions including the following key activities:

- Traffic regulation (volume, speed, weight);
- Information collection and dissemination;
- Accidents and congestion monitoring; and
- Facility security

Control, largely exercised by traffic police, includes monitoring of speed and driving behavior to ensure a safe operating environment.

Traffic information facilities are expected to require sophisticated treatment in future particularly as volume on key demand sectors approach saturation capacity. Closed-circuit television, radio broadcasts, variable-message boards and loop-type traffic detectors will, in all likelihood, be desirable in future.

6. PRELIMINARY DESIGN WORK

6.1 Alignment Design

1) Basic Data

Based on the aerial photography, plotting works at a scale of 1:5,000 for topographic mapping was developed.

The topographic map plotted covers 840 km^2 with 282 models and 117 sheets.

A soils and materials survey was carried out along the length of the proposed tollway to provide information and data for earthwork, pavement, structural work and other items for the tollway.

2) Geometric Design Standard

a) Design Speed

Since the terrain is flat except for part of the route near Cikampek and Cirebon areas in the project corridor, a design speed of 120 km and 100 km is used for tollway carriageways in flat and rolling areas respectively.

b) Lane Width

No modification or change is made to the current government standard of 3.60 m.

c) Shoulder

The governmental standard of 3.00 m and 1.50 m are adopted for outer shoulder and inner shoulder respectively.

d) Median

A minimum width of 5.00 m is considered sufficient allowance for the construction of piers of flyover bridges and drainage structures.

e) Others

Based on the design speed adopted, other design criteria and elements such as sight distance, horizontal curvature, vertical alignment, superelevation, etc. are determined by following government standards.

A typical cross-section is shown in Fig. 6.1.

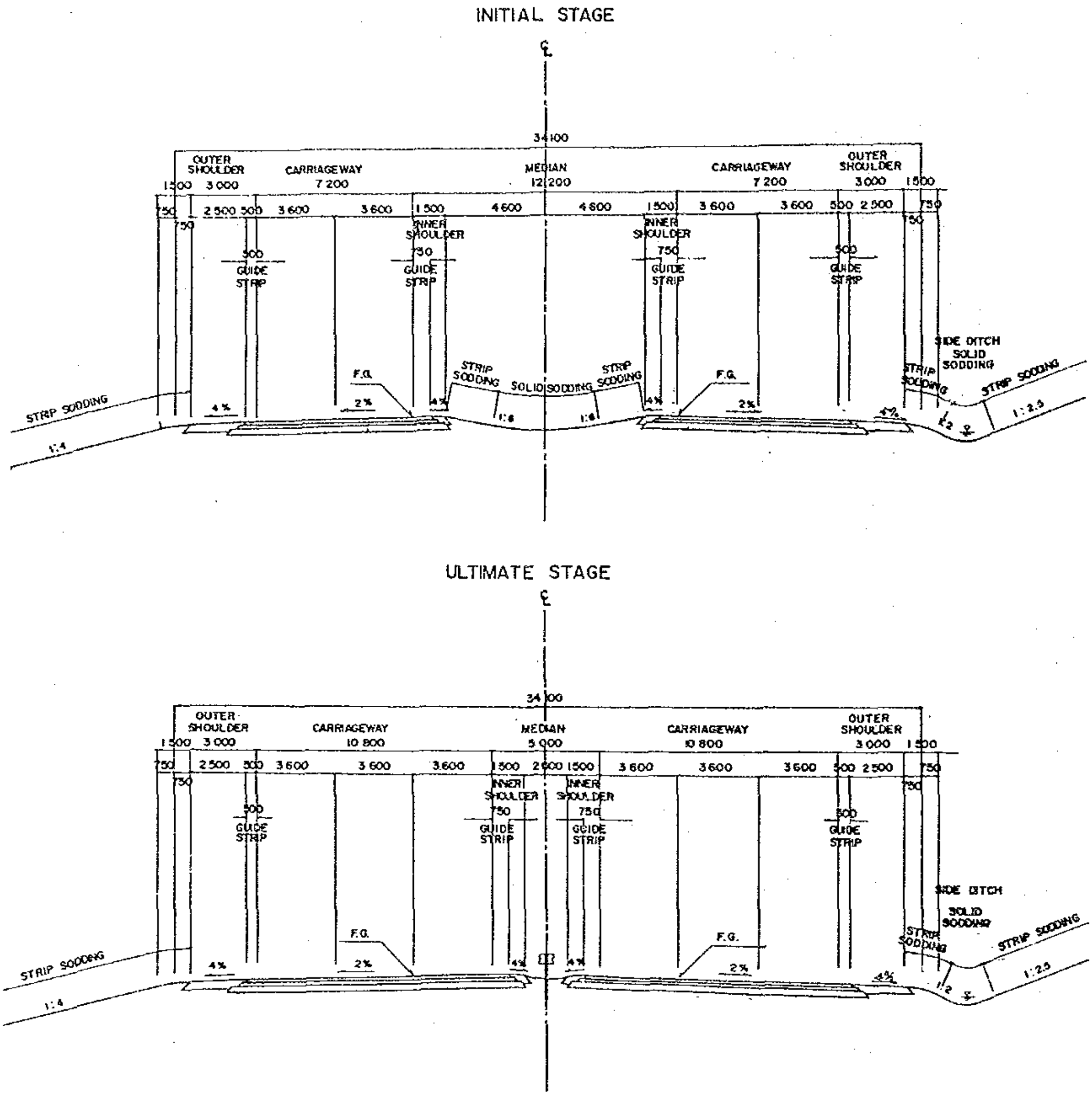


Fig. 6.1 Typical Cross Section

3) Alignment Design

a) Horizontal Alignment

The following major factors are considered in setting up the horizontal alignment.

- to provide horizontal alignment with gentle curvature reflecting the flat terrain conditions,
- to shift the alignment to the most suitable distance to the built up areas and development centers in the proposed interchange areas,
- to avoid cutting through local communities and villages,
- to avoid as much as possible public facilities, factories and buildings, and
- to avoid parks, and cemeteries.

