THE KINGDOM OF THAILAND
MINISTRY OF COMMUNICATIONS
DEPARTMENT OF HIGHWAYS

FINAL REPORT

FOR

ROAD DEVELOPMENT STUDY
IN THE NORTHEASTERN REGION

VOLUME 3 : ROUTE REPORT

MARCH 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

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STUDY ROAD

Study Road No.	Changwat	Origin - destination	Route Page
1	Nakhon Ratchasima/ Chaiyaphum	A.Khong -J.R.2180	1-1 - 1-21
2	Buri Ram	B.Waeo(J.R.202) -K.A.Na Pho	2-1 - 2-17
3	Khon Kaen/ Maha Sarakham	J.R.2301 -A.Na Chuak	3-1 - 3-21
4	Khon Kaen	A.Chonnabot(J.R.2057) -B.Kut Ru(J.R.2065)	4-1 - 4-23
5	Khon Kaen	A.Nam Phong(J.R.2039) -J.R.209	5-1 - 5-19
6	Udon Thani/ Khon Kaen	B.Sok Chan(J.R.2146) -Ubolrattana Dam(J.R.2109)	6-1 - 6-17
7	Udon Thani	B.Khok Lat(J.R.2313) -B.Tha Yom(J.R.2316)	7-1 - 7-19
8	Udon Thani	B.Huai Koeng (J.R.2) -A.Kumphawapi(J.R.2023)	8-1 - 8-16
9	Udon Thani	A.Nong Han(J.R.22) -A.Kumphawapi(J.R.2023)	9-1 - 9-21
10	Udon Thani/ Nong Khai	A.Phen(J.R.2022) -J.R.212	10-1 - 10-23
11	Udon Thani	B.Thung Yai(J.R.2096) -K.A.Thung Fon	11-1 - 11-17
12	Sakon Nakhonn	A.Sawang Daen Din(J.R.22) -A.Song Dao	12-1 - 12-16
13	Sakon Nakhon/ Nakhon Phanom	B.Chuam(J.R.2094) -A.Na Wha	13-1 - 13-17
14	Sakon Nakhon	J.R.223 -K.A.Tao Ngai	14-1 - 14-17
15	Nakhon Phanom	A.Renu Nakhon(J.R.2031) -B.Ku Ru Khu(J.R.22)	15-1 - 15-19
16	Nakhon Phanom	J.R.212 -K.A.Whan Yai	16-1 - 16-16
17	Kalasin	A.Kuchinarai(J.R.2042,2030) -B.Na Khu	17-1 - 17-19
18	Kalasin/ Roi Et	C.Kalasin -B.Khok Nong Bua(J.R.2116)	18-1 - 18-21
19	Roi Et	A.Selaphum(J.R.23) -B.Kham Phon Sung(J.R.2136)	19-1 - 19-18
20	Ubon Ratchathani	B.Na Hai(J.R.2049) -A.Kut Khao Pun	20-1 - 20-17
21	Ubon Ratchathani	A.Trakan Phut Phon(J.R.2049) -A.Khemarat (J.R.202)	21-1 - 21-20
22	Ubon Ratchathani	A.Khemarat -B.Huasa Phan(J.R.217)	22-1 - 22-27
23	Ubon Ratchathani	B.Don Chik(J.R.217) -B.Non Riang	23-1 - 23-19
24	Ubon Ratchathani	B.Na Suang(J.R.24) -B.Na Yia	24-1 - 24-17
25	Yasothon/ Si Sa Ket	A.Maha Chana Chai(J.R.2083) -A.Yang Chum Noi(J.R.2165)	25-1 - 25-23
26	Surin/ Si Sa Ket	B.Nong Dang(J.R.2030,2033,2034) -A.Rattana Buri	26-1 - 26-18
27	Surin/ Buri Ram	B.Nong Khao(J.R.2079) -A.Chom Phra(J.R.214)	27-1 - 27-19
28	Buri Ram	C.Buri Ram -Lam Chi (River)(J.R.2078)	28-1 - 28-20
29	Buri Ram/ Surin	A.Prakhon Chai(J.R.24) -A.Krasang	29-1 - 29-20
30	Buri Ram/ Nakhon Ratchasima	A.Huai Thalaeng -B.Kasang(J.R.218)	30-1 - 30-20
31	Buri Ram	A.Lam Plai Mat(J.R.2073) -A.Nong Ki(J.R.24)	31-1 - 31-20
32	Nakhon Ratchasima/ Buri Ram	B.Yok Kham(J.R.2309) -A.Soeng Sang(J.R.2119)	32-1 - 32-19
33	Nakhon Ratchasima	J.R.2 -A.Chok Chai(J.R.24)	33-1 - 33-18

LEGEND

STAGE I PROGRAM
STAGE II PROGRAM
NATIONAL HIGHWAYS
PROVINCIAL AND RURAL ROADS
CHANGWAT, AMPHOE
RIVER, RESERVOIR

SCALE
0 10 20 30 40 50 km
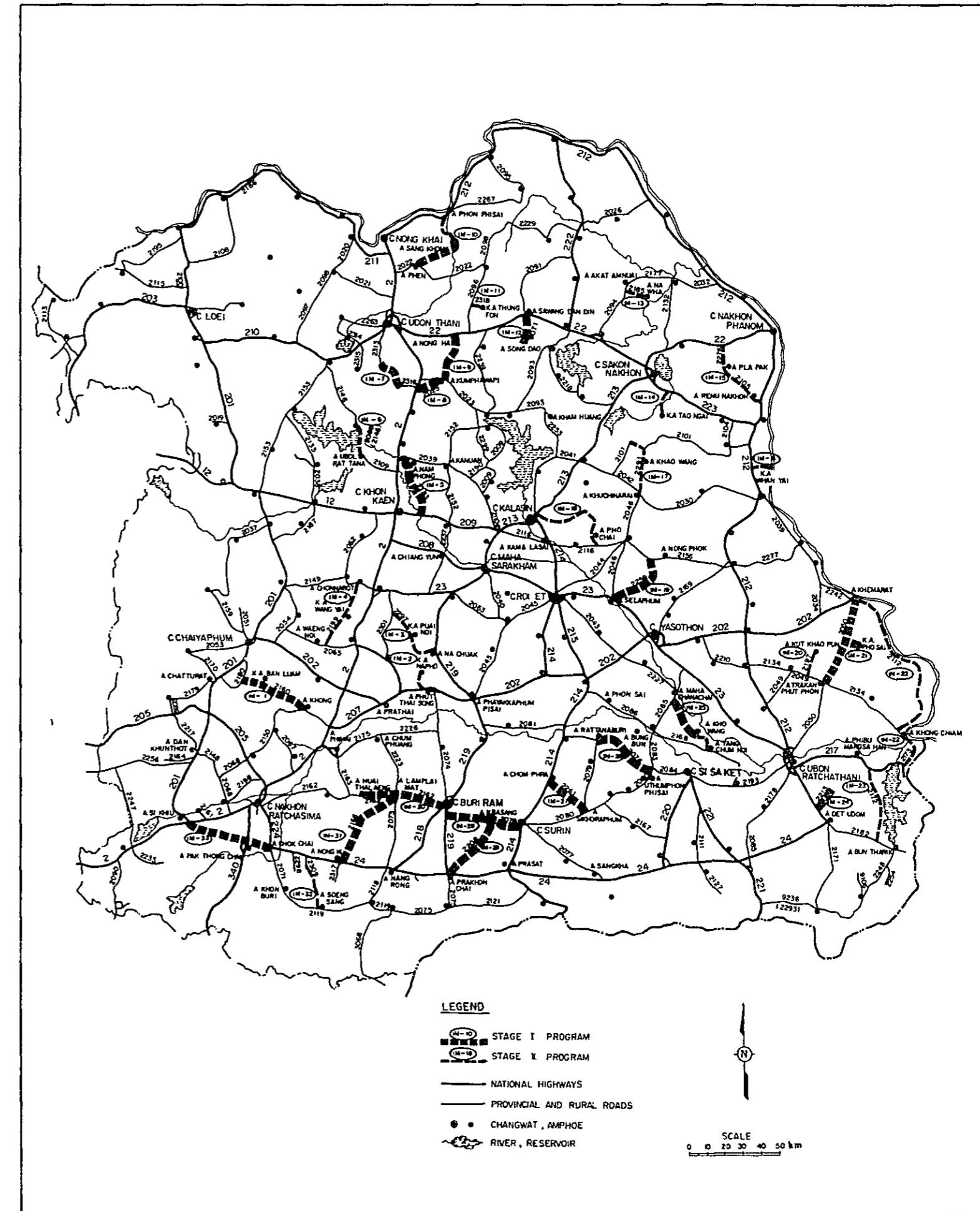
PROPOSED ROUTE NO. IM - 1

Changwat :   Nakhon Ratchasima / Chaiyaphum

A. Khong - J.R. 2180

Length   ·   48.0 KM.

SUMMARY

PROPOSED ROUTE   IM-1

Item	Description
Changwat	Nakhon Ratchasima/Chaiyaphum
Origin	A. Khong.
Destination	J.R. 2180
Length	
Total	48.0 km
Improvement Section	46.0 km
DOH Road	R.2160 33.5 km
ARD Road	3.0 km
Others	9.5 km
New Alignment Section	2.0 km
Surface Type and Condition	Soil Aggregate, Poor
Terrain	Flat and Partially Rolling
Influence Area	
Area	269 km^2
Population (1982)	27,900
Principal Crops	Paddy
Traffic (ADT)	
Existing	81
1993	521
2001	675
Proposed Standard	F4 (DBST)
Construction Cost	
Financial	91,483 . 10^3 ฿
Economic	82,908 . 10^3 ฿
IRR	9.6 %
B/C	0.81
Social Impact	High
Recommendation	For immediate implementation

LOCATION OF PROPOSED ROUTE

National Highway
Provincial Road
Proposed Route
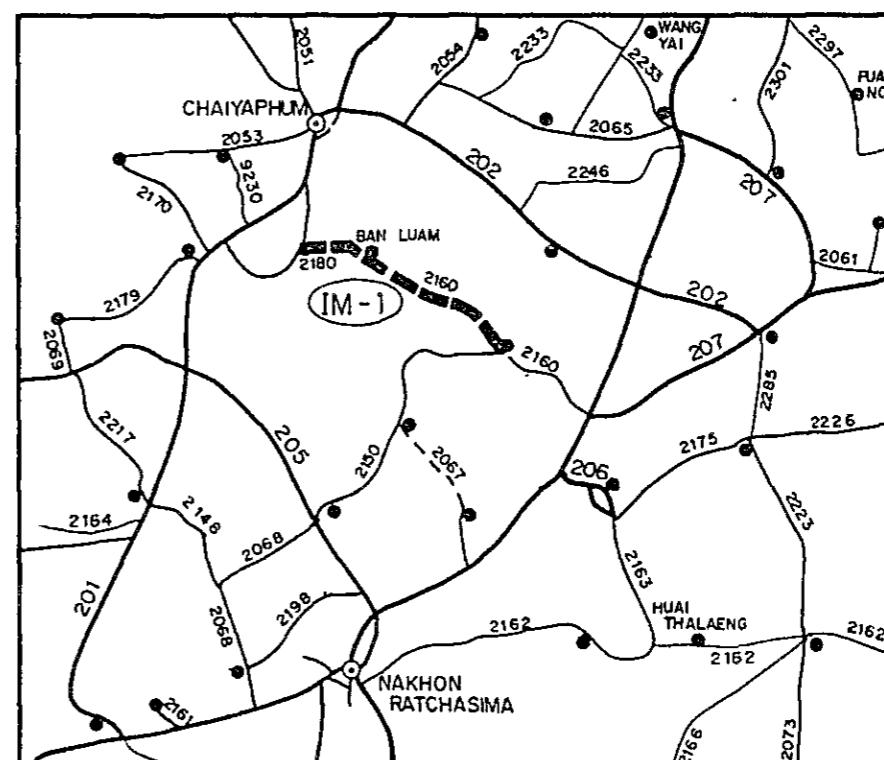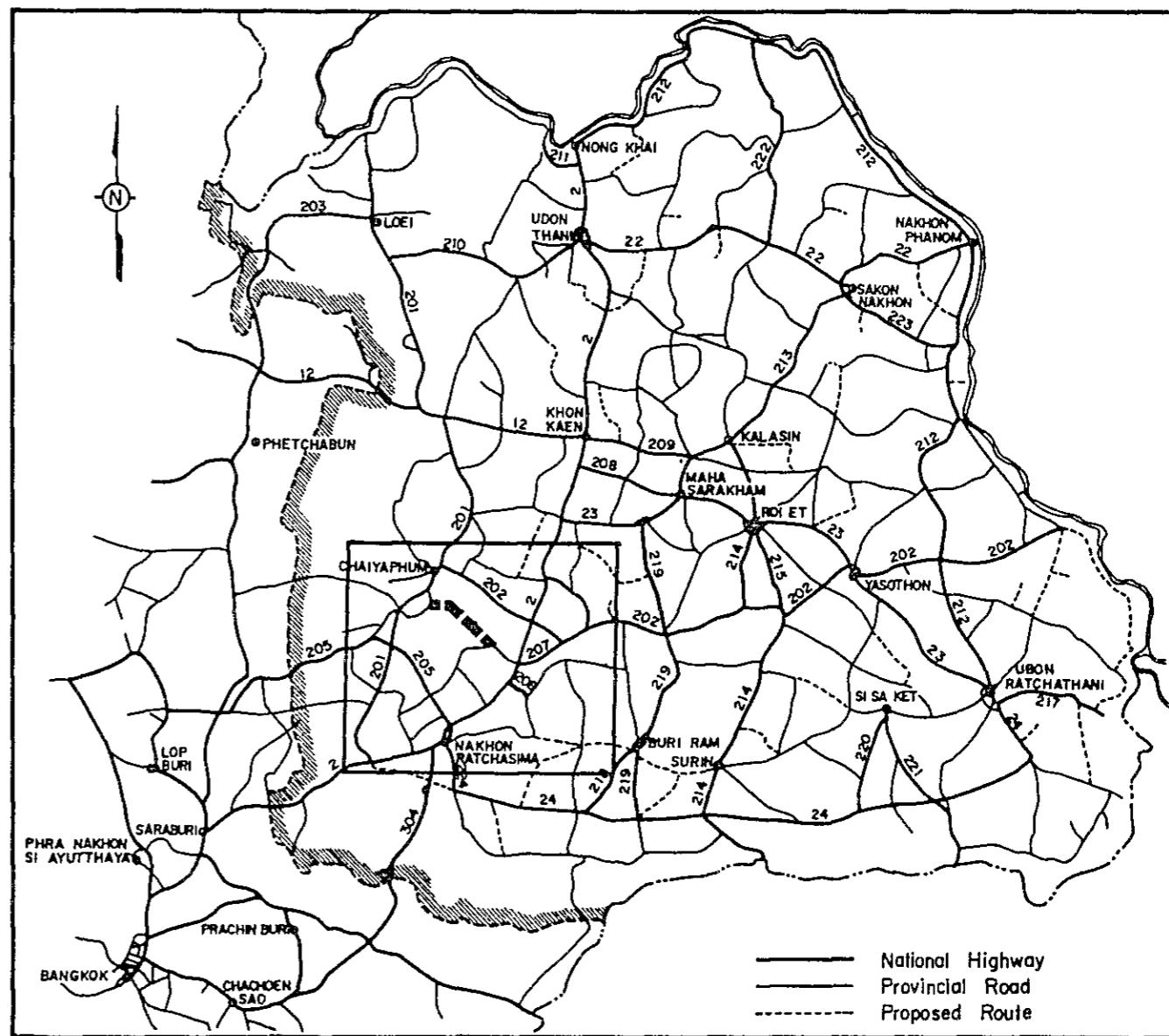
1. GENERAL

1.1 Characteristics of the Route

The proposed route extends in two Changwat of Nakhon Ratchasima and Chai-yaphum.

The route originating at Amphoe Khong, runs northwestward passing through Ban Non Toe, King Amphoe Ban Luam and Ban Non Rai and ends at the intersection with Route 2180. Its total length is 48.0 km (Figure 1.5.2).

The terrain is almost flat while some sections are rolling. In the influence area, there exists several villages with total population of 27,900. There are three medical centers and two secondary schools but no hospital along the proposed route.

The proposed route, upon completion, will form an important part of road network to connect two artery highways, Route 2 and 201 in the developed agricultural area.

An existing road diverging from Ban Don Plao at 37 km away from the beginning point of the proposed route is a main route connecting the east part of the area with Route 201 through Route 2180. This route, however, often becomes impassable for long duration owing to the flooding from the Chi river as it passes closely along the river. Therefore, the proposed route was planned at a distance of about 5 km from the Chi river taking westward direction.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route are summarized in Table 1.1.1. The details are shown as the results of inventory survey in Table 1.1.2.

2. TRAFFIC

2.1 Method

Assignment Method was employed for traffic forecasting as considerable diverted and induced traffic are expected after improvement of the proposed road due to time savings of transportation.

2.2 Zoning and Road Links

The related area of proposed route was divided into five traffic zones and three Amphoe of Khong, Ban Luam and Muang Chaiyaphum were chosen as the major destinations of transport demand originated in the area. The proposed route together with surrounding roads concerned were divided into six road links, four links in the proposed roads and two links in the surrounding road.

Zoning map and characteristics of zone and links are shown in Figure 1.2.1, Table 1.2.1 and 1.2.2.

2.3 Transport Movement

1) Passenger

The transport demand in terms of trips per day by origin/destination pair in base year was estimated basing on the formula described in 7.3.3-1) of the Main Report, as shown below:

Zone	1	2	3	4	5	11
1	0	623	222	191	52	223
2	0	0	144	314	32	215
3	0	0	0	199	47	162
4	0	0	0	0	89	220
5	0	0	0	0	0	0
11	0	0	0	0	0	0

Grand Total = 2733

The transport demand which can be obtained by assigning transport demand
mentioned above to road links, are estimated as shown in the following table:

PASSENGER MOVEMENT (1982)

PROPOSED ROAD LINK	TRIPS PER DAY
1	710
2	595
3	691
4	387

2) Freight

The freight movement in terms of tonnage per day on proposed route was esti-
mated in accordance with the procedure described in 7.3.3-1) of the Main Report.
The basis and results of the estimation of freight movement are shown in the
following tables:

Ratios of Total Non-Agricultural Freight Movement

Year	1987	1993	2001
Ratio	3.83	3.13	2.35

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	27	98	125
2	22	78	100
3	26	95	121
4	12	45	57

2.4 Future Growth of Transport Movement

The growth rate of passenger and freight movements for the periods of 1981-
1987, 1987-1993 and 1993-2001 were predicted by the formula described in 7.3.3-
2) of the Main Report. The basis for the prediction is shown in the following
table:

GROWTH RATE OF PASSENGER MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
PER CAPITA INCOME	4.2	4.5	4.7
TRANS. PRICE INCREASE	4.5	4.5	4.5
POPULATION	0.5	0.4	0.4
PASSENGER MOVEMENT	4.5	4.8	5.0

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
NON-AGRI.	5.8	6.2	6.5
AGRICULTURE	0.4	0.4	0.4
FREIGHT	1.8	2.3	3.0

2.5 Induced and Developed Traffic

The following ratios are used for the estimation of induced and developed
traffic described in 7.3.3-3) of the Main Report:

RATE OF INDUCED AND DEVELOPED TRAFFIC
_____

	YEAR			(%)
ITEM	1987	1993	2001	
INDUCED	92.6	99.1	107.5	
DEVELOPED	0.0	1.9	2.0	

2.6 Future Traffic

1) Traffic Composition

The movement of passenger and freight transport were transformed into traffic
volume by vehicle type applying future traffic composition as shown in the
following table:

TRAFFIC COMPOSITION
_____

(UNIT : %)

| LINK | YEAR | PASSENGER | | | | | FREIGHT | | | |
NO.		P/C	P/P	L/B	M/B	H/B	P/T	4/T	6/T	10/T
1-4	1982	0.0	52.7	0.0	47.3	0.0	4.5	15.2	65.1	15.2
	1987	3.5	49.2	4.5	40.4	2.4	7.8	15.4	57.2	19.6
	1993	7.6	45.1	9.9	32.1	5.3	11.7	15.7	47.7	24.9
	2001	13.2	39.5	17.1	21.0	9.2	17.0	16.0	35.0	32.0

2) Forecasted ADT

The average of the forecasted traffic on proposed road links is shown in the
following table and details by road link by traffic type are shown in Table
1.2.3.

AVERAGE FUTURE TRAFFIC ON PROPOSED ROUTE
_____

| YEAR | TYPE OF VEHICLE | | | | | | | | ADT | M/C | TOTAL |
	P/C	L/B	M/B	H/B	P/P&T	4/T	6/T	10/T			
1987	5	6	54	3	70	8	29	10	185	242	428
1993	14	18	57	10	88	9	28	15	239	282	521
2001	34	44	55	24	116	12	26	24	335	339	675

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

Nearly 87% of cultivated land in the influence area is covered by paddy
field. In the upland field, cassava ranks first followed by kenaf, maize
and groundnuts. Cassava roots are shipped to the cassava pellet or flour
factories on Route No.2 via drying places along Route 2150 or 2160.
Unused cultivable land remains for only upland field. Land use and capabi-
lity condition in the area of influence are shown in Table 1.3.1 and Figure
1.3.1.

Typical cropping calendar in the Chaiyaphum and Nakhon Ratchasima areas are
shown in Figure 1.3.2.

3.2 Development Projection

Future agricultural development in the area of influence was projected for
both cases of without project and with project. The projected planted
area, unit yields by crop, and the consequent production volumes are
shown in Table 1.3.2.

Farmgate prices and production costs of the selected crops are estimated
as follows, referring to the Changwat data and field survey information
as shown in Table 1.3.3.

Based on the above projected production volume, farmgate prices, production costs and land preparation cost estimated separately, net production value (NPV) was obtained as shown in Table 1.3.4. The difference between NPV of with project case and NPV of without project case is deemed to be the development benefit of the subject road.

4. VOC SAVINGS

In accordance with the concept and basic data given in Chapter 7 of Vo.1 Main Report, VOCs on each road link concerned were calculated in both cases of with project and without project.

Elements of road condition, which affect the calculation of additional costs of VOC of each link, are shown below.

Road Condition

Link		Without Project				With Project			
No.	Terrain	Length (km)	Road/1 class	Nos. of wooden Bridge	Nos. of Narrow C.Bridge	Length (km)	Road Class/1 case 1	Nos. of case 2	Wooden Narrow Bridge
1	Flat	13.0	3	1	0	13.0			0
2	Flat& Rolling	15.0	3	0	0	15.0	1(F4)	2A(F5)	0
3	Flat	7.0	3	1	0	7.0			0
4	Flat	13.0	3	7	0	13.0			0

/1 Road 1 : Paved Road

    Road 2A : Laterite Road with good surface condition and alignment

    Road 2B : Laterite Road with good surface condition but poor alignment

    Road 3 : Laterite Road with poor surface condition and alignment

    Road 4 : Earth Road

VOC savings, obtained from the difference of total link VOCs in the cases of with project and those of without project case, were calculated as follows.

Vehicle Operating Cost Saving

			(Unit: 1,000 Baht)
Road Class	1987	1993	2001
1 (F4)	7,115	9,622	14,919
2A(F5)	4,526	6,541	10,965

5. ENGINEERING

5.1 Preliminary Design

Preliminary design was carried out based on the following design criteria.

Design Standard   : F4 (if not feasible, F5)

Geometric Design   : AASHTO (Rural Highways)

Typical Cross Section   : as shown in Figure 1.5.1

Minimum Height of Embankment

   Ordinary Section   : 1.0m

   Approach of Bridge in Flat Area : 2.0m

   Flood Section   : 0.7m (above flood level)

Pavement Structure

  In case of F4 Standard

    DBST   : 2.5cm

    Crushed Stone Base   CBR$\geq$80% : 15.0cm

    Soil Aggregate Subbase CBR$\geq$20% : 15.0cm

    Selected Material   CBR$\geq$ 6% : 20.0cm

  In case of F5 Standard

    Soil Aggregate Surface CBR$\geq$20% : 15.0cm

    Selected Material   CBR$\geq$ 6% : 20.0cm

Pipe Culvert

    Standard Size   : ϕ 100cm

    Standard Interval

        Paddy Area   :   200 m

        Others   :   500 m

Box Culvert

    Standard Size   : 2.4m x 2.4m

    Location   : as required

Bridge

    Standard Type (width 7.0m)

      Short Span Bridge   : RC – Slab

      Long Span Bridge   : PC – Girder

    Location   : as shown in Bridge List in Figure 1.5.2

Alignment of the route is shown in Figure 1.5.2

5.2 Work Quantity and Construction Cost

Work quantities based on the preliminary design and construction cost together with unit rate by work item are shown in Table 1.5.1.

Total financial and economic construction costs by applied road class are as given below:

Financial and Economic Construction Cost

Road Class	Length (km)	Construction Cost (10^3 ₿)		Remark
		Financial Cost	Economic Cost	
F4 (DBST)	48.0	91,483	82,908	
F5 (Soil Aggregate)	48.0	49,380	44,611	

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits, and the calculated economic indicators for evaluation are given in Table 1.6.1 and 1.6.2. The result indicated that the proposed project seems to be not feasible in case of F4 Standard but feasible under F5 Standard.

7. SOCIAL IMPACTS

Detailed data and results of quantification of indicators of social impacts are tabulated in Table 1.7.1. Social impacts of the proposed route are considerably high.

Table 1.1.1   SUMMARY OF ROAD INVENTORY

Item	Description		
Origin	A. Khong		
Destination	J.R. 2180		
Length			
Total		48.0 km	
Improvement Section		46.0 km	
DOH Road	R. 2160	33.5 km	
ARD Road		3.0 km	
Others		9.5 km	
New Alignment Section		2.0 km	
Terrain	Flat and Partially Rolling		
Alignment (Hori./Vert.)	Fair / Fair		
Formation Width	6.0 m – 7.5 m, 6.5 m (Weighted average)		
Embankment Section			
Length		48.0 km	
Height	0.2 m – 1.2 m		
Cut Section			
Length		0 km	
Depth	m – m		
Surface Type and Condition			
SBST or DBST	Poor	3.7 km	
Soil Aggregate	Poor	40.8 km	
Earth	Poor	3.5 km	
Pipe Culvert	14 each		
Box Culvert	0 each	0 m	
Bridge			
Permanent Bridge	0 each	0 m	
Narrow Concrete Bridge	0 each	0 m	(4m)
Wooden Bridge	5 each	47.0 m	
Overflow Section	1 place	5.0 km	

1 - 7

Table 1.1.2 ROAD INVENTORY(1)

PROPOSED ROUTE NO. __IM-1__   ROUTE NO. 2160   A. KHONG (J.R. 2150, 2160) ∿ J.R. 2180   L = __48.0__ Km.
ARD
RURAL
C. NAKHON RATCHASIMA/CHAIYAPHUM

STATION (Km)	0 — 30 (scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30)
VILLAGE – Name / Household (H) / Population (P)	A. KHONG (at 0); B. MON H=150 P=1050 (~8); ก. Non Toe H=250 P=1750 (~12); B. Nong Ya Khao H=80 P=500 (~18); B. NONG KHAEM H=40 P=280 (~28)
TERRAIN	Flat … Rolling … Flat
CROSS SECTION – Formation Width (m)	6.00 / 7.00 / 6.50 / 7.00 / 7.50 / 6.50 / 7.50 / 7.00 / 6.50 / 7.00 / 6.00 / 6.50 / 7.50
CROSS SECTION – Embankment Height (m)	0.40 / 0.30 / 0.20 / 0.50 / 0.40 / 0.50 / 0.40 / 0.60 / 1.00 / 0.40 / 0.70 / 0.50 / 1.80 / 0.90
CROSS SECTION – Cutting Depth (m)	
PAVEMENT – Type/Length	DT / Laterite / DT / Laterite / DT / Laterite
PAVEMENT – Condition	Good … Poor
FLOODING – Overflow Length(Km)/Height(m)	
LAND USE – Left	Paddy / Kenaf / Paddy / Cassava / Paddy / Kanaf / Paddy
LAND USE – Right	Paddy / Cassava / Bush / Paddy / Cassava / Paddy
PIPE CULVERT – Total Number	14 pipes
BOX CULVERT & BRIDGE – Station (Km)	2.8
BOX CULVERT & BRIDGE – Dimension	W-Br 4.30 × 13.00
RIGHT OF WAY (m)	
ALIGNMENT – Horizontal	Fair
ALIGNMENT – Vertical	Fair
ROUTE NO., AGENCIES	DOH 2160

PROPOSED ROUTE NO. __IM-1__   ROUTE NO. 2160   A. KHONG (J.R. 2150, 2160) ∿ J.R. 2180 (Cont'd)   L = __48.0__ Km.
ARD
RURAL   C. NAKHON RATCHASIMA/CHAIYAPHUM

STATION (Km)	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
VILLAGE – Name / Household (H) / Population (P)	K.A.BAN LUAM H = 200 P = 1600				B.DON PLAO H = 120 P = 650	No Existing Road	B.NON RAI H = 40 P = 120	B.NONG KHAM H = 200 P = 1800								
TERRAIN	Flat						Flat									
CROSS SECTION — Formation Width (m)	7.00	6.50	7.00		6.00		4.00	5.00	5.50							
CROSS SECTION — Embankment Height (m)	0.40	0.30	1.00				0.20	1.20	0.80							
CROSS SECTION — Cutting Depth (m)																
PAVEMENT — Type/Length	Laterite				Earth		Laterite									
PAVEMENT — Condition	Poor		Fair		Poor		Poor									
FLOODING — Overflow Length(Km)/Height(m)					L=1.0 H=0.4											
LAND USE — Left	Paddy						Paddy									
LAND USE — Right	Paddy						Paddy									
PIPE CULVERT — Total Number																
BOX CULVERT & BRIDGE — Station (Km)		32.7			38.0			44.6	46.1							
BOX CULVERT & BRIDGE — Dimension		W-Br 4.50 × 8.00			W-Br 4.50 × 15.00			W-Br 4.50 × 5.50	W-Br 4.50 × 5.50							
RIGHT OF WAY (m)			15.0					15.0								
ALIGNMENT — Horizontal	Fair						Fair									
ALIGNMENT — Vertical	Fair						Fair									
ROUTE NO., AGENCIES	DOH 2160		ARD	Rural			Rural									