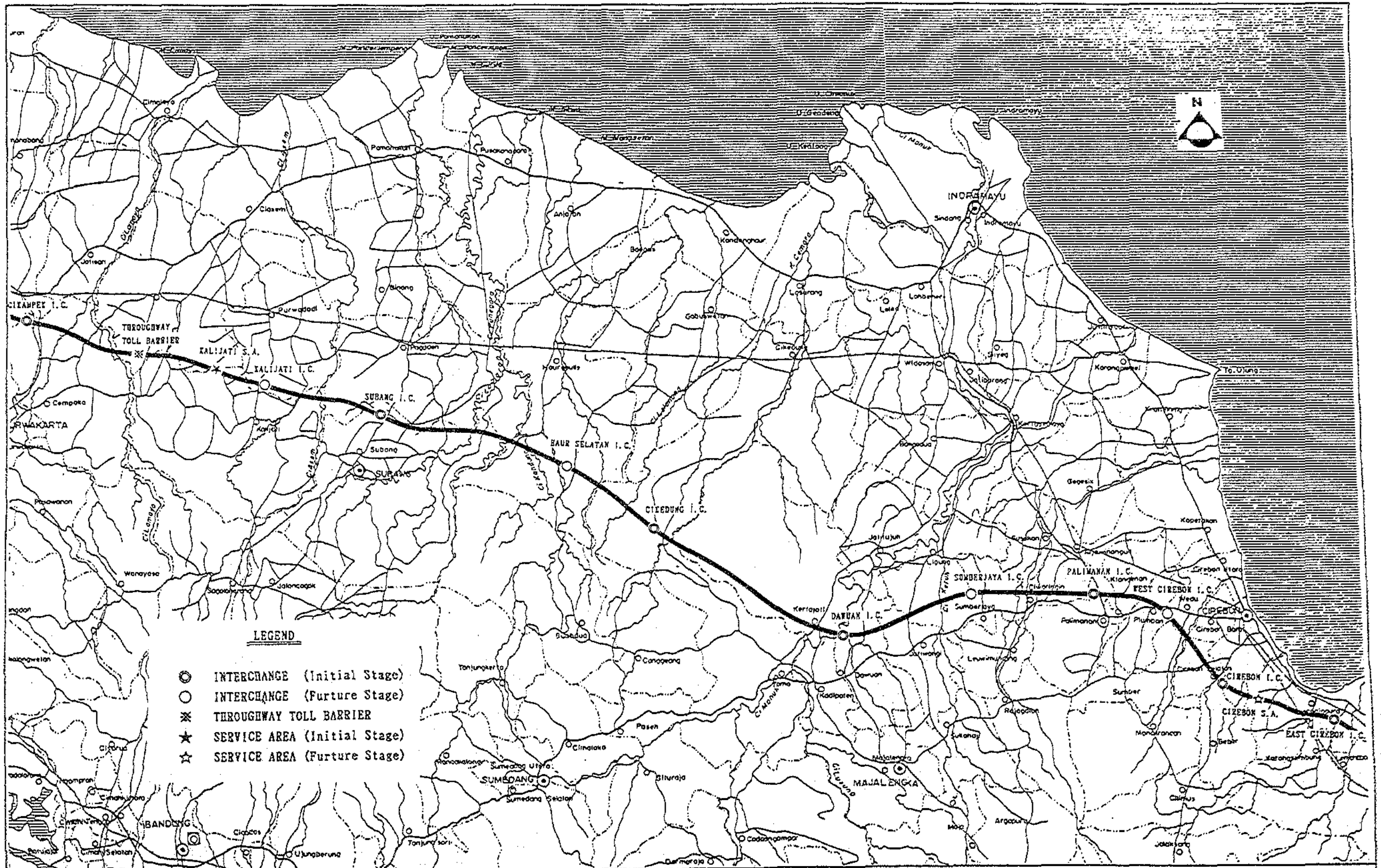
b) Vertical Alignment

The vertical alignment is attained considering the following constraints:

- to maintain local activities and communications by provision of box culverts or over passes based on comparative study of both alternatives,
- to keep a minimum embankment height of 2.0 m above existing ground in paddy fields for pipe culverts,
- to provide necessary vertical clearance for roads, rivers and narrow gauge railway tracks, and
- to provide over passes for existing roads over the tollway for grade separation, in principle.

6.2 Interchange Design

The location and type of interchanges are decided on the basis of future traffic demand and socio-economic conditions in the project area as listed in Table 6.1 and Fig. 6.2.



Feasibility Study on Cikampek - Cirebon Tollway Project

Fig. 6.2 Route and Interchange Location Map

Table 6.1 Interchange List

Initial Stage	Future Stage		
Cikampek		Single Trumpet	Province road Route 080
	Kalijati		
Subang		Single Trumpet	Province road Route 075
	Haur Selatan		
Cikedung		Single Trumpet	Province road Route 074
Dawuan		Single Trumpet	National road Route 023
	Sumberjaya		
Palimanan		Single Trumpet	Province road Route 025
	West Cirebon		
Cirebon		Single Trumpet (+ grade separation intersection)	Province road Route 067
East Cirebon		(Single Trumpet)	National road Route 023

Note: ( ) shows future plan

6.3 Structural Design

Based on the design concept of economy, ease of construction, construction period and aesthetics, preliminary structural designs for bridges, culverts and retaining walls were conducted to establish standardization of structural types.

A comprehensive study was made to establish standards of structure types for throughway bridges and over bridges.

The structures are as follows:

- Superstructure : PC hollow slab
  RC hollow slab
  PC continuous box girder
- Substructure : Column type
  Wall type
- Foundation : Precast PC Pile
  Precast RC Pile
  Steel Pipe Pile

6.4 Hydrology and Drainage

In this preliminary design, based on examination of the developed topographic maps (1:5,000 scale) and site investigation, the following major check points were studied.

- Bridge location
- River or channel width for bridge design
- Clearance between bridge and high water level of rivers

1) Rivers

Over crossing structures of rivers were designed to keep a clearance of at least 180 cm and 120 cm for 50 and 100 year storms respectively.

2) Irrigation Canals

In the knowledge that the proposed alignment runs through upland areas of technical irrigation and semi technical irrigation areas with many irrigation canal crossings along the proposed tollway, careful attention was paid to maintain the existing conditions of irrigation canals.

3) Waterways

The existing waterways based on Indonesian Standards were classified on analysis of topographical data and field investigations as follows:

- Drainage : Rivers (major, minor and local)
- Irrigation : Canals

The classification identifies where bridges, box culverts or pipe-culverts are used.

4) Roadway and Roadside Drainage

In the course of the study the basic policy for roadway and roadside drainage was considered:

- to avoid discharging the road surface water into irrigation canals,
- to maintain the existing water usage in local areas, and
- to design median run-off by median channels of earth, mortared rubble and U-ditches following the conditions of horizontal and vertical alignment.

6.5 Pavement Design

1) Cost Comparative Study

A cost comparison of flexible pavement and rigid pavement over a 20 year life span is shown in Table 6.2.

Table 6.2 Cost Comparison

	Rigid Pavement		Flexible Pavement			
			Overlay once 5 years		Overlay once 10 years	
	Cost (Rp./m^2)	PV (Rp./m^2)	Cost (Rp./m^2)	PV (Rp./m^2)	Cost (Rp./m^2)	PV (Rp./m^2)
Initial Cost	35,200	35,200	34,330	34,330	34,330	34,330
Maintenance Cost	4,390	680	26,520	6,178	17,840	3,475
Total Cost	39,590 (100%)	35,880 (100%)	60,850 (154%)	40,508 (113%)	52,170 (132%)	37,805 (105%)

Note: PV means the present value of 15% discount rate.

2) Difference in Vehicle Operating Cost

A rough surface causes relatively high vehicle running cost compared to a smooth pavement.

The two cost elements of vehicle maintenance and type consumption were considered to be affected by the roughness of road pavement.

Based on the future traffic volume a present value of the increased cost in vehicle operation, when using the rigid pavement road, was calculated using a discount rate of 15%. The total surface area is estimated in the engineering study to be about 2,361,000 m^2, so that the accumulated present value of the increased vehicle operating cost resulted in Rp. 13,010/m^2.

3) Determination of Surface Pavement

Combining the previously estimated costs for pavement construction and maintenance, and incremental costs for vehicle operation, the difference between rigid and flexible pavement appeared as shown in Table 6.3.

Table 6.3 Comparison between Rigid and Flexible Pavement by Present Value over 20 Years Period

(Rp./m^2)

	Rigid Pavement	Flexible Pavement	
		Overlay (5 yrs)	Overlay (10 yrs)
Pavement/Maintenance	35,880	40,508	37,805
Incremental Cost to use Rigid Pavement	13,010	-	-
Total	48,890	40,508	37,805

As obviously shown in Table 6.3, the rigid pavement incurs higher costs from the combined aspects of road operator and user.

From a road user point of view, in addition to the above, flexible pavement is more comfortable due to smooth surface dressing and lack of construction joints.

In overall view of the above considerations it is recommended to use flexible pavement for the proposed tollway.

6.6 Tollway Facilities

The following tollway facilities are considered for the proposed tollway:

- Road lighting
- Traffic signals
- Traffic signs
- Toll gates and islands
- Other road facilities
- Traffic control facilities
- Administration and operation office building
- Toll Collection and Control System

6.7 Environmental Consideration

1) Results of Field survey of the Project Area

A field survey of the project area was conducted and revealed that the area did not fall under any of the following categories:

a) Areas containing objects of historical, archaeological, religious, artistic or scientific value, or precious natural products

b) Areas containing useful or scarce animals or vegetation that need to be preserved

c) Areas with soft ground where the tollway may incur negative impacts on the existing housing area

d) Areas that may have an impact on the natural scenery

2) Study Results

In order to minimize negative impacts on the environment, criteria for the selection of the project route and mitigation measures against negative impact are established as follows:

a) Public institution areas should be avoided.

b) Cemetery areas should be avoided.

c) Irrigation channels should be crossed over keeping their existing condition.

d) An embankment road should be applied to rice field areas to allow crossing of small irrigation channels. (minimum 2 meters high for embankment).

e) Forest preservation areas should be avoided.

f) Community separation should be minimized.

g) The route selected should be as far as possible away from schools, mosques and hospitals.

h) A detour distance, when unifying the existing road by a grade separation, should be made as short as possible.

Even after the above considerations are taken into the regional and route selection studies, the following four problems may still remain to be examined.

a) Water pollution due to sewage from the proposed service areas.

b) Alteration of the groundwater level caused by large scale excavation work in the rubber plantation area around Kerta Jati and its effects on the downstream rubber plantations.

c) Air pollution and noise in the densely built up areas around Cirebon City.

d) Effects of earth, sand and dust caused by the construction on the residential areas and cultivated land.

A detailed field study based on Indonesian environmental standards should be conducted at the detailed design stage.

7. FORECAST TRAFFIC VOLUME AND STAGED CONSTRUCTION

7.1 Assigned Traffic Volumes

The traffic volume on the project tollway was based on the OD matrices that were estimated previously by the present pattern method and the gravity method. The OD matrices used for future tollway traffic were made by the present pattern method for years 1995 and 2005, and those by the gravity method for years 2005 and 2015.

The traffic volume estimated on the gravity model basis is assumed to apply for years after the Cikampek-Cirebon link is completed, because a direct tollway linkage between Jakarta-Cikampek and Cikampek-Cirebon will induce regional development and attract large numbers of traffic resulting in the alteration of the traffic distribution pattern in the influenced region.

The forecast traffic volume is presented in Fig. 7.1, where the 1995 volumes are based on the present pattern method and the 2005 and 2015 volumes are based on the gravity model method.