Figure 1.2.1 ZONING AND ROAD NETWORK

PROPOSED ROUTE NO. IM-1
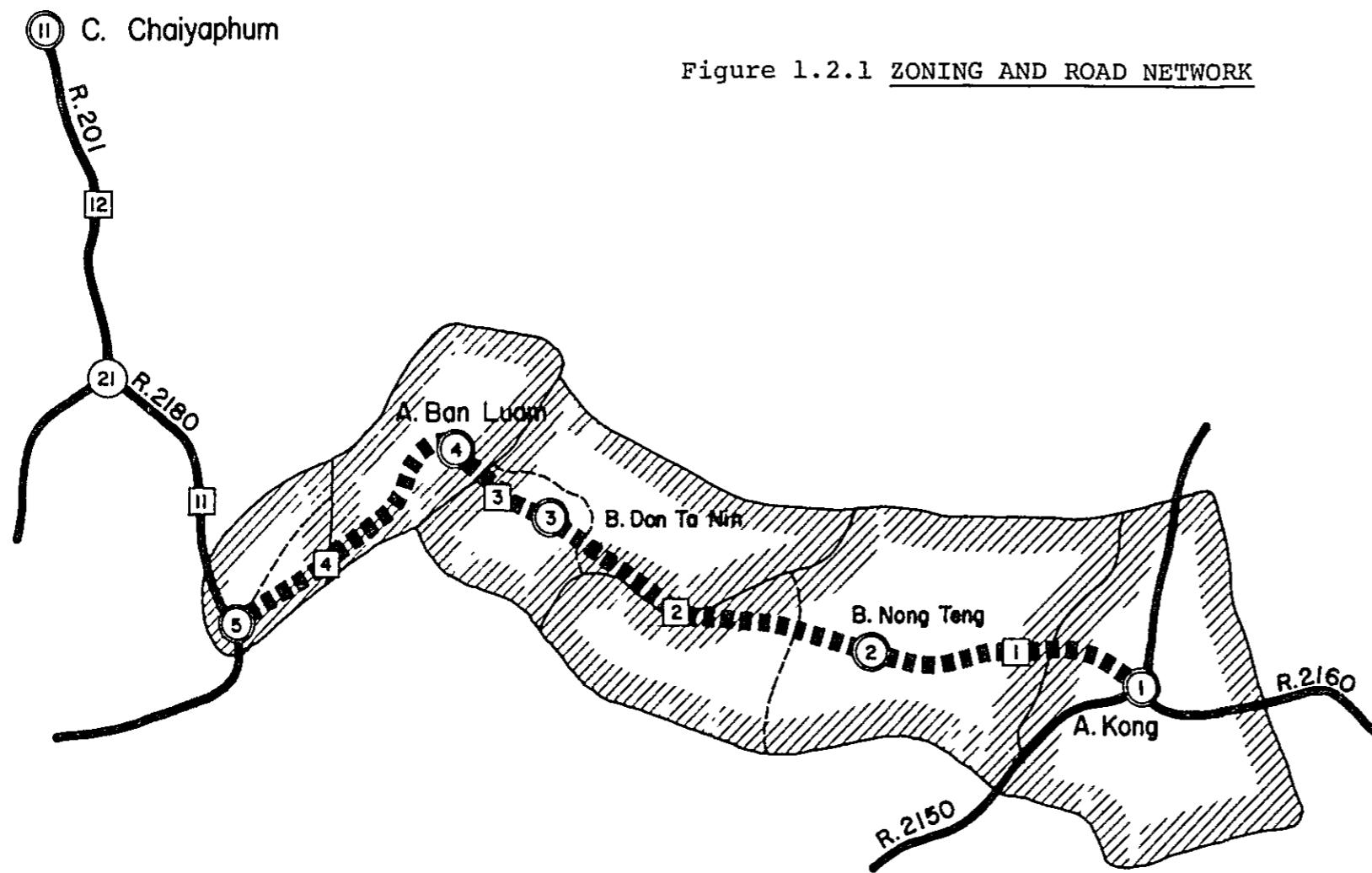
LEGEND

ⓘ	Traffic Zone
Ⓙ	Dummy Node
35	Road Link Code
▪▪▪▪	Proposed Road Link
▬▬▬	Other Road

Table 1.2.1 ZONE CHARACTERISTICS

	Administrative Division			Population			
Zone	Changwat	Amphoe	Tambon Code	Tambon	%	Zone	Attraction
1	Nakhon Ratchasima	Khong	1	13,214	100	13.2	64.3
2	Nakhon Ratchasima	Khong	6	5,849	90	5.3	
			7	7,071	70	4.9	
			Total			10.2	
3	Nakhon Ratchasima	Ban Luam	2	2,272	100	2.3	
			3	6,575	50	3.3	
			Total			5.6	
4	Nakhon Ratchasima	Ban Luam	1	6,349	100	6.3	20.4
5	Chaiyaphum	Chatturat	8	5,317	20	1.1	
			9	4,637	30	1.4	
			Total			2.5	
11	Chaiyaphum	Muang	1	15,713	100	15.7	137.4

Table 1.2.2 LINK CHARACTERISTICS

Link No	Node Pair		Length		Grade		Remark
	Start Node	End Node	$\overline{W}$	W	$\overline{W}$	W	
1	1. A. Kong	2. B. Nong Teng	13.0	13.0	9	4	R.2160
2	2. B. Nong Teng	3. B. Don Ta Nin	15.0	15.0	9	4	R.2160
3	3. B. Don Ta Nin	4. K. A. Ban Luam	7.0	7.0	9	4	R.2160
4	4. K. A. Ban Luam	5. J.R.2180	13.0	13.0	11	4	ARD Rural
11	5. J.R.2180	21. J.R.201	11.0	11.0	4	4	R.2180
12	21. J.R.201	11. C. Chaiya phum	15.0	15.0	3	3	R.2

Table 1.2.3   TRAFFIC VOLUME ON ROUTE IM - 1

YEAR		1987					1993					2001				
LINK		1	2	3	4	AVR.	1	2	3	4	AVR.	1	2	3	4	AVR.
P/C	N+D	3	2	3	1	2	7	6	7	4	6	19	16	18	10	15
	I	2	3	3	2	3	6	8	8	7	7	16	21	20	17	18
	DV	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	TOTAL	5	5	5	4	5	14	15	15	11	14	35	37	38	28	34
L/B	N+D	3	3	3	2	3	10	8	9	5	8	24	20	24	13	20
	I	3	4	4	3	3	8	11	10	9	9	20	27	25	22	24
	DV	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	TOTAL	6	7	7	5	6	18	19	20	14	18	45	48	50	36	44
M/B	N+D	30	25	29	16	25	31	26	30	17	26	30	25	29	16	24
	I	25	34	32	28	30	26	35	33	29	31	25	33	31	27	29
	DV	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	TOTAL	56	59	61	44	54	59	63	64	47	57	56	60	61	44	55
H/B	N+D	2	2	2	1	1	5	4	5	3	4	13	11	13	7	11
	I	2	2	2	2	2	4	6	5	5	5	11	15	14	12	13
	DV	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
	TOTAL	3	4	4	3	3	10	10	11	8	10	24	26	27	19	24
P/P&T	N+D	40	33	39	22	33	50	41	48	26	40	65	54	63	35	53
	I	32	43	40	35	37	39	52	49	43	46	52	69	65	56	60
	DV	0	0	0	0	0	2	2	2	1	2	2	2	2	2	2
	TOTAL	72	76	79	56	70	91	95	99	70	88	119	126	130	93	116
4/T	N+D	7	5	7	3	5	8	6	7	3	6	9	7	8	4	7
	I	2	3	3	2	2	3	4	4	3	3	4	6	6	4	5
	DV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	9	8	9	5	8	11	10	11	6	9	13	13	14	8	12
6/T	N+D	26	20	25	12	20	23	18	22	10	18	19	15	18	9	15
	I	8	11	10	8	9	9	12	11	9	10	10	13	12	9	11
	DV	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	TOTAL	34	31	35	20	29	32	30	34	19	28	29	28	31	18	26
10/T	N+D	9	7	8	4	7	12	10	12	5	9	17	14	17	8	14
	I	3	4	3	3	3	5	6	6	5	5	9	12	11	9	10
	DV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	12	11	12	7	10	17	16	18	10	15	26	26	28	17	24
ADT	N+D	119	98	116	61	96	145	120	141	75	118	195	161	190	102	158
	I	77	102	96	82	89	101	134	125	108	117	147	196	183	157	170
	DV	0	0	0	0	0	4	5	5	3	4	6	7	7	5	6
	TOTAL	196	200	211	143	185	251	258	272	186	239	349	364	380	264	335
M/C	N+D	181	158	178	113	155	207	182	203	131	178	250	221	245	163	217
	I	70	97	86	94	87	81	112	99	110	101	95	131	114	134	119
	DV	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3
	TOTAL	252	255	264	207	242	291	297	305	244	282	348	355	363	300	339
TOTAL	N+D	300	256	293	174	251	352	302	344	206	296	445	383	435	264	375
	I	148	199	182	176	176	182	246	224	218	218	242	326	298	291	290
	DV	0	0	0	0	0	7	8	8	6	7	10	10	11	8	10
	TOTAL	448	455	475	350	428	542	555	576	430	521	697	719	743	564	675

NOTE
N : NORMAL TRAFFIC   D : DIVERTED TRAFFIC
DV : DEVELOPED TRAFFIC   I : INDUCED TRAFFIC

Figure 1

Figure 1.3.1 LAND USE AND CAPABILITY OF INFLUENCE AREA
PROPOSED ROUTE NO. IM – I
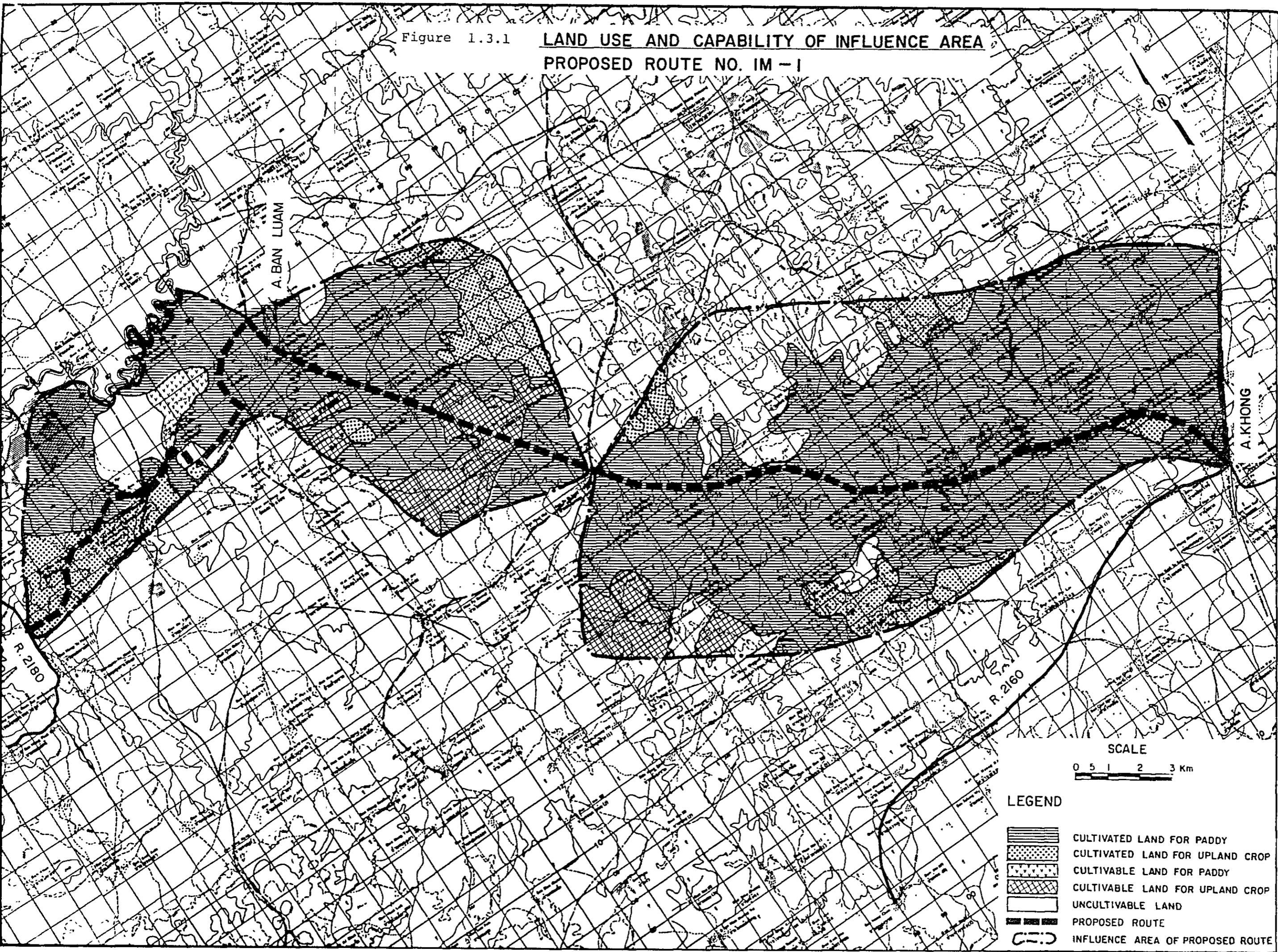
1200 CHANGWA

NAME OF CI

RICE, 1st CROP

TOBACCO (TURKIS

KENAF

CASSAVA

MAIZE

SUGAR CANE

MUNG BEAN

SORGHUM

GROUND NUT

COTTON

A. BAN LUAM

A. KHONG

R.2180

R.2160

SCALE

0 5 I 2 3 Km

LEGEND

CULTIVATED LAND FOR PADDY
CULTIVATED LAND FOR UPLAND CROP
CULTIVABLE LAND FOR PADDY
CULTIVABLE LAND FOR UPLAND CROP
UNCULTIVABLE LAND
PROPOSED ROUTE
INFLUENCE AREA OF PROPOSED ROUTE

Figure 1.3.2 **CROPPING CALENDAR(I)**

1200 CHANGWAT ___ CHAIYAPHUM ___

NAME OF CROP	JAN.	FEB	MAR	APR	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
RICE, Ist CROP { TRANSPLANT												
BROADCAST												
TOBACCO (TURKISH & LOCAL)												
KENAF												
CASSAVA												
MAIZE												
SUGAR CANE												
MUNG BEAN												
SORGHUM												
GROUND NUT												
COTTON												
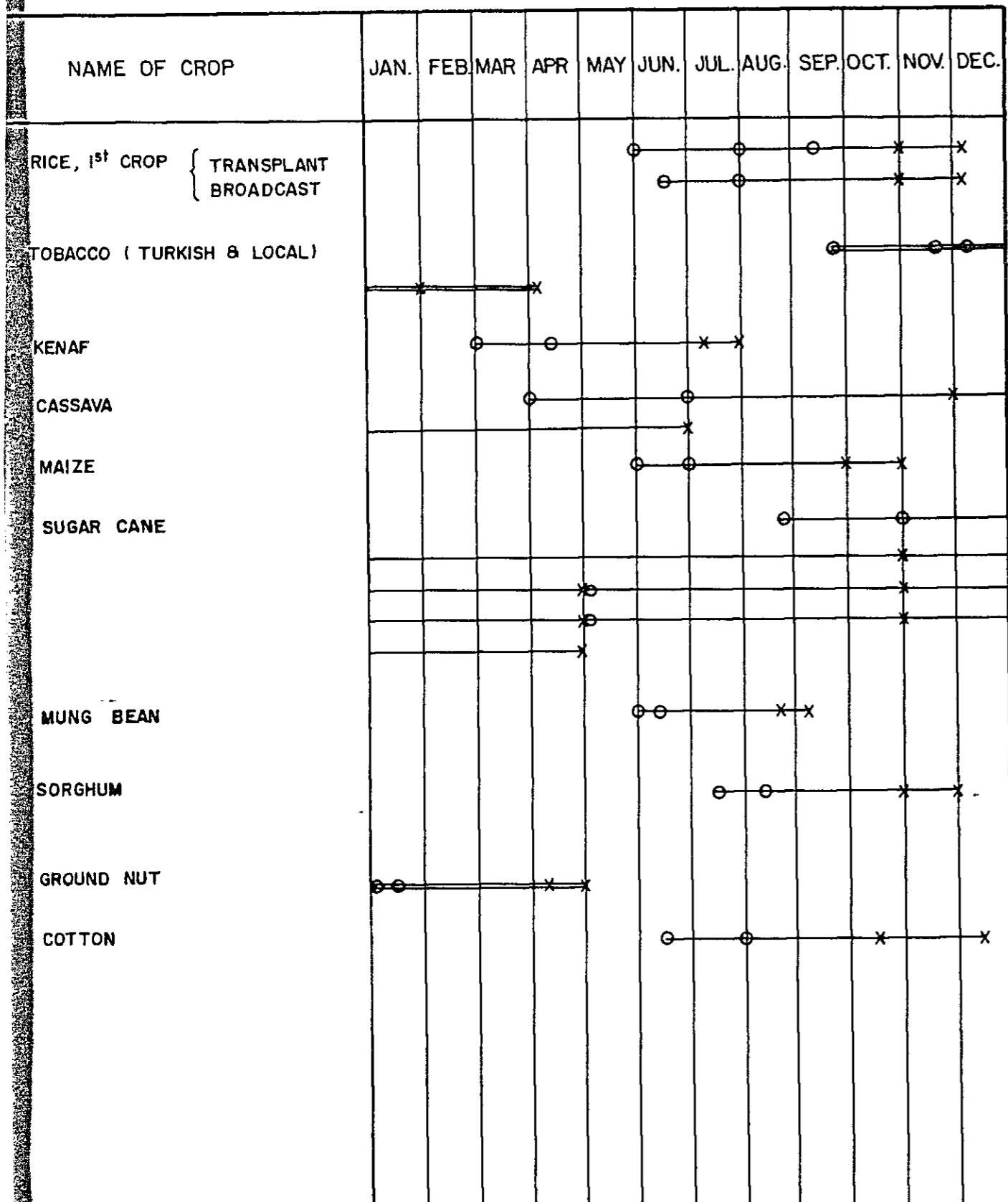
CROPPING CALENDAR(2)