7.2 Characteristics of Assigned Traffic in the Study Area

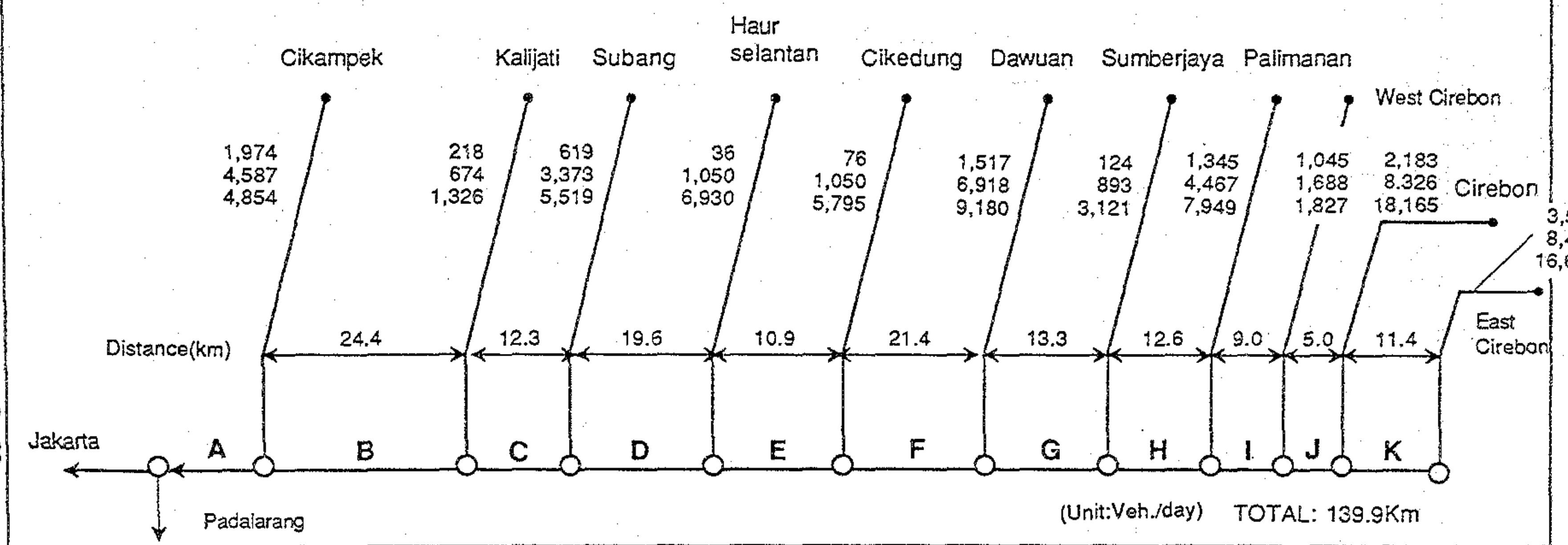
The number of project tollway users on average was estimated at 10,422, 38,352 and 74,728 vehicles in 1995, 2005 and 2015 respectively as shown in Table 7.1. The higher increase in traffic volume between 1995 and 2005 was brought about by the factor of reduced travel time through the tollway, which was incorporated into the gravity model applied to estimating 2005 and 2015 traffic demand.

Table 7.1 Characteristics of Project Tollway Users

Tollway Traffic	Year		
	1995	2005	2015
(1) No. of Tollway Users (Veh./day)	10,422	38,352	74,728
(2) Total Veh.-Km on Tollway (x1000)	783	3,344	6,665
(3) Average Trip Length of Users (Km/Veh.)	75.1	87.2	89.2
(4) Average Cross Sectional Traffic (Veh./day) on Tollway with Toll Charge Condition	5,611	24,198	48,160
(5) Average Cross Sectional Traffic (Veh./day) on Tollway with Toll Free Condition	17,200	41,000	59,700
(6) Average % of Diverted Traffic (%) to Tollway	33	59	81

The average trip length of the tollway traffic was 75.1 Km, 87.2 Km and 89.2 Km for years 1995, 2005 and 2015 respectively. As tollway traffic increases, travel distance becomes longer. The average travel distance covers about 54% ~ 64% of the total length, i.e. 140 Km of Cikampek and Cirebon.

Fig. 7.1 Future Traffic Demand on Cikampek-Cirebon Tollway with All Interchanges



	A	B	C	D	E	F	G	H	I	J	K	Average
1995	(8,167)	6,417	6,224	6,051	6,060	5,984	5,828	5,743	6,745	5,700	3,540	5,611
2005	(35,274)	31,802	31,196	28,441	27,898	26,865	21,133	20,553	18,402	16,715	8,404	24,198
2015	(68,180)	65,379	64,162	59,580	54,469	48,894	41,155	39,362	36,507	34,680	16,610	48,160

7.3 **Number of Traffic Lanes and Staged Construction**

The relationship between the traffic demand and the tollway capacity is shown diagrammatically in Fig. 7.2. The tollway capacity was estimated by the Highway Capacity Manual.

The traffic volume on the tollway almost reaches the capacity of a 2-lane/2-way road in the assumed opening year of 1998. Therefore, the initial stage construction of the tollway should be a 4-lane tollway.

The second stage construction to widen the tollway from 4-lane to 6-lane should be completed before the year 2010 for the Cikampek-Dawuan section and before the year 2015 for the Dawuan-Cirebon section.

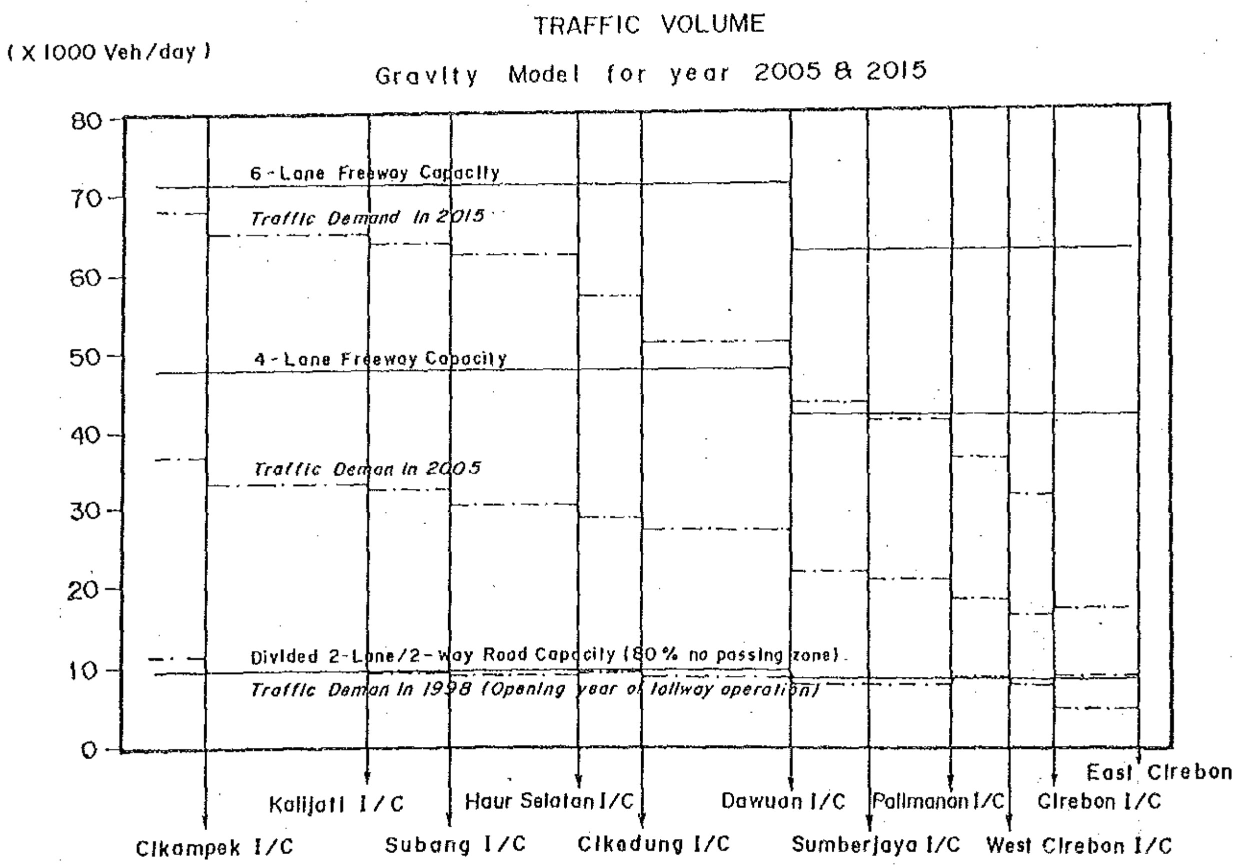


Fig. 7.2 Relationship between Traffic Demand and Tollway Capacity

8. ESTIMATED PROJECT COST

The construction work is divided into 3 packages according to the construction plan and the work schedule. The quantity of each work item of construction per section is estimated and the construction cost is calculated according to the unit cost based on similar past projects.

Tables 8.1 and 8.2 show the project cost for the initial stage and remaining works for the ultimate stage per package.

Table 8.1 Project Cost (Initial 4 Lanes)

(1,000,000 Rp.)

	Item	Package A	Package B	Package C	Total
1	Earth Work	49,414	31,567	73,248	154,228
2	Pavement	23,844	33,439	33,876	91,159
3	Bridges	29,407	26,250	27,028	82,684
4	Grade Separation Structure	9,539	10,025	18,324	37,888
5	Drainage	5,854	6,818	8,471	21,143
6	Interchange	7,000	7,000	7,000	21,000
7	Throughway Toll Barrier	5,700	0	0	5,700
8	Service & Parking Area	4,200	8,240	4,120	16,560
9	Related Construction	3,254	2,449	7,761	13,463
10	Miscellaneous	2,390	3,169	3,878	9,437
11	Vehicle & Furniture	1,042	1,042	1,042	3,126
12	Contingency	21,090	19,343	27,556	67,989
13	Overhead & Profit	16,169	14,830	21,126	52,125
14	Engineering Fee	12,450	11,419	16,267	40,136
15	Tax	19,135	17,559	24,970	61,664
16	Land Acquisition/Compensation	17,364	35,093	16,780	69,237
	Project Cost	227,852	228,242	291,445	747,539

Table 8.2 Project Cost (Remaining Works for 6 Lanes)

(1,000,000 Rp.)

	Item	Package A	Package B	Package C	Total
1	Earth Work	0	0	0	0
2	Pavement	10,313	14,491	14,584	39,388
3	Bridges	0	0	0	0
4	Grade Separation Structure	0	0	0	0
5	Drainage	2,504	3,523	3,536	9,563
6	Interchange	3,500	3,500	7,000	14,000
7	Throughway Toll Barrier	0	0	5,700	5,700
8	Service & Parking Area	0	0	4,200	4,200
9	Related Construction	0	0	0	0
10	Miscellaneous	3,560	4,910	5,005	13,475
11	Vehicle & Furniture	0	0	0	0
12	Contingency	2,982	3,964	6,004	12,950
13	Overhead & Profit	2,286	3,039	4,603	9,928
14	Engineering Fee	1,760	2,340	3,544	7,644
15	Tax	2,691	3,577	5,418	11,686
16	Land Acquisition/Compensation	0	0	0	0
	Project Cost	29,597	39,344	59,594	128,534

Note: Package A: Section from Cikampek to Subang (37.5 km)
Package B: Section from Subang to Dawuan (52.0 km)
Package C: Section from Dawuan to East Cirebon (52.8 km)