1300 CHANGWAT ___ NAKHON RATCHASIMA ___

NAME OF CROP	JAN.	FEB	MAR	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV	DEC.
RICE, Ist CROP { TRANSPLAN												
BROADCAST												
GROUND NUT												
KENAF												
CASSAVA												
MAIZE												
SORGHUM												
MUNG BEAN												
COTTON												

Note : FIRST CROP   SECOND CROP

sowing season — growing season — harvesting season
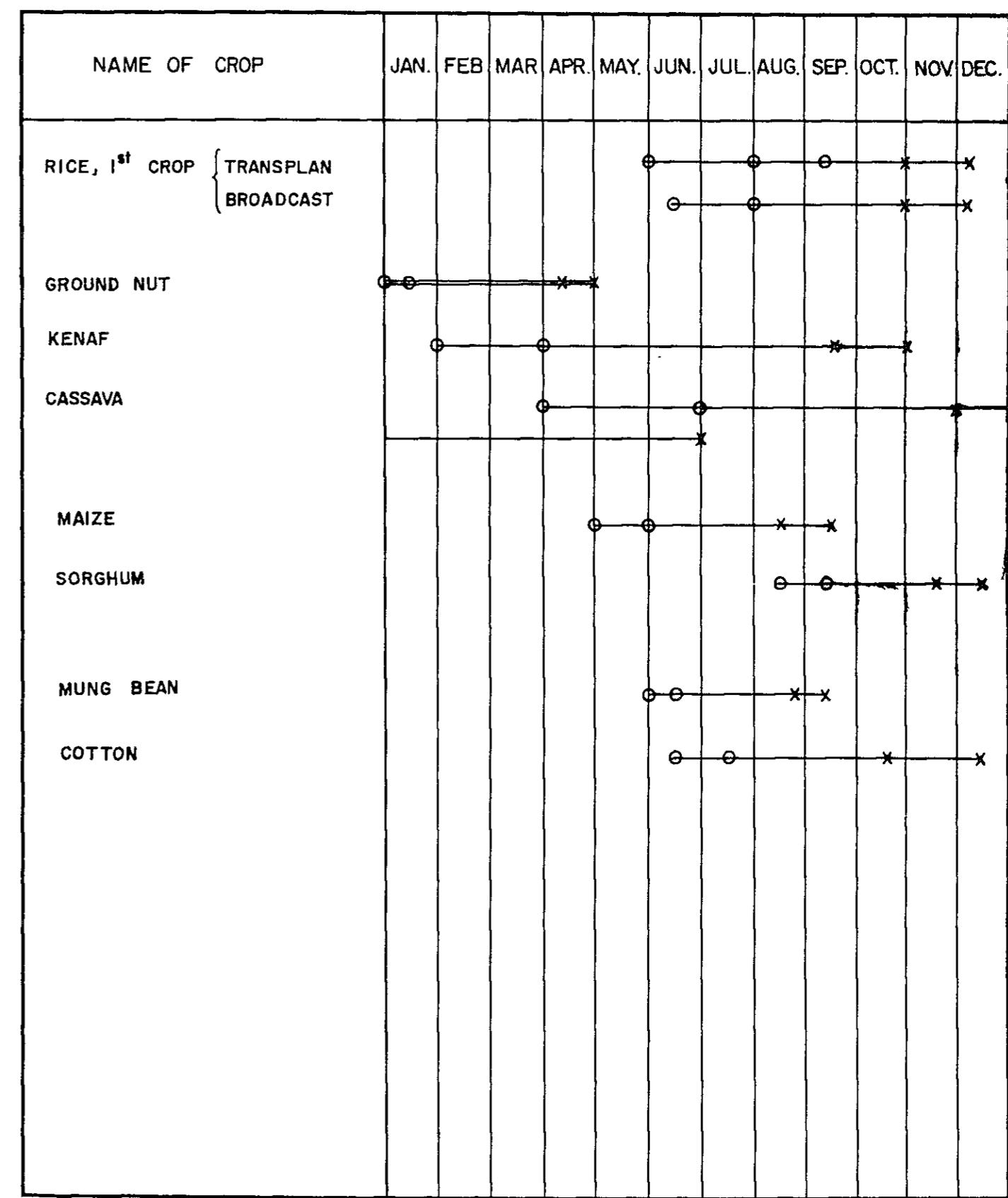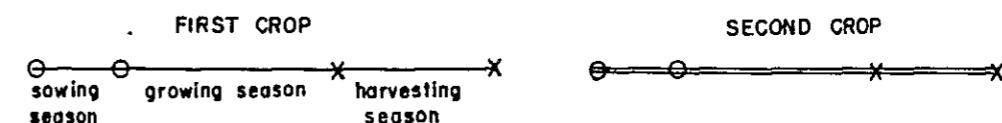
TABLE 1.3.1   CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM^2)]

AMPHOE	AMPHOE	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
CODE	NAME	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		121.875 (195.0)	16.250 (26.0)	138.125 (221.0)	1.250 (2.0)	10.313 (16.5)	11.563 (18.5)
1213	CHATTURAT	5.000 (8.0)	5.625 (9.0)	10.625 (17.0)	—	—	—
1303	BAN LUAM	34.375 (55.0)	5.625 (9.0)	40.000 (64.0)	1.250 (2.0)	6.438 (10.3)	7.688 (12.3)
1304	KHONG	82.500 (132.0)	5.000 (8.0)	87.500 (140.0)	—	3.875 (6.2)	3.875 (6.2)

TABLE 1.3.2   CROP PRODUCTION

ITEM		PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)											
1981		97.77	0.25	—	0.06	11.11	—	4.92	—	16.34	114.12
1987		97.77	0.26	—	0.06	11.58	—	4.92	—	16.84	114.61
1993	WITHOUT PROJECT	97.77	0.28	—	0.06	12.08	—	4.92	—	17.35	115.12
	WITH PROJECT	99.02	0.30	—	0.06	13.05	—	4.92	—	18.35	117.37
2001	WITHOUT PROJECT	97.77	0.30	—	0.06	12.77	—	4.92	—	18.07	115.84
	WITH PROJECT	99.02	0.33	—	0.07	13.80	—	4.92	—	19.13	118.15
CROP YIELD (KG/RAI)											
1981		234.3	293.1	—	150.0	2044.2	—	198.5	—		
1987		234.3	294.9	—	150.0	2056.5	—	198.5	—		
1993	WITHOUT PROJECT	234.3	296.7	—	150.0	2068.9	—	198.5	—		
	WITH PROJECT	237.1	300.2	—	150.9	2081.3	—	198.5	—		
2001	WITHOUT PROJECT	234.3	299.0	—	150.0	2085.5	—	198.5	—		
	WITH PROJECT	240.9	307.5	—	152.1	2114.8	—	198.5	—		
CROP PRODUCTION (TON)											
1981		22,907	72	—	9	22,711	—	976	—	23,770	46,678
1987		22,907	77	—	9	23,824	—	976	—	24,889	47,796
1993	WITHOUT PROJECT	22,907	82	—	9	24,992	—	976	—	26,062	48,970
	WITH PROJECT	23,480	91	—	9	27,153	—	976	—	28,233	51,713
2001	WITHOUT PROJECT	22,907	90	—	9	26,638	—	976	—	27,717	50,624
	WITH PROJECT	23,858	101	—	10	29,174	—	976	—	30,265	54,123

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 1.3.3   FARMGATE PRICE AND PRODUCTION COST

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	4,332	2,478	—	6,651	677	—	4,841	—
WITH PROJECT (1987 - 2001)	4,440	2,540	—	6,651	694	—	4,962	—
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	596	490	—	886	829	—	717	—
WITH PROJECT (1987 - 2001)	606	510	—	906	856	—	717	—

TABLE 1.3.4   NET PRODUCTION VALUE

(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	40,923	7,805	48,728	42,419	8,017	50,436
1993	40,923	8,191	49,114	44,203	9,092	53,295
2001	40,923	8,740	49,663	45,883	9,867	55,750

Figure 1.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE

FILL SECTION

CUT SECTION

DOUBLE BITUMINOUS SURFACE TREATMENT (DBST) ROAD (Class F4)

SOIL AGGREGATE SURFACED ROAD (Class F5)
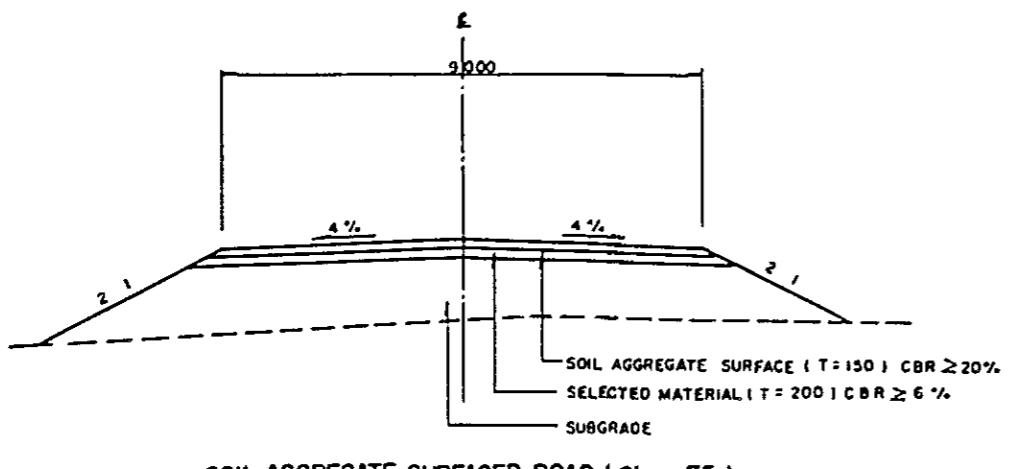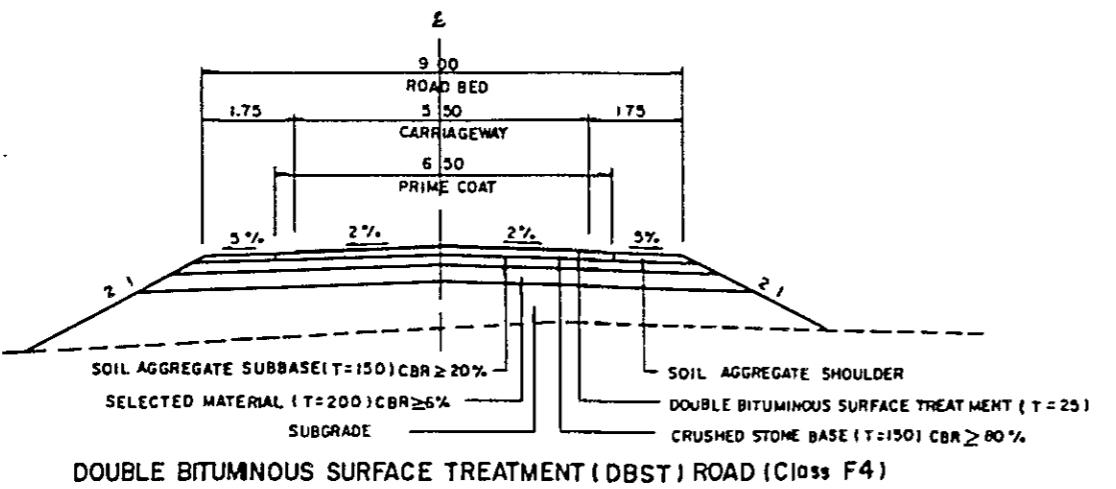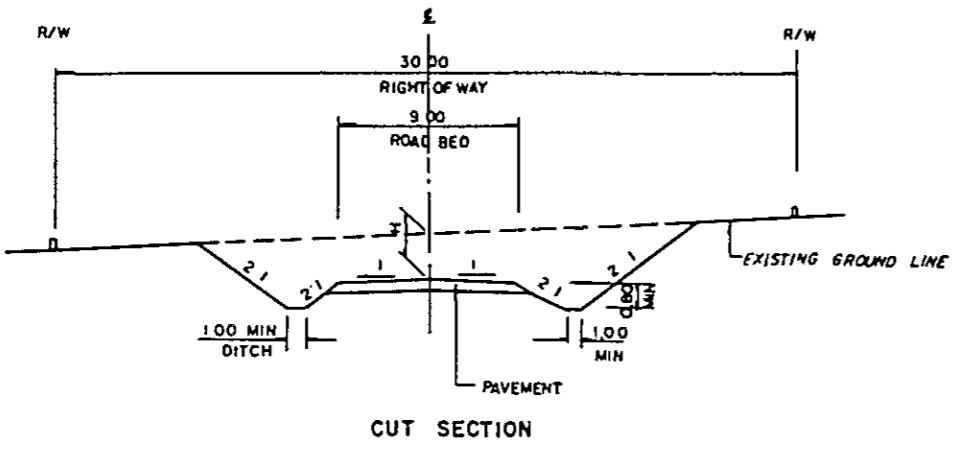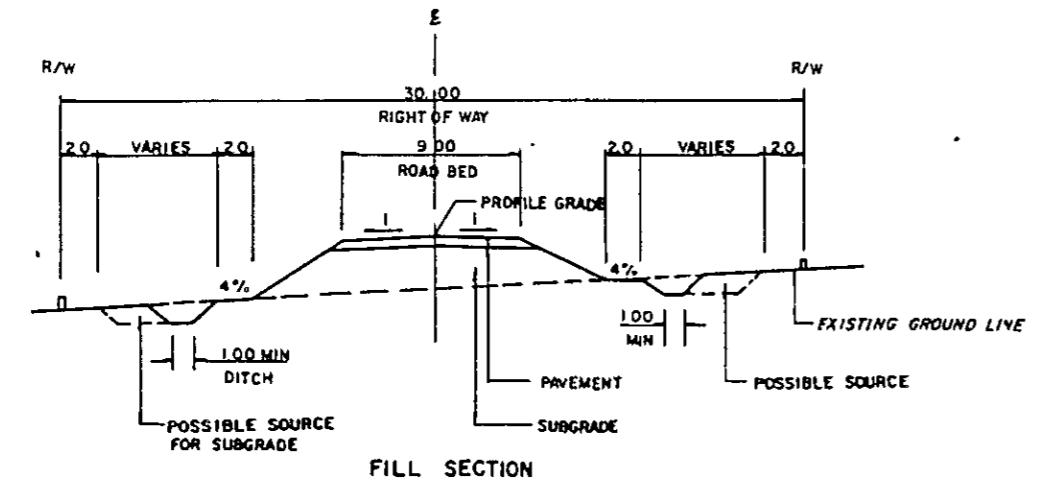
Figure 1.5.2 **PROPOSED ROUTE NO. IM-1**   C. NAKHON RATCHASIMA   A. KHONG(J.R.2150, 2160) - J.R. 2180
C. CHAIYAPHUM   ROUTE NO. R.2160 + ARD + RURAL   L = 48.0
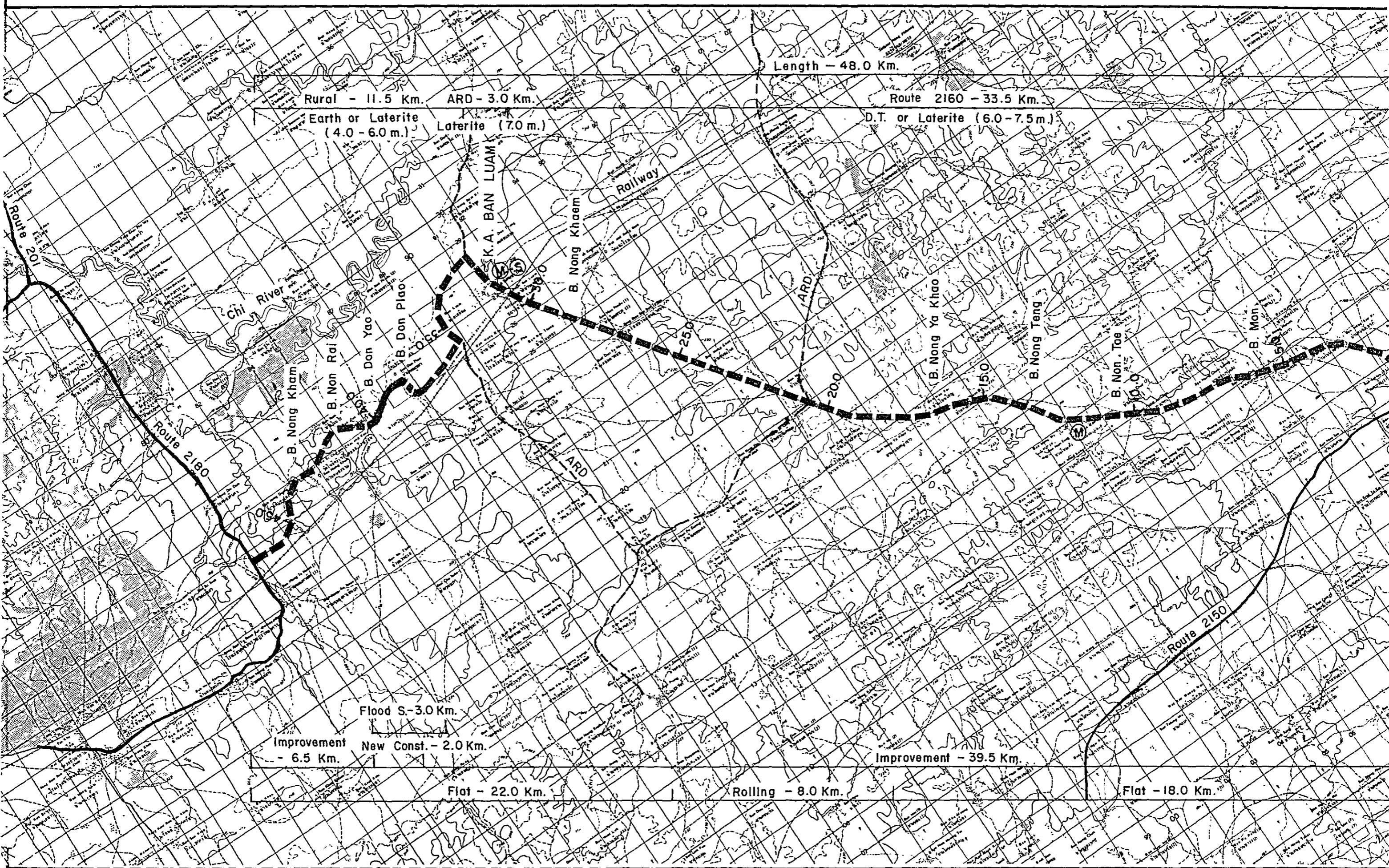
C. NAKHON RATCHASIMA   **A. KHONG (J.R. 2150, 2160) – J.R. 2180**
C. CHAIYAPHUM   **ROUTE NO. R. 2160 + ARD + RURAL**   **L = 48.0 Km.**