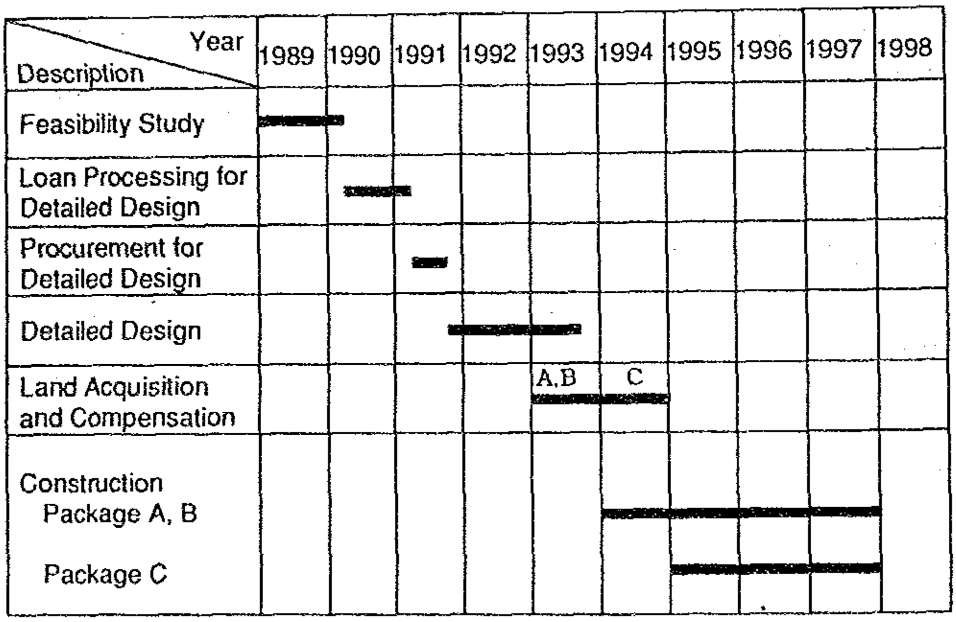
9. ECONOMIC PROJECT ANALYSIS

9.1 Project Cost and Implementation Schedule

The initial investment cost for construction and land acquisition costs of the proposed tollway were estimated at a total of 747,539.0 million rupiah in constant 1989 prices. Of this total, 658,234 million rupiah is the construction and supervision cost, 69,237.0 million rupiah is the land acquisition and compensation cost and the remaining 20,068.0 million rupiah is the final engineering costs. The implementation schedule followed in the analyses indicates that final engineering activities will continue from late 1991 through 1993, with land acquisition starting in 1993. Construction is scheduled over four years from 1994 to 1997.

The economic costs are estimated in constant 1989 prices by adjusting and eliminating all transfer payments such as taxes and duties. The economic costs in constant 1989 prices are properly phased according to the construction schedule as shown in Table 9.1.

Table 9.1 Implementation Schedule



9.2 Vehicle Operating Costs

The estimation of the vehicle operating costs is based on the method accepted by Jasa Marga in previous similar studies. All cost components and variables were up-dated according to the latest information collected in this study.

The weighted averages of the vehicle operating costs by speed, by vehicle category in financial and economic prices were obtained. The results were then applied directly to the vehicle kilometers in different speed groups of tollway users in both network cases of "with" and "without" the project tollway.

9.3 Vehicle Time Cost

The vehicle time costs estimated were directly applied to the vehicle hours of the potential tollway users derived from the "with" (with the project) and "without" (without the project) traffic assignment in order to estimate the vehicle time costs which would be saved with the implementation of the Tollway.

The vehicle time costs were estimated as shown in Table 9.2

Table 9.2 Vehicle Time Cost

Vehicle Type	Time Cost (Rp./hr.)
Financial/Economic Costs:	
Passenger Car*	9,300
Pick-up	7,260
Truck	8,580
Bus	17,100

Note: * Including mini buses for private use

9.4 Economic Benefits

The quantified economic benefits in travel costs are defined as the savings in economic travel costs when comparing the "with" and "without" project situations. Travel costs are divided into vehicle operating cost and time cost.

These savings in vehicle operating costs and time costs are summarized for the planning years as described in Table 9.3.

Table 9.3 Estimated Economic User Benefits of Project Tollway

(Unit: Rp. Million/Year)

Year	Economic Benefits of Savings In:		Total Benefits	Remarks
	Vehicle Operating Costs	Time Costs		
1995	3,680	59,145	62,825	Present Pattern Model
2005	(50,227) 208,738	(176,270) 430,861	(226,497) 639,599	(Present Pattern Model) Gravity Model
2015	(250,787) 553,589	(585,367) 1,080,224	(836,154) 1,633,813	(Present Pattern Model) Gravity Model

9.5 Economic Cost-Benefit Analysis and Project Returns

The basic assumptions for the economic project cost-benefit analysis are described below:

Base Year	:	1989
Project Life	:	25 years after the completion of the full length between Cikampek and Cirebon
Prices	:	Constant 1989 prices
Residual Value	:	None

The total economic project cost and benefit streams are presented in Table 9.4.

Following the conventional discounted cash flow methodology, the efficiency measures were calculated and the results are as follows:

Internal rate of return (EIRR)	=	32.28%
Net present value at 15% (NPV)	=	818,896 Million Rp. at 1989 constant price
Benefit Cost ratio at 15% (B/C)	=	4.29