LOCATION MAP

Length – 48.0 Km.
Route 2160 – 33.5 Km.
D.T. or Laterite (6.0 – 7.5 m.)

Improvement – 39.5 Km.
Rolling – 8.0 Km.
Flat – 18.0 Km.
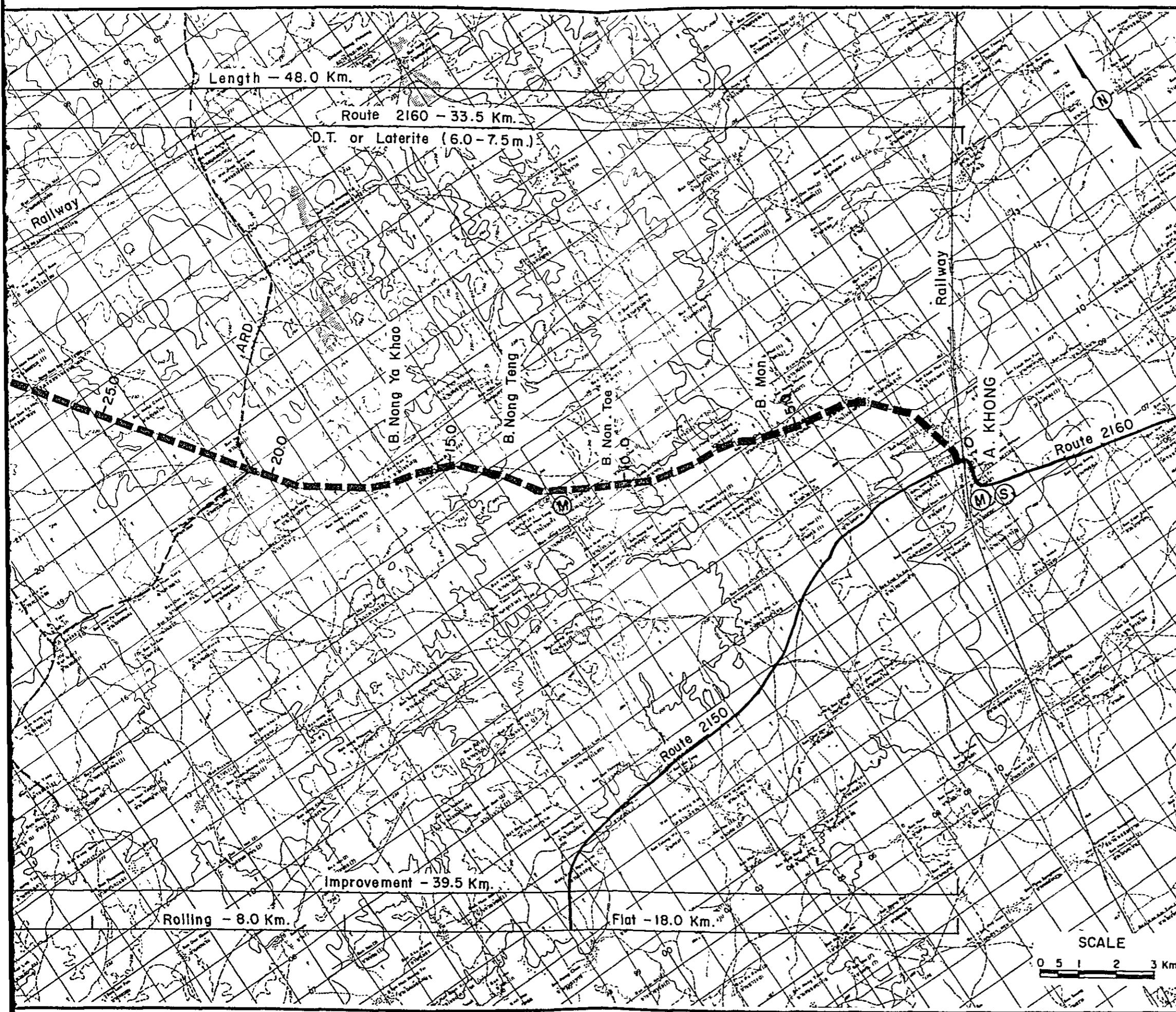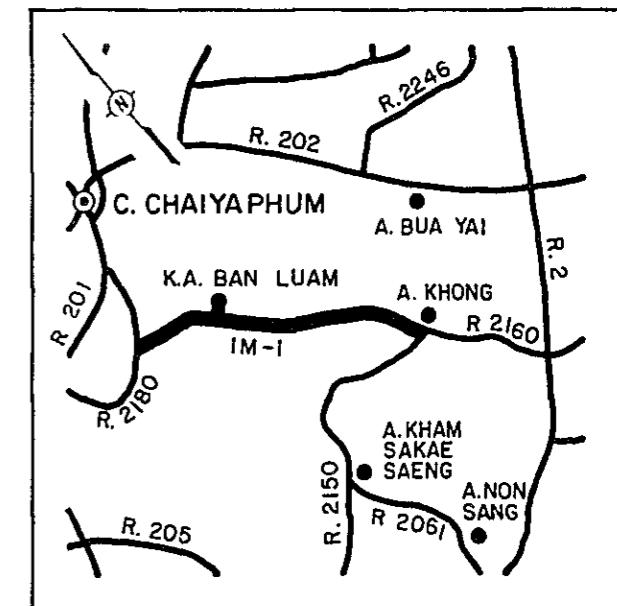
BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	2 8	C – 7 00 x 16.00	W – 4.30 x 13.00
2	32 7	C – 7. 00 x 10.00	W – 4 50 x 8.00
3	38.0	C – 7 00 x 18 00	W – 4 50 x 15.00
4	39 0	C – 7 00 x 10.00	—
5	44 6	C – 7 00 x 8.00	W – 4.50 x 5.50
6	46.1	C – 7.00 x 8.00	W – 4.50 x 5.50

LEGEND

- ━ ━ ━ PROPOSED ROUTE (IMPROVEMENT)
- ━━━━ PROPOSED ROUTE (NEW CONSTRUCTION)
- ──── PAVED ROUTE
- – – – – UNPAVED ROUTE
- • • • • • INVENTORY SURVEY ROUTE
- (H) HOSPITAL
- (M) MEDICAL CENTER
- (S) SECONDARY SCHOOL

SCALE
0 5 1 2 3 Km.

1 – 17

Table 1.5.1   CONSTRUCTION QUANTITIES AND COSTS IM-1 (48.0 km)

Items	Unit of Q'ty	Financial Unit Rate ฿	(DBST)			(Soil Aggregate Surface)		
			Q'ty	Financial Cost $(10^3฿)$	Economic Cost $(10^3฿)$	Q'ty	Financial Cost $(10^3฿)$	Economic Cost $(10^3฿)$
DIRECT CONSTRUCTION COST								
Clearing and Grubbing	ha	15,000	114	1,710	1,556	.114	1,710	1,556
Excavation – Soil	m^3	20	0	0	· 0	0	0	· 0
Excavation – Hard Rock	m^3	160	0	0	0	0	0	0
Embankment	m^3	45	196,800	8,856	8,058	196,800	8,856	8,058
Selected Material	m^3	80	101,800	8,144	7,248	101,800	8,144	7,248
Soil Aggregate Surface or Subbase	m^3	105	71,300	7,486	6,662	71,300	7,486	6,662
Crushed Stone Base	m^3	370	46,800	17,316	15,930	3,400	1,258	1,157
Soil Aggregate Shoulder	m^3	105	20,200	2,121	1,887	1,500	157	140
Prime Coat and DBST	m^2	55	264,000	14,520	13,068	19,300	1,062	956
Pipe Culvert	m	2,100	2,110	4,431	4,076	2,110	4,431	4,076
Box Culvert	m	16,000	0	0	0	0	0	0
Long Span Bridge	m	80,000	0	0	0	0	0	0
Short Span Bridge	m	40,000	72	2,880	2,563	72	2,880	2,563
Sub Total (a)				67,464	61,052		35,985	32,420
Miscellaneous Works (a) x 7%				4,722	4,274		2,519	2,269
Total (b)				72,186	65,326		38,504	34,689
PHYSICAL CONTENGENCY (b) x 15%				10,828	9,799		5,776	5,203
ENGINEERING AND								
ADMINISTRATION (b) x 10%				7,219	6,533		3,850	3,469
Sub Total				18,047	16,332		9,626	8,672
LAND ACQUISITION								
Highly Developed Land	ha	50,000	25	1,250	1,250	25	1,250	1,250
Less Developed Land	ha	15,000	0	0	0	0	0	0
Sub Total				1,250	1,250		1,250	1,250
GRAND TOTAL				91,483	82,908		49,380	44,611

Table 1.6.1 COST AND BENEFITS

(F4 STANDARD)

(1000 BAHT)

YEAR	COST CONST. COST	BENEFITS AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	DISCOUNTED(12%) COST	BENEFIT
1984	16,581	0	0	0	0	23,295	0
1985	41,452	0	0	0	0	51,997	0
1986	24,871	0	0	0	0	27,856	0
1987	0	1,708	7,115	-278	8,545	0	7,629
1988	0	2,061	7,533	-262	9,332	0	7,439
1989	0	2,414	7,951	-246	10,119	0	7,202
1990	0	2,767	8,369	-230	10,906	0	6,931
1991	0	3,120	8,786	-213	11,693	0	6,635
1992	0	3,473	9,204	-197	12,480	0	6,323
1993	0	3,826	9,622	-181	13,267	0	6,001
1994	23,232	4,107	10,284	-157	14,235	10,509	5,749
1995	0	4,389	10,946	-133	15,203	0	5,482
1996	0	4,671	11,608	-109	16,171	0	5,207
1997	0	4,953	12,271	-85	17,139	0	4,927
1998	0	5,235	12,933	-61	18,107	0	4,648
1999	0	5,517	13,595	-37	19,075	0	4,371
2000	0	5,798	14,257	-13	20,043	0	4,101
2001	-38,812	6,080	14,919	12	21,011	-7,091	3,839
TOTAL	67,324	60,118	159,392	-2,188	217,323	106,566	86,484

DISCOUNTED ECONOMIC COSTS :   106,566

DISCOUNTED ECONOMIC BENEFITS :   86,484

   AGRICULTURAL DEVELOPMENT BENEFIT   22,979
   VOC SAVING   64,780
   RMC SAVING   -1,276

NET PRESENT VALUE :   -20,082

BENEFIT COST RATIO :   0.81

INTERNAL RATE OF RETURN :   9.6 %

Table 1.6.2 COST AND BENEFITS

(F5 STANDARD)

(1000 BAHT)

YEAR	COST CONST. COST	BENEFITS AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	DISCOUNTED(12%) COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	17,844	0	0	0	0	22,384	0
1986	26,767	0	0	0	0	29,979	0
1987	0	1,708	4,526	-118	6,115	0	5,460
1988	0	2,061	4,861	-108	6,815	0	5,433
1989	0	2,414	5,197	-97	7,514	0	5,348
1990	0	2,767	5,533	-86	8,214	0	5,220
1991	0	3,120	5,869	-76	8,913	0	5,058
1992	0	3,473	6,205	-65	9,613	0	4,870
1993	0	3,826	6,541	-54	10,312	0	4,665
1994	1,694	4,107	7,094	-38	11,164	766	4,509
1995	0	4,389	7,647	-21	12,015	0	4,333
1996	0	4,671	8,200	-5	12,866	0	4,143
1997	0	4,953	8,753	12	13,718	0	3,943
1998	0	5,235	9,306	28	14,569	0	3,739
1999	0	5,517	9,859	45	15,420	0	3,534
2000	0	5,798	10,412	61	16,272	0	3,329
2001	-21,196	6,080	10,965	77	17,123	-3,872	3,128
TOTAL	25,109	60,118	110,968	-445	170,642	49,256	66,712

DISCOUNTED ECONOMIC COSTS :   49,256

DISCOUNTED ECONOMIC BENEFITS :   66,712

   AGRICULTURAL DEVELOPMENT BENEFIT   22,979
   VOC SAVING   44,125
   RMC SAVING   -393

NET PRESENT VALUE :   17,456

BENEFIT COST RATIO :   1.35

INTERNAL RATE OF RETURN :   15.7 %

Table 1.7.1 SOCIAL INDICATORS

(Proposed Route IM-1)

Population (1,000)	
1982	: 27.9
1993	: 29.3
Average travelling speed, without (kph)	: 40
Isolation	
Access to Amphoe	
Average distance to Amphoe (km)[1]/	: 8.7 (8.8)
Per capita time savings (10^{-4})	: 0.034
Score	: 100
Access to Artery Highway	
Average distance to highway (km)[1]/	: 12 (13)
Per capita time savings (10^{-4})	: 0.054
Score	: 117
Impassability	
Impassable week a year	: 12
Impassability per year	: 0.231
Impassability per capita (10^{-4})	: 0.079
Score	: 658
Health	
Access to Hospital	
Average distance to Hospital (km)[1]/	: 12 (14)
Per capita time savings (10^{-4})	: 0.062
Score	: 147
Access to Medical Facilities	
Average distance to facilities (km)[1]/	: 5.1 (5.3)
Per capita time savings (10^{-4})	: 0.021
Score	: 84

Education	
Access to Secondary School	
Number of Student in 1993 (1,000)[2]/	: 4.4
Average distance to school (km)	: 8.4 (8.5)
Per capita time savings (10^{-4})	: 0.218
Score	: 117
Teacher Intensity	
Number of teachers[3]/	
University graduate	: -
Total	: 8
Number of Student	: 239
Indicators	
E1 [4]/	: -
E2 [5]/	: 33.5
E [6]/	: 33.5
Degree of Improvement[7]/	: 2.04
Score	: 130
Disparity	
G.P.V. in 1993 (Mn B)[8]/	
With project	: 128.3
Without project	: 121.2
Per capita G.P.V. in 1993 (B)	
With project (W)	: 4,379
Without project (w)	: 4,137
Degree of Disparity	
(A/W) - (A/w)[9]/	: 0
Score	: 0
Total Score	: 1,374

Note:

1/ ( ) shows the length or distance in without project case. Unless otherwise, lengthes are same both in with project case and without project case.

2/ Number of secondary school student estimated based on the projected population of the areas of influence applying ratios of secondary school students to the total population in the sample area.

3/ Numbers of the sample areas

4/ (Number of University Graduate Teachers)/(Total Number of Student) x 1,000

5/ (Total of Teachers)/(Total Number of Student) x 1,000

6/ Sum of 4/ and 5/

7/ Ratio of E value of each route to an average value of the same indicator E in case of the sample areas, 33 in number, along paved road near the proposed routes.
The average value of E in case of paved roads were calculated at 68.4 from the following data:
Number of university graduate teachers   438
Number of Teachers   1,285
Number of student   25,196

8/ Estimated gross value of crop production in the areas of influence

9/ "A" indicates an average per capita value of crop production in the Northeastern Region, which is estimated assuming that:
- GRP per capita of the Northeast is estimated at 11,897 Baht in 1993,
- Agricultural sector shares 40% of GRP, and
- Crop production shares 80% of agricultural production.

PROPOSED ROUTE NO. IM - 2

Changwat : Buri Ram

  B. Waeo (J.R. 202) - K.A. Na Pho

Length   ·   9.4 KM.

SUMMARY

PROPOSED ROUTE IM-2

Item	Description	
Changwat	Buri Ram	
Origin	B Waeo (J.R. 202)	
Destination	K.A. Na Pho	
Length		
Total		9.4 km
Improvement Section		9.4 km
DOH Road	R.2061	1.0 km
ARD Road		8.4 km
Others		0 km
New Alignment Section		0 km
Surface Type and Condition	Soil Aggregate, Good	
Terrain	Flat	
Influence Area		
Area		58 km^2
Population (1982)		11,400
Principal Crops		Paddy
Traffic (ADT)		
Existing		169
1993		668
2001		900
Proposed Standard	F4 (DBST)	
Construction Cost		
Financial		16,277 .10^3 ฿
Economic		14,778 .10^3 ฿
IRR		10.2 %
B/C		0.86
Recommendation	For further consideration	

LOCATION OF PROPOSED ROUTE

National Highway
Provincial Road
Proposed Route
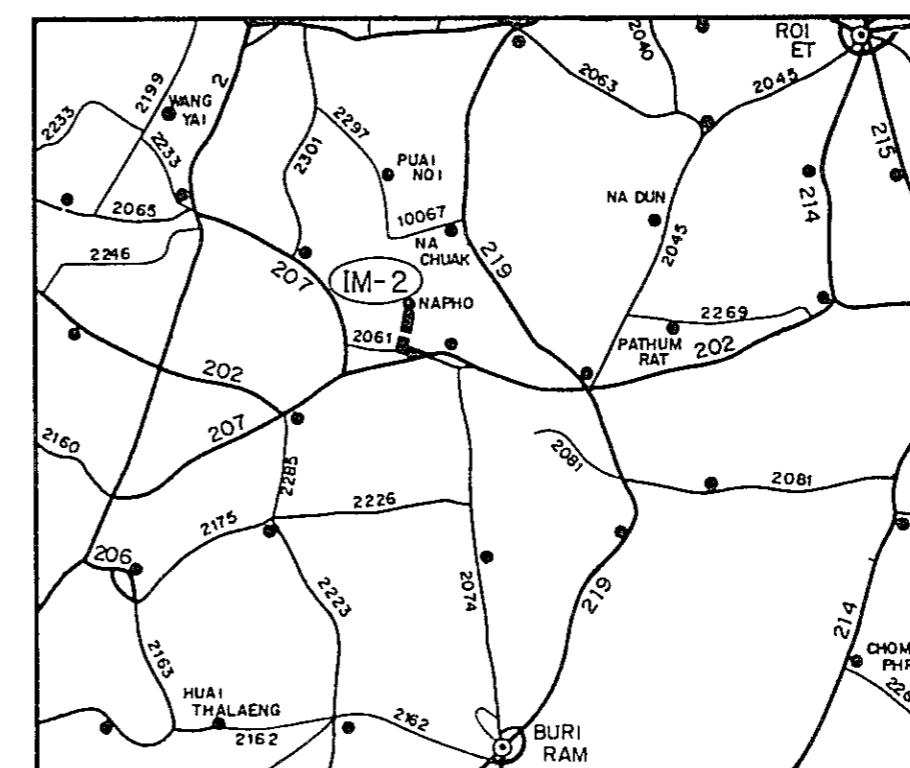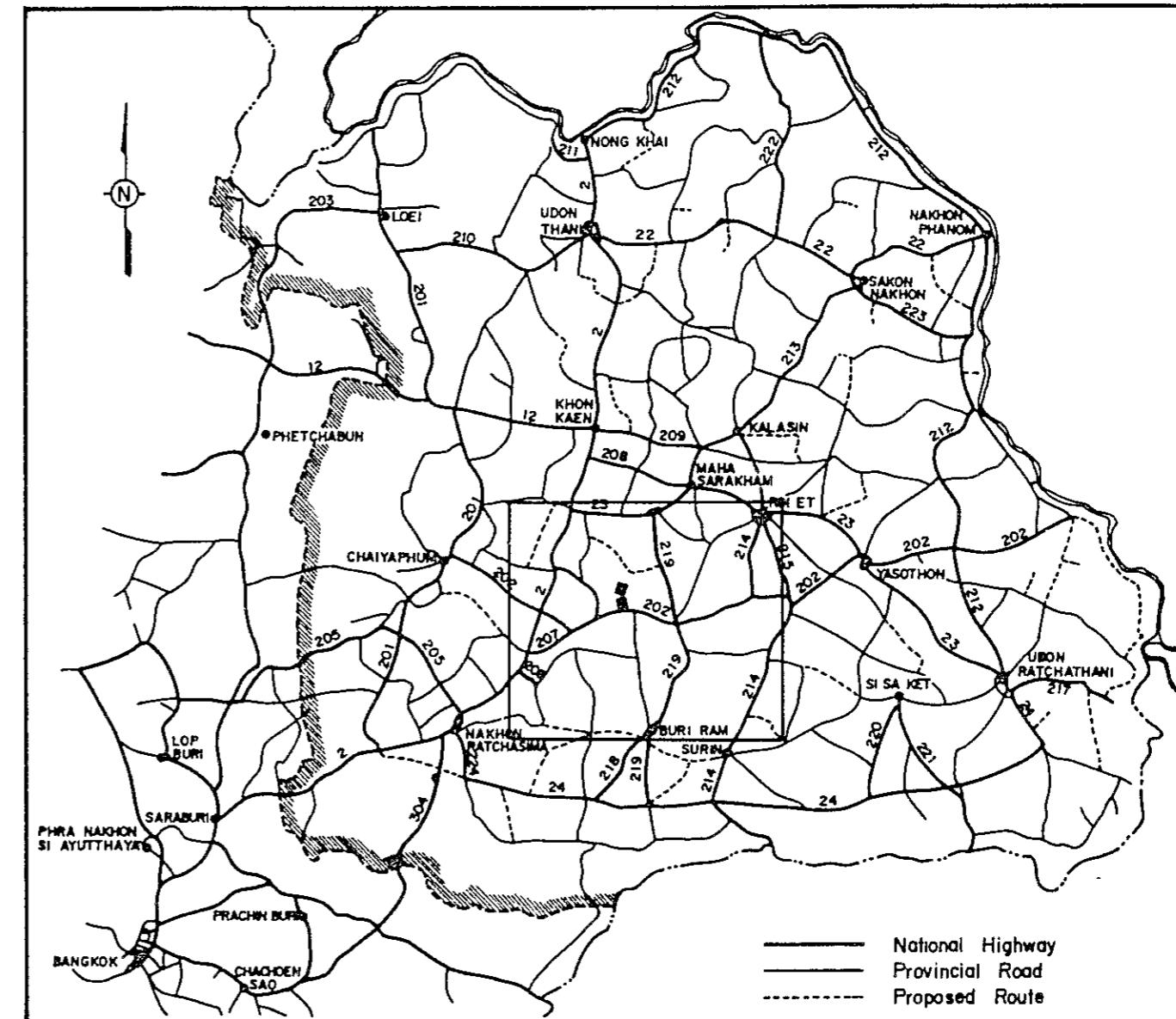
1. GENERAL

1.1 Characteristics of the Route

The proposed route is located in the north part of Changwat Buri Ram. The route starting at Ban Waeo on Route 202 runs northward and ends at King Amphoe Napho. Its total length is 9.4 km (Figure 2.5.2).

The terrain is almost flat. In the influence area, there exists a few villages with total population of 11,400. There is only one medical center at King Amphoe Napho on the route, but one hospital and one secondary school at Amphoe Phut Thaisong near the beginning point of the proposed route.

The proposed route, upon completion, will play vital role to connect King Amphoe Napho with artery highway Route 202.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route are summarized in Table 2.1.1. The details are shown as the results of inventory survey in Table 2.1.2.

2. TRAFFIC

2.1 Method

Growth Rate Method was employed for traffic forecasting as no diverted traffic is expected after improvement of the subject road.

2.2 Base Year Traffic

The base year traffic by road link by vehicle type was estimated basing on manual classified counts as shown below:

Proposed Road Link

Legend

○ Road Node

□ Road Link Code

■ ■ ■ Proposed Road Link

━━━ Other Road
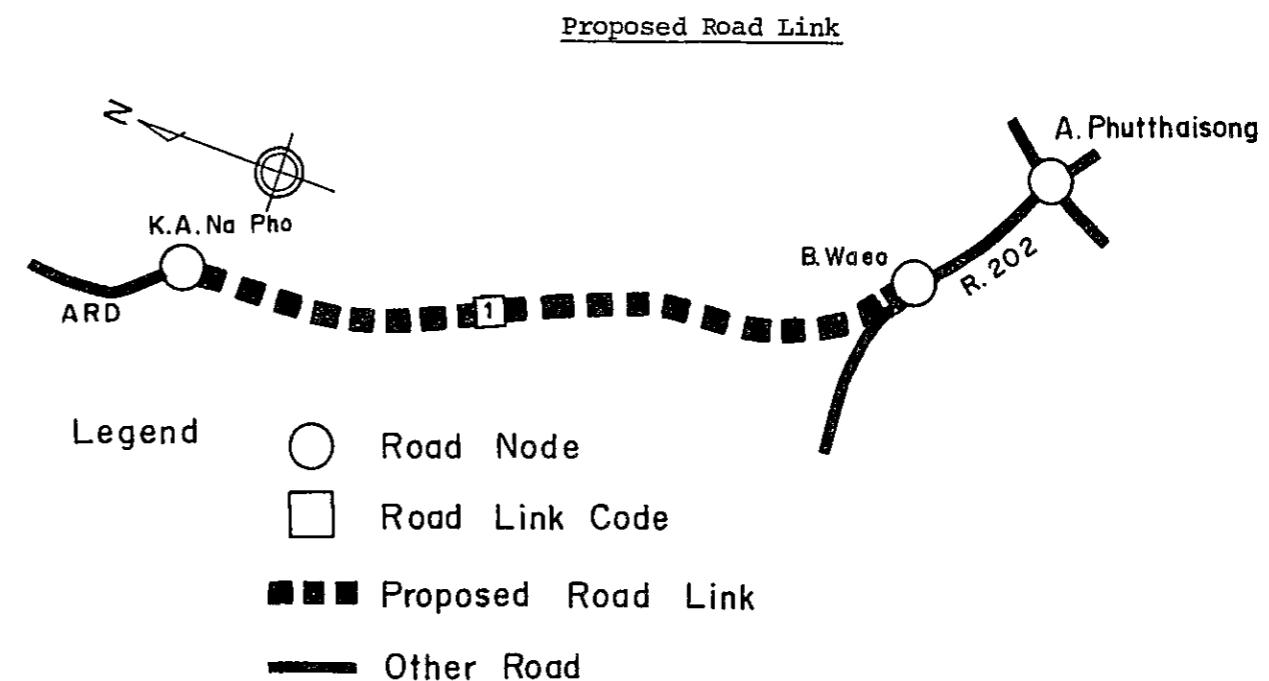
Traffic Volume in Base Year

Source (base year)	Link No	Vehicle Type									
		P/C	P/P	L/B	M/B	H/B	P/T	4/T	6/T	10/T	ADT
Manual Counts (1982)	1	–	83	1	33	1	9	14	23	5	169

2.3 Transport Movement

Passenger movement in terms of trips per day and freight movement in terms of tonnage per day on the proposed road links were estimated multiplying traffic volume in base year by the occupancy or average load obtained from roadside interview, as shown below:

PASSENGER MOVEMENT (1982)

PROPOSED ROAD LINK	TRIPS PER DAY
1	1048

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	94	14	109

2.4 Future Growth of Transport Movement

The growth rates of passenger and freight movements for the periods of
1981 - 1987, 1987 - 1993 and 1993 - 2001 were predicted by the formula
described in 7.3.3-2) of the Main Report. The basis for the prediction is
shown in the following tables:

GROWTH RATE OF PASSENGER MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
PER CAPITA INCOME	4.2	4.5	4.7
TRANS. PRICE INCREASE	4.5	4.5	4.5
POPULATION	1.5	1.2	1.1
PASSENGER MOVEMENT	5.5	5.6	5.7

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
NON-AGRI.	7.1	7.2	7.3
AGRICULTURE	0.4	0.4	0.4
FREIGHT	6.2	6.3	6.4

2.5 Induced and Developed Traffic

The following ratios are used for the estimation of induced and developed
traffic described in 7.3.3-3) of the Main Report:

RATE OF INDUCED AND DEVELOPED TRAFFIC

(%)

ITEM	YEAR		
	1987	1993	2001
INDUCED	15.0	15.0	15.0
DEVELOPED	0.0	3.0	3.0

2.6 Future Traffic

1) Traffic Composition

The movements of passenger and freight transport were transformed into
traffic volume by vehicle type applying future traffic composition as shown
in the following table:

TRAFFIC COMPOSITION

(UNIT : %)

LINK NO.	YEAR	PASSENGER					FREIGHT			
		P/C	P/P	L/B	M/B	H/B	P/T	4/T	6/T	10/T
1	1982	0.0	70.3	0.8	28.0	0.8	17.6	27.5	45.1	9.8
	1987	4.6	65.7	3.4	24.1	2.1	17.5	24.4	42.4	15.6
	1993	10.2	60.2	6.6	19.4	3.7	17.3	20.8	39.3	22.7
	2001	17.6	52.8	10.7	13.2	5.8	17.0	16.0	35.0	32.0

2) Forecasted ADT

The average of the forecasted traffic on proposed road links is shown in the following table and details by road link by traffic type are shown in Table 2.2.1.