Table 9.4 Economic Project Cost and Benefit Streams

CONSTANT 1989 MILLION RP

	PROJECT COSTS			BENEFITS	INCREMENTAL PROJECT BENEFIT
YEAR	CAPITAL COSTS	O/M COSTS	TOTAL COSTS	TOTAL SAVINGS	
1 1989	0	0	0	0	0
2 1990	0	0	0	0	0
3 1991	3,343	0	3,343	0	-3,343
4 1992	6,687	0	6,687	0	-6,687
5 1993	59,144	0	59,144	0	-59,144
6 1994	80,917	0	80,917	0	-80,917
7 1995	156,440	0	156,440	0	-156,440
8 1996	176,940	0	176,940	0	-176,940
9 1997	125,006	0	125,006	0	-125,006
10 1998	0	14,186	14,186	111,927	97,741
11 1999	0	14,186	14,186	187,309	173,123
12 2000	0	14,186	14,186	262,690	248,504
13 2001	0	14,186	14,186	338,072	323,886
14 2002	0	14,186	14,186	413,454	399,268
15 2003	0	14,186	14,186	488,836	474,650
16 2004	0	14,186	14,186	564,217	550,031
17 2005	0	14,186	14,186	639,599	625,413
18 2006	0	14,186	14,186	739,020	724,834
19 2007	0	14,186	14,186	838,442	824,256
20 2008	27,648	14,186	14,186	937,863	923,677
21 2009	27,648	14,186	14,186	1,037,285	1,023,099
22 2010	0	15,099	15,099	1,136,706	1,121,607
23 2011	0	15,099	15,099	1,236,127	1,221,028
24 2012	0	15,099	15,099	1,335,549	1,320,450
25 2013	23,552	15,099	15,099	1,434,970	1,419,871
26 2014	23,552	15,099	15,099	1,534,392	1,519,293
27 2015	0	15,464	15,464	1,633,813	1,618,349
36 2016	0	15,464	15,464	1,633,813	1,618,349
29 2017	0	15,464	15,464	1,633,813	1,618,349
30 2018	0	15,464	15,464	1,633,813	1,618,349
31 2019	0	15,464	15,464	1,633,813	1,618,349
32 2020	0	15,464	15,464	1,633,813	1,618,349
33 2021	0	15,464	15,464	1,633,813	1,618,349
34 2022	0	15,464	15,464	1,633,813	1,618,349
TOTAL	710,877	369,439	977,916	26,306,962	25,329,046

ECONOMIC IRR= 32.28%

NET PRESENT VALUE
Disc. at 15%= 818,896

B/C RATIO 4.29

10. FINANCIAL PROJECT ANALYSIS

10.1 Assumptions

The following assumptions are made for the financial analysis:

1) Project Life

Opening year of the operation : 1998
Project life : 25 years after open to traffic.

2) Salvage Value

The project life of 25 years is the period for the purpose of this analysis. The facility of the tollway will continue to have value for a much longer period.

Accordingly, the salvage value (undepreciated value) is assumed as a negative cost in the final year of the project life.

3) Prices

For financial analysis, two prices are assumed as follows:

- Constant 1989 price
- Current price

In the case of constant price, the annual 3% increase of toll rate is according to the assumed growth ratio of GDP per capita in Indonesia.

In the cases of current price, the increase of toll rate of 40% for three years (about 12% increase per annum) is based on interview with Jasa Marga, and the annual 8% increase of cost is according to the assumed growth ratio of consumer prices in Indonesia.

10.2 Toll Rate and Revenue

In the analysis of the traffic demand projection, the toll model was derived from the study result of the existing tollway tariff which was prepared for the traffic assignment. The toll rates for the revenue estimation of financial analysis are based on the said toll rate model.

As a result of calculation of traffic assignment, the toll per vehicle-kilometer and the financial benefit per vehicle-kilometer are obtained.

Table 10.1 shows a summary of the comparison of the toll per vehicle-kilometer and the financial benefit per vehicle-kilometer by vehicle type. The toll per vehicle-kilometer is about Rp. 80-160 for sedan and pick-up, and about Rp. 120-230 for truck and bus at 1989 prices. The ratios of toll to financial benefit in terms of per vehicle-kilometer show values of about 0.2 to 0.5.

Table 10.1 Summary of Ratios of Toll per Vehicle-Km and Financial Benefit per Vehicle-Km

Year	Vehicle Type	Financial Benefit per Vehicle-Km (Rp.) (1)	Toll per Vehicle-Km (Rp.) (2)	Ratio (2)/(1)
1995	Passenger Car	318	85	0.267
	Bus	283	123	0.435
	Pickup	195	88	0.453
	Truck	248	122	0.491
2005	Passenger Car	605	112	0.186
	Bus	599	164	0.273
	Pickup	386	116	0.299
	Truck	651	167	0.256
2015	Passenger Car	755	153	0.203
	Bus	903	220	0.244
	Pickup	486	158	0.324
	Truck	817	227	0.277

Note: at 1989 prices

10.3 Financial Internal Rate of Return

Based on the estimated construction cost and operation/maintenance cost, and the estimated revenue, the financial internal rate of return (FIRR) is calculated for the cases of constant price and current price. In this case, the Return on Investment (ROI) is examined, which is an indicator for evaluation of the Project, regardless of the condition of fund raising for the project.

Table 10.2 shows a summary of the calculation result of FIRR (ROI) and Net Present Value in a discount rate of 15 percent for each case.

Table 10.2 Summary of Calculation of FIRR

	FIRR (ROI) (%)	NPV (15% discount rate) (Million Rp.)
In Constant Price	14.31	-28,287
In Current Price	23.80	1,230,625

The calculation results show that the implementation of the Project is financially justifiable and feasible from the viewpoint of FIRR (ROI).

10.4 Cash Flow Analysis

In this analysis, several alternatives varying the conditions of financial sources (i.e. the equity/loan (long-term loan) ratio and the interest rate of long-term loan) are assumed and examined.

1) Assumption of Equity/Loan Ratio

The following cases for the equity/loan ratio are assumed:

a) Equity 30%: Loan 70%
b) Equity 40%: Loan 60%

2) Assumption of Long-Term Loan Condition

The following conditions of long-term loan are assumed:

a) Interest rate : 10%
Grace period : 5 years and
Repayment period : 15 years

b) Interest rate : 15%
(Grace period and repayment period as a))

c) Interest rate : 20%
(Grace period and repayment period as a))

3) Assumption of Short-Term Loan

It is assumed that in the case of cash flow deficit of the total financial source against the total financial use, the deficit is financed by a short-term loan. In particular, the interest during the construction period is assumed to be financed by a short-term loan. The repayment of principal and payment of interest (20 percent per annum) is assumed to be made in the year following the borrowing.

Table 10.3 shows a summary of the calculation results for each alternative case.