AVERAGE FUTURE TRAFFIC ON PROPOSED ROUTE

YEAR	TYPE OF VEHICLE								ADT	M/C	TOTAL
	P/C	L/B	M/B	H/B	P/P&T	4/T	6/T	10/T			
1987	8	6	43	4	128	16	28	10	243	282	525
1993	26	16	49	9	165	17	32	19	333	334	668
2001	68	42	51	22	224	18	39	35	499	401	900

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

All of the cultivated land is covered by paddy fields and remaining unused cultivable land is also for paddy. The average yield of paddy is comparatively low because of salinity affection in the existed paddy field.

Land use and capability conditions in the area of influence are shown in Table 2.3.1. and Figure 2.3.2.

A typical cropping calendar in the Buri Ram area is shown in Figure 2.3.1.

3.2 Development Projection

Future agricultural development in the area of influence was projected for both cases of without project and with project. The projected planted area, unit yields by crop, and the consequent production volumes are shown in Table 2.3.2.

Framgate prices and production costs of the selected crops are estimated as follows, referring to the Changwat data and field survey information as shown in Table 2.3.3.

Based on the above projected production volume, farmgate prices, production costs and land preparation cost estimated separately, net production value (NPV) was obtained as shown in Table 2.3.4. The difference between NPV of with project case and NPV of without project case is deemed to be the development benefit of the subject road.

4. VOC SAVINGS

In accordance with the concept and basic data given in Chapter 7 of Vol. 1 Main Report, VOCs on each road link concerned were calculated in both cases of with project and without project.

Elements of road condition, which affect the calculation of additional costs of VOC of each link, are shown below.

Road Condition

Link		Without Project				With Project			
No.	Terrain	Length (km)	Road/1 class	Nos. of wooden Bridge	Nos. of Narrow C.Bridge	Length (km)	Road Class/1 case 1	case 2	Nos. of Narrow Wooden Bridge
1	Flat	9.4	2B	1	0	9.4	1(F4)	2A(F5)	0

/1 Road 1 : Paved Road
    Road 2A : Laterite Road with good surface condition and alignment
    Road 2B : Laterite Road with good surface condition but poor alignment
    Road 3 : Laterite Road with poor surface condition and alignment
    Road 4 : Earth Road

VOC savings, obtained from the difference of total link VOCs in the cases of with project and those of without project case, were calculated as follows.

Vehicle Operating Cost Saving

(unit: 1,000 Baht)

Road Class	1987	1993	2001
1 (F4)	1,074	1,692	3,002
2A (F5)	399	821	1,754

5. ENGINEERING

5.1 Preliminary Design

Preliminary design was carried out based on the following design criteria.

Design Standard	: F4 (if not feasible, F5)
Geometric Design	: AASHTO (Rural Highways)
Typical Cross Section	: as shown in Figure 2.5.1

Minimum Height of Embankment

Ordinary Section	: 1.0m
Approach of Bridge in Flat Area	: 2.0m
Flood Section	: 0.7m (above flood level)

Pavement Structure

In case of F4 Standard

DBST		: 2.5cm
Crushed Stone Base	CBR$\geq$80%	: 15.0cm
Soil Aggregate Subbase	CBR$\geq$20%	: 15.0cm
Selected Material	CBR$\geq$ 6%	: 20.0cm

In case of F5 Standard

Soil Aggregate Surface	CBR$\geq$20%	: 15.0cm
Selected Material	CBR$\geq$ 6%	: 20.0cm

Pipe Culvert

Standard Size	: ϕ 100cm

Standard Interval

Paddy Area	: 200 m
Others	: 500 m

Box Culvert

Standard Size	: 2.4m x 2.4m
Location	: as required

Bridge

Standard Type (width 7.0m)

Short Span Bridge	: RC – Slab
Long Span Bridge	: PC – Girder
Location	: as shown in Bridge List in Figure 2.5.2

Alignment of the route is shown in Figure 2.5.2.

5.2 Work Quantity and Construction Cost

Work quantities based on the preliminary design and construction cost together with unit rate by work item are shown in Table 2.5.1.

Total financial and economic construction costs by applied road class are as given below:

Financial and Economic Construction Cost

| Road Class | Length (km) | Construction Cost (10^3 ฿) | | Remark |
		Financial Cost	Economic Cost	
F4 (DBST)	9.4	16,277	14,778	
F5 (Soil Aggregate)	9.4	8,809	7,985	

6.   ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits and the calculated economic indicators for evaluation are given in Table 2.6.1 and 2.6.2.

The result indicates that the proposed project seems to be not feasible in case of F4 standard but feasible under F5.

7.   SOCIAL IMPACTS

Detailed data and results of quantification of indicators of social impacts are tabulated in Table 2.7.1

Table 2.1.1 SUMMARY OF ROAD INVENTORY

Item	Description		
Origin	B. Waeo (J.R. 202)		
Destination	K.A. Na Pho		
Length			
Total		9.4 km	
Improvement Section		9.4 km	
.DOH Road	R. 2061	1.0 km	
ARD Road		8.4 km	
Others		0 km	
New Alignment Section		0 km	
Terrain	Flat		
Alignment (Hori./Vert.)	Fair / Fair		
Formation Width	6.5 m – 8.0 m, 6.7 m (Weighted average)		
Embankment Section			
Length		9.4 km	
Height	0.3 m – 0.8 m		
Cut Section			
Length		0 km	
Depth	m – m		
Surface Type and Condition			
SBST or DBST		0 km	
Soil Aggregate	Good	9.4 km	
Earth		0 km	
Pipe Culvert	9 each		
Box Culvert	0 each	0 m	
Bridge			
Permanent Bridge	0 each	0 m	
Narrow Concrete Bridge	0 each	0 m	(4m)
Wooden Bridge	1 each	5.1 m	
Overflow Section	0 place	0 km	

Table 2.1.2 ROAD INVENTORY

PROPOSED ROUTE NO. IM-2   ROUTE NO. 2061   B. WAEO (J.R. 202) ∿ K.A. NA PHO   L = 9.4 Km
ARD   BURI RAM

STATION (Km)		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
VILLAGE – Name – Household (H) – Population (P)		B. WAEO H = 300 P = 1500				KA. NA PHO											
TERRAIN			Flat														
CROSS SECTION	Formation Width (m)	8.00	6.50			6.80											
	Embankment Height (m)	0.80	0.50	0.30	0.70	0.80											
	Cutting Depth (m)																
PAVEMENT	Type/Length			Laterite													
	Condition			Good		Poor	Fair										
FLOODING	Overflow Length(Km)/Height(m)																
LAND USE	Left			Paddy													
	Right			Paddy													
PIPE CULVERT	Total Number			9 Pipes													
BOX CULVERT & BRIDGE	Station (Km)		2.6														
	Dimension		W-Br. 4.60 x 5.10														
RIGHT OF WAY (m)			16.50														
ALIGNMENT	Horizontal			Fair													
	Vertical			Fair													
ROUTE NO., AGENCIES		DOH 2061	ARD														

Table 2.2.1 TRAFFIC VOLUME ON ROUTE IM - 2

YEAR	1987		1993		2001	
LINK	1	AVR.	1	AVR.	1	AVR.
P/C N+D	7	7	22	22	58	58
P/C I	1	1	3	3	9	9
P/C DV	0	0	1	1	2	2
P/C TOTAL	8	8	26	26	68	68
L/B N+D	5	5	14	14	35	35
L/B I	1	1	2	2	5	5
L/B DV	0	0	0	0	1	1
L/B TOTAL	6	6	16	16	42	42
M/B N+D	37	37	41	41	43	43
M/B I	6	6	6	6	6	6
M/B DV	0	0	1	1	2	2
M/B TOTAL	43	43	49	49	51	51
H/B N+D	3	3	8	8	19	19
H/B I	0	0	1	1	3	3
H/B DV	0	0	0	0	1	1
H/B TOTAL	4	4	9	9	22	22
P/P&T N+D	111	111	139	139	189	189
P/P&T I	17	17	21	21	28	28
P/P&T DV	0	0	5	5	7	7
P/P&T TOTAL	128	128	165	165	224	224
4/T N+D	14	14	14	14	15	15
4/T I	2	2	2	2	2	2
4/T DV	0	0	1	1	1	1
4/T TOTAL	16	16	17	17	18	18
6/T N+D	24	24	27	27	33	33
6/T I	4	4	4	4	5	5
6/T DV	0	0	1	1	1	1
6/T TOTAL	28	28	32	32	39	39
10/T N+D	9	9	16	16	30	30
10/T I	1	1	2	2	4	4
10/T DV	0	0	1	1	1	1
10/T TOTAL	10	10	19	19	35	35
ADT N+D	211	211	281	281	421	421
ADT I	32	32	42	42	63	63
ADT DV	0	0	10	10	15	15
ADT TOTAL	243	243	333	333	499	499
M/C N+D	259	259	306	306	374	374
M/C I	22	22	24	24	23	23
M/C DV	0	0	5	5	5	5
M/C TOTAL	282	282	334	334	401	401
TOTAL N+D	471	471	587	587	795	795
TOTAL I	54	54	66	66	86	86
TOTAL DV	0	0	15	15	19	19
TOTAL TOTAL	525	525	668	668	900	900

NOTE
N : NORMAL TRAFFIC   D : DIVERTED TRAFFIC
DV : DEVELOPED TRAFFIC   I : INDUCED TRAFFIC

Figure 2.3.1 LAND USE AND CAPABILITY OF INFLUENCE AREA
PROPOSED ROUTE NO. IM - 2

LEGEND

CULTIVATED LAND FOR PADDY
CULTIVATED LAND FOR UPLAND CROP
CULTIVABLE LAND FOR PADDY
CULTIVABLE LAND FOR UPLAND CROP
UNCULTIVABLE LAND
PROPOSED ROUTE
INFLUENCE AREA OF PROPOSED ROUTE

SCALE
0 5 1   2   3 Km.
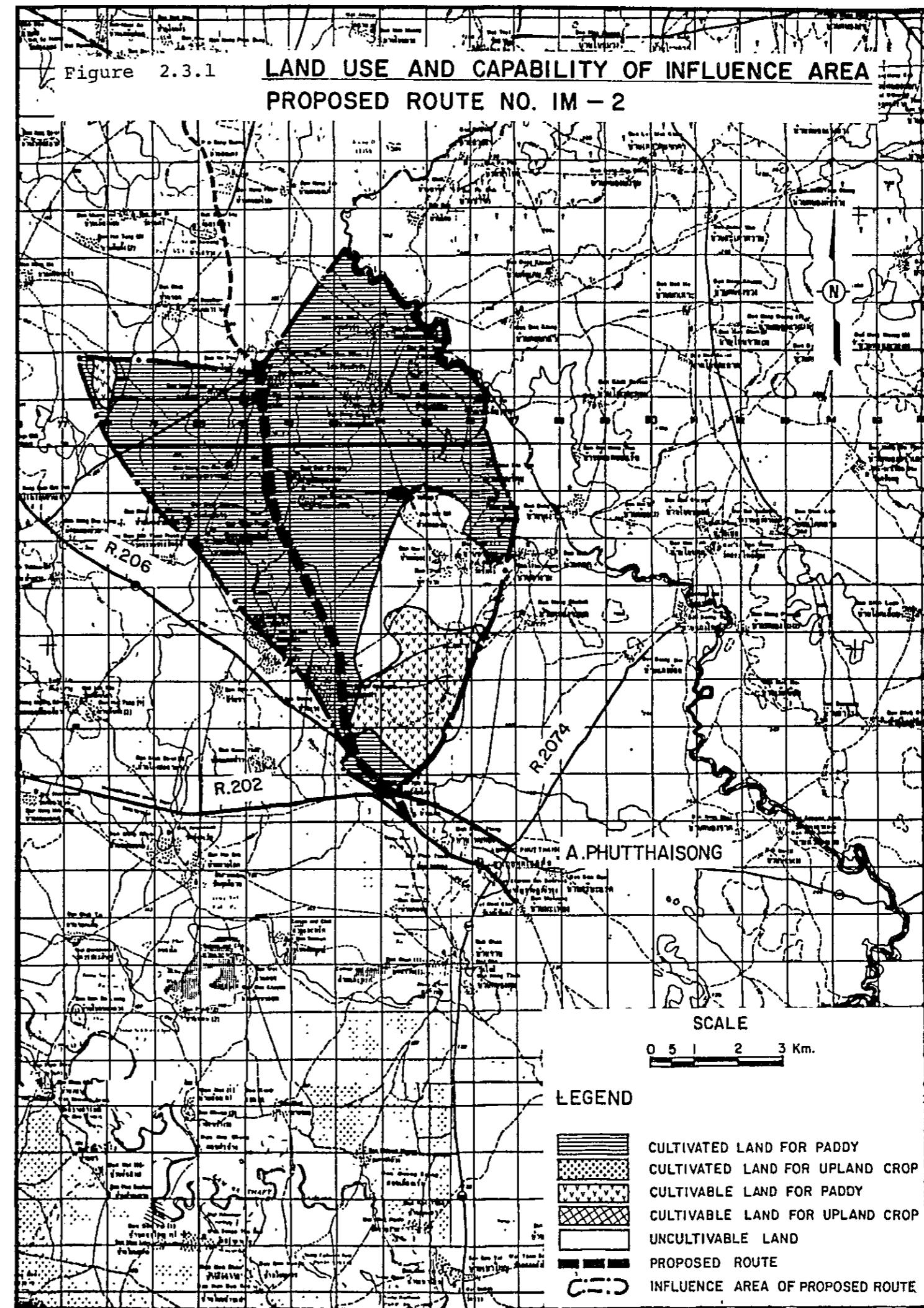
Figure 2.3.2 **CROPPING CALENDAR**

1400 CHANGWAT _____ BURI RAM _____

NAME OF CROP	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT	NOV.	DEC.
RICE, 1st CROP					⊖——	——⊖——	——⊖——	——×——	——×			
GROUND NUT	⊖—⊖———————	————×——×										
KENAF		⊖————	————⊖————	————————	————×———	——×						
CASSAVA			⊖————	————⊖				×				
				×								
MAIZE				⊖——	——⊖——	——×——×						
SORGHUM								⊖—⊖———	————×—×			
SUGAR CANE								⊖————	————⊖			
									×			
			×⊖					×				
			×⊖					×				
			———————×								

Note :

FIRST CROP   SECOND CROP

⊖————⊖————————×————×   ⊖————⊖————————×————×

sowing   growing season   harvesting
season   season

2 – 10

TABLE 2.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM^2)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		27.500 (44.0)	-	27.500 (44.0)	3.750 (6.0)	-	3.750 (6.0)
1402	PHUTTHAISONG	27.500 (44.0)	-	27.500 (44.0)	3.750 (6.0)	-	3.750 (6.0)

TABLE 2.3.2 CROP PRODUCTION

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)										
1981	24.99	-	-	-	-	-	-	-	-	24.99
1987	25.60	-	-	-	-	-	-	-	-	25.60
1993 WITHOUT PROJECT	26.22	-	-	-	-	-	-	-	-	26.22
WITH PROJECT	27.01	-	-	-	-	-	-	-	-	27.01
2001 WITHOUT PROJECT	27.07	-	-	-	-	-	-	-	-	27.07
WITH PROJECT	27.89	-	-	-	-	-	-	-	-	27.89
CROP YIELD (KG/RAI)										
1981	199.0	-	-	-	-	-	-	-		
1987	199.0	-	-	-	-	-	-	-		
1993 WITHOUT PROJECT	199.0	-	-	-	-	-	-	-		
WITH PROJECT	203.8	-	-	-	-	-	-	-		
2001 WITHOUT PROJECT	199.0	-	-	-	-	-	-	-		
WITH PROJECT	210.4	-	-	-	-	-	-	-		
CROP PRODUCTION (TON)										
1981	4,973	-	-	-	-	-	-	-	-	4,973
1987	5,094	-	-	-	-	-	-	-	-	5,094
1993 WITHOUT PROJECT	5,217	-	-	-	-	-	-	-	-	5,217
WITH PROJECT	5,505	-	-	-	-	-	-	-	-	5,505
2001 WITHOUT PROJECT	5,386	-	-	-	-	-	-	-	-	5,386
WITH PROJECT	5,868	-	-	-	-	-	-	-	-	5,868

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 2.3.3   FARMGATE PRICE AND PRODUCTION COST