- Constant Price Case

In the constant price case, the 30% : 70% equity/loan ratio case shows a severe deficit in cash flow. The deficit in cash flow requires the raising of a short-term loan, and this causes a high increase in payment of interest which then leads to the next deficit. Only the 10% interest rate case shows a sound financial condition. In the 40% : 60% equity/loan ratio case, the 20% interest case shows a deficit in cash flow. The 40% : 60% equity/loan ratio and the 15% interest rate case shows that the first year of accumulated surplus in the profit and loss statement is 2014, which is 16 years after the opening of the tollway operation.

- Current Price Case

On the other hand, the current price case shows favorable conditions even in severe interest rate cases. This is mainly because of a high level of revenue. In the 40% : 60% equity/loan ratio and 15% interest rate case, the first year of accumulated surplus in the profit and loss statement is 2005.

Table 10.3 Summary of Results of Financial Analysis

	Equity /Loan Ratio	Interest Rate	(No.)	FIRR (ROI) (%)	NPV (Discount Rate = 15%) (Mil.Rp.)	FIRR (ROE) (%)	NPV (Discount Rate = 15%) (Mil.Rp.)	First Year of Surplus: Annual Surplus in Profit & Loss (Year)	First Year of Surplus: Accum. Surplus in Profit & Loss (Year)	First Year of Surplus: Annual Surplus in Cash Flow (Year)	Maximum Short-term Loan Amount (Mil.Rp.)	Year of Maximum Short-term Loan (Year)
1. (Constant Price)	30%:70%	10%	(1)	14.31	(28,287)	15.70	20,863	2004	2010	2012	393,242	2005
(1) Toll Rate: 3% up/Year		15%	(2)	14.31	(28,287)	13.58	(46,550)	2014	*)	*)	1,828,487	2014
		20%	(3)	14.31	(28,287)	11.80	(113,961)	*)	*)	*)	-	-
(2) Cost: Constant	40%:60%	10%	(4)	14.31	(28,287)	15.43	13,611	2003	2007	2009	212,461	2003
		15%	(5)	14.31	(28,287)	13.74	(42,992)	2007	2014	2016	742,333	2009
		20%	(6)	14.31	(28,287)	12.26	(99,594)	*)	*)	*)	-	-
2. (Current Price)	30%:70%	10%	(7)	23.80	1,230,625	27.06	1,335,099	2001	2004	2005	306,199	2000
(1) Toll Rate: 40% up/ 3 Year		15%	(8)	23.80	1,230,625	25.32	1,225,940	2004	2007	2007	772,357	2003
		20%	(9)	23.80	1,230,625	23.81	1,116,782	2004	2009	2010	1,434,208	2004
(2) Cost: 8% up/Year	40%:60%	10%	(10)	23.80	1,230,625	26.38	1,324,431	2001	2003	2004	198,408	2000
		15%	(11)	23.80	1,230,625	25.05	1,232,793	2002	2005	2006	465,665	2002
		20%	(12)	23.80	1,230,625	23.84	1,141,152	2004	2007	2008	889,716	2004

Note: (1) Figure in ( ) indicates a minus value.
(2) *) ..... Null first year of surplus within the project life.

11. CONCLUSION AND RECOMMENDATION

11.1 Conclusion

It is concluded as a result of the feasibility study that the project tollway is technically, economically, and financially feasible, and the project should be implemented at the earliest opportunity.

Economic evaluation indicates a high internal rate of return of more than 30%. Further sensitivity analysis confirmed the feasibility of the project.

The financial IRR analysis resulted in a reasonably high rate of return of 14.3% at a constant 1989 price and 23.8% at a current price. FIRR calculations based on current prices is higher than the prevailing interest rate at commercial banks of around 18%.

11.2 Recommendations

1) Construction Method and Sections

It is recommended that the tollway is constructed as a 4-lane divided highway covering the whole length between Cikampek and Cirebon and widened to a 6-lane at inner lanes at the ultimate stage. (see 7.8.3)

The construction is recommended to be divided into nine (9) sections taking into consideration operations for hauling, excavation and filling, accessibility to each section, and proper work volume. (see 12.2)

2) Initial Stage Interchange Construction

Trumpet type interchanges should be constructed at Cikampek, Subang, Cikedung, Dawuan, Palimanan, Cirebon, and East Cirebon during the initial stage of construction. (see 8.2.2 and 10.3.3)

3) Urban Transport Study in Cirebon

Cirebon city has the most potential for development. Since the project tollway will have considerable impact on the city area it will cause conflicts in urban land use and will also cause changes in traffic flow. A regional transport plan therefore is recommended for the Cirebon urban area. In the course of this urban transport study, the necessity of the West Cirebon Interchange should be examined.

4) Operation and Maintenance Facilities

Since the project tollway is to be operated by an independent organization different from the Jakarta-Cikampek Tollway, a throughway toll barrier gate becomes necessary. It is recommended that this toll barrier gate be located about 12 km east of the Cikampek interchange.

Service areas are necessary at intervals of about 100 km in maximum length. In this project, one service area is recommended at initial stage in Kalijati district and another service area is recommended to construct near the Lake Sitopatok, if the tollway is extended east of Cirebon. (see 10.4.2)

5) Environmental Study

In order to minimize negative impacts on the environment, careful attention was paid for the selection of the project route. Problems that may be necessary to examine in a detailed environmental study will include the following items:

- Water pollution due to sewage from service area
- Change in the ground water level caused by large scale excavation work in the rubber plantation area around Kerta Jati
- Air pollution and noise in the densely built up areas around Cirebon city
- Effects of earth, sand, and dust caused by the construction on the residential areas and cultivated land

The detailed environmental study should be conducted in the beginning of the detailed design work. (see 10.10)

6) Land Use Plan in Interchange Area

The project tollway attracts various types of development particularly in the interchange areas. Speculation in land and conflicts in land use should be avoided by a proper land development plan and law enforcement, otherwise inefficient scattered development with poor infrastructure will take place.

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