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	4,144	-	-	-	-	-	-	-
WITH PROJECT (1987 - 2001)	4,248	-	-	-	-	-	-	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	573	-	-	-	-	-	-	-
WITH PROJECT (1987 - 2001)	593	-	-	-	-	-	-	-

TABLE 2.3.4   NET PRODUCTION VALUE

(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	6,441	-	6,441	6,460	-	6,460
1993	6,598	-	6,598	7,369	-	7,369
2001	6,811	-	6,811	8,393	-	8,393

Figure 2.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE

R/W · R/W
30.00
RIGHT OF WAY
2.0 VARIES 2.0 · 9.00 · 2.0 VARIES 2.0
ROAD BED
PROFILE GRADE
4% · 4%
EXISTING GROUND LINE
1.00 MIN · 1.00 MIN
DITCH
PAVEMENT · POSSIBLE SOURCE
POSSIBLE SOURCE FOR SUBGRADE · SUBGRADE

FILL SECTION

R/W · R/W
30.00
RIGHT OF WAY
9.00
ROAD BED
2:1 · 2:1 · 2:1 · 2:1
EXISTING GROUND LINE
1.00 MIN · 1.00 MIN
DITCH
PAVEMENT

CUT SECTION

9.00
ROAD BED
1.75 · 5.50 · 1.75
CARRIAGEWAY
6.50
PRIME COAT
5% · 2% · 2% · 5%
2:1 · 2:1
SOIL AGGREGATE SUBBASE(T=150)CBR≥20% · SOIL AGGREGATE SHOULDER
SELECTED MATERIAL (T=200)CBR≥6% · DOUBLE BITUMINOUS SURFACE TREATMENT (T=25)
SUBGRADE · CRUSHED STONE BASE (T=150) CBR≥80%

DOUBLE BITUMINOUS SURFACE TREATMENT (DBST) ROAD (Class F4)

9.000
4% · 4%
2:1 · 2:1
SOIL AGGREGATE SURFACE (T=150) CBR≥20%
SELECTED MATERIAL (T=200) CBR≥6%
SUBGRADE

SOIL AGGREGATE SURFACED ROAD (Class F5)

2 - 13

Figure 2.5.2
PROPOSED ROUTE NO. IM-2   C. BURI RAM   B. WAEO (J.R. 202) – K.A. NA PHO
ROUTE NO. 2061 + ARD   L = 9.4 Km.
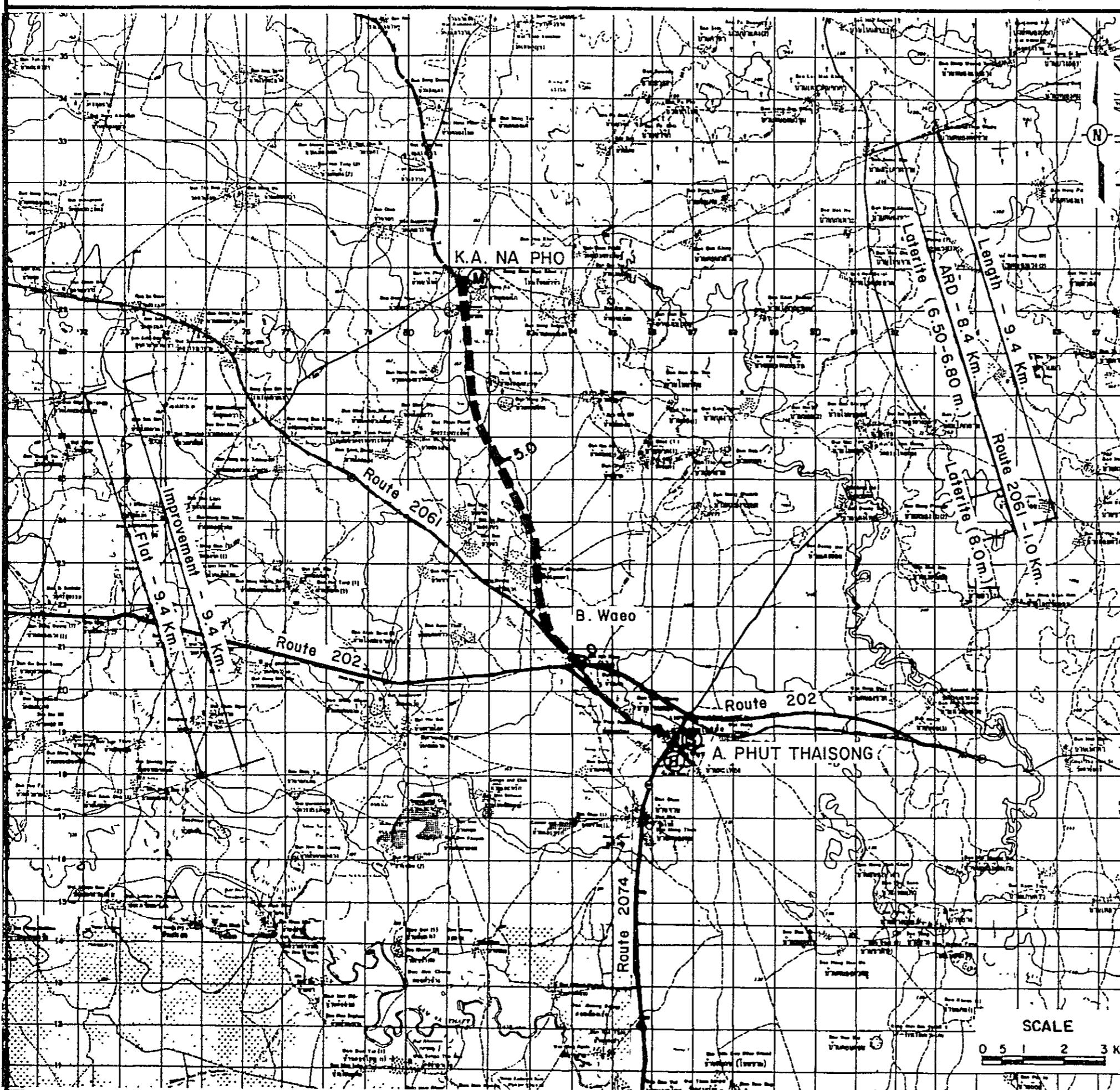
LOCATION MAP
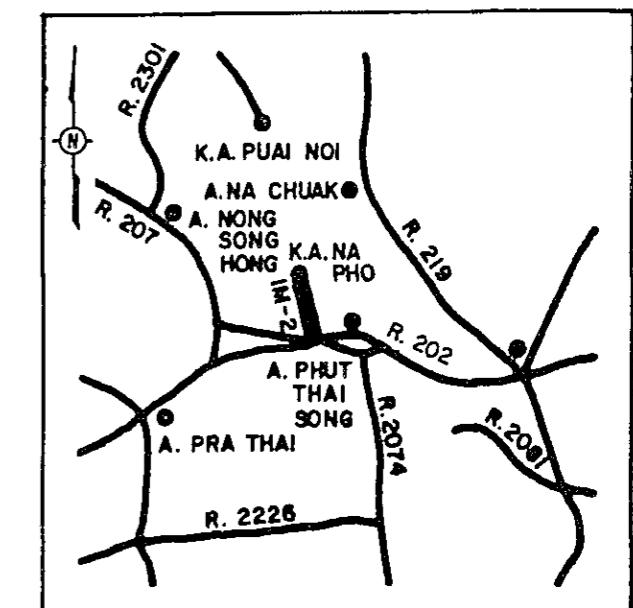
BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	2.6	C - 7.00 x 8.00	W - 4.60 x 5.10

LEGEND

PROPOSED ROUTE (IMPROVEMENT)
PROPOSED ROUTE (NEW CONSTRUCTION)
PAVED ROUTE
UNPAVED ROUTE
INVENTORY SURVEY ROUTE
(H) HOSPITAL
(M) MEDICAL CENTER
(S) SECONDARY SCHOOL

SCALE
0 5 1 2 3 Km.

2 - 14

Table 2.5.1 CONSTRUCTION QUANTITES AND COSTS IM-2 (9.4 km)

Items	Unit of Q'ty	Financial Unit Rate ฿	(DBST)			(Soil Aggregate Surface)		
			Q'ty	Financial Cost $(10^3฿)$	Economic Cost $(10^3฿)$	Q'ty	Financial Cost $(10^3฿)$	Economic Cost $(10^3฿)$
DIRECT CONSTRUCTION COST								
Clearing and Grubbing	ha	15,000	22	330	330	22	330	300
Excavation - Soil	m^3	20	0	0	0	0	0	0
Excavation - Hard Rock	m^3	160	0	0	0	0	0	0
Embankment	m^3	45	15,000	675	614	15,000	675	614
Selected Material	m^3	80	19,900	1,592	1,416	19,900	1,592	1,416
Soil Aggregate Surface or Subbase	m^3	105	14,000	1,470	1,308	14,000	1,470	1,308
Crushed Stone Base	m^3	370	9,200	3,404	3,131	1,500	555	510
Soil Aggregate Shoulder	m^3	105	3,900	409	364	600	63	56
Prime Coat and DBST	m^2	55	51,700	2,844	2,560	8,300	456	410
Pipe Culvert	m	2,100	340	714	656	340	714	656
Box Culvert	m	16,000	0	0	0	0	0	0
Long Span Bridge	m	80,000	0	0	0	0	0	0
Short Span Bridge	m	40,000	8	320	284	8	320	284
Sub Total (a)				11,759	10,638		6,175	5,558
Miscellaneous Works (a) x 7%				823	745		432	389
Total (b)				12,582	11,383		6,607	5,948
PHYSICAL CONTENGENCY (b) x 15%				1,887	1,707		991	892
ENGINEERING AND								
ADMINISTRATION (b) x 10%				1,258	1,138		660	594
Sub Total				3,145	2,845		1,651	1,486
LAND ACQUISITION								
Highly Developed Land	ha	50,000	11	550	550	11	550	550
Less Developed Land	ha	15,000	0	0	0	0	0	0
Sub Total				550	550		550	550
GRAND TOTAL				16,277	14,778		8,809	7,985

Table 2.6.1 COST AND BENEFITS
(F4 STANDARD)

(1000 BAHT)

YEAR	COST CONST. COST	BENEFITS AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	DISCOUNTED(12%) COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	2,956	0	0	0	0	3,708	0
1986	11,822	0	0	0	0	13,241	0
1987	0	19	1,074	-12	1,080	0	965
1988	0	123	1,177	-9	1,291	0	1,029
1989	0	228	1,280	-6	1,502	0	1,069
1990	0	332	1,383	-2	1,713	0	1,089
1991	0	437	1,486	1	1,924	0	1,091
1992	0	541	1,589	4	2,134	0	1,081
1993	0	645	1,692	7	2,345	0	1,061
1994	4,550	762	1,856	12	2,631	2,058	1,062
1995	0	879	2,020	17	2,916	0	1,052
1996	0	995	2,184	22	3,201	0	1,031
1997	0	1,112	2,347	27	3,487	0	1,002
1998	0	1,229	2,511	32	3,772	0	968
1999	0	1,346	2,675	37	4,058	0	930
2000	0	1,462	2,838	42	4,343	0	889
2001	-7,095	1,579	3,002	47	4,629	-1,296	846
TOTAL	12,233	11,690	29,114	223	41,026	17,711	15,165

DISCOUNTED ECONOMIC COSTS :   17,711

DISCOUNTED ECONOMIC BENEFITS :   15,165

AGRICULTURAL DEVELOPMENT BENEFIT   3,779
VOC SAVING   11,343
RMC SAVING   43

NET PRESENT VALUE :   -2,546

BENEFIT COST RATIO :   0.86

INTERNAL RATE OF RETURN :   10.2 %

Table 2.6.2 COST AND BENEFITS
(F5 STANDARD)

(1000 BAHT)

YEAR	COST CONST. COST	BENEFITS AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	DISCOUNTED(12%) COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	1,597	0	0	0	0	2,003	0
1986	6,388	0	0	0	0	7,155	0
1987	0	19	399	4	422	0	377
1988	0	123	469	5	598	0	476
1989	0	228	540	6	773	0	550
1990	0	332	610	7	949	0	603
1991	0	437	680	8	1,125	0	638
1992	0	541	751	9	1,300	0	659
1993	0	645	821	10	1,476	0	668
1994	726	762	938	11	1,711	328	691
1995	0	879	1,054	13	1,946	0	702
1996	0	995	1,171	15	2,181	0	702
1997	0	1,112	1,288	16	2,416	0	695
1998	0	1,229	1,404	18	2,651	0	680
1999	0	1,346	1,521	20	2,886	0	661
2000	0	1,462	1,637	21	3,121	0	639
2001	-3,970	1,579	1,754	23	3,356	-725	613
TOTAL	4,741	11,690	15,037	185	26,911	8,761	9,354

DISCOUNTED ECONOMIC COSTS :   8,761

DISCOUNTED ECONOMIC BENEFITS :   9,354

AGRICULTURAL DEVELOPMENT BENEFIT   3,779
VOC SAVING   5,511
RMC SAVING   65

NET PRESENT VALUE :   593

BENEFIT COST RATIO :   1.07

INTERNAL RATE OF RETURN :   12.7 %

Table 2.7.1 SOCIAL INDICATORS

(Proposed Route IM-2)

Population (1,000)		
1982	:	11.4
1993	:	13.2
Average travelling speed, without (kph)	:	48
Isolation		
Access to Amphoe		
Average distance to Amphoe (km)1/	:	5.0
Per capita time savings (10^{-4})	:	0.026
Score	:	76
Access to Artery Highway		
Average distance to highway (km)1/	:	10
Per capita time savings (10^{-4})	:	0.053
Score	:	115
Impassability		
Impassable week a year	:	-
Impassability per year	:	0
Impassability per capita (10^{-4})	:	0
Score	:	0
Health		
Access to Hospital		
Average distance to Hospital (km)1/	:	5.0
Per capita time savings (10^{-4})	:	0.026
Score	:	60
Access to Medical Facilities		
Average distance to facilities (km)1/	:	2.9
Per capita time savings (10^{-4})	:	0.015
Score	:	60

Education		
Access to Secondary School		
Number of Student in 1993 (1,000)2/	:	1.5
Average distance to school (km)	:	2.5
Per capita time savings (10^{-4})	:	0.116
Score	:	63
Teacher Intensity		
Number of teachers3/		
University graduate	:	-
Total	:	7
Number of Student	:	129
Indicators		
E1 4/	:	-
E2 5/	:	(51.0)
E 6/	:	51.0
Degree of Improvement7/	:	1.34
Score	:	85
Disparity		
G.P.V. in 1993 (Mn B)8/		
With project	:	23.4
Without project	:	21.6
Per capita G.P.V. in 1993 (B)		
With project (W)	:	1,773
Without project (w)	:	1,636
Degree of Disparity		
(A/W) - (A/w)9/	:	0.15
Score	:	268
Total Score	:	727

Note:

1/ ( ) shows the length or distance in without project case. Unless otherwise, lengthes are same both in with project case and without project case.

2/ Number of secondary school student estimated based on the projected population of the areas of influence applying ratios of secondary school students to the total population in the sample area.

3/ Numbers of the sample areas

4/ (Number of University Graduate Teachers)/(Total Number of Student) x 1,000

5/ (Total of Teachers)/(Total Number of Student) x 1,000

6/ Sum of 4/ and 5/

7/ Ratio of E value of each route to an average value of the same indicator E in case of the sample areas, 33 in number, along paved road near the proposed routes.
The average value of E in case of paved roads were calculated at 68.4 from the following data:
Number of university graduate teachers 438
Number of Teachers 1,285
Number of student 25,196

8/ Estimated gross value of crop production in the areas of influence

9/ "A" indicates an average per capita value of crop production in the Northeastern Region, which is estimated assuming that:
- GRP per capita of the Northeast is estimated at 11,897 Baht in 1993,
- Agricultural sector shares 40% of GRP, and
- Crop production shares 80% of agricultural production.

PROPOSED ROUTE NO. IM-3

Changwat : Khon Kaen / Maha Sarakham

J.R. 2301 - A Na Chuak

Length ·   30.6 KM.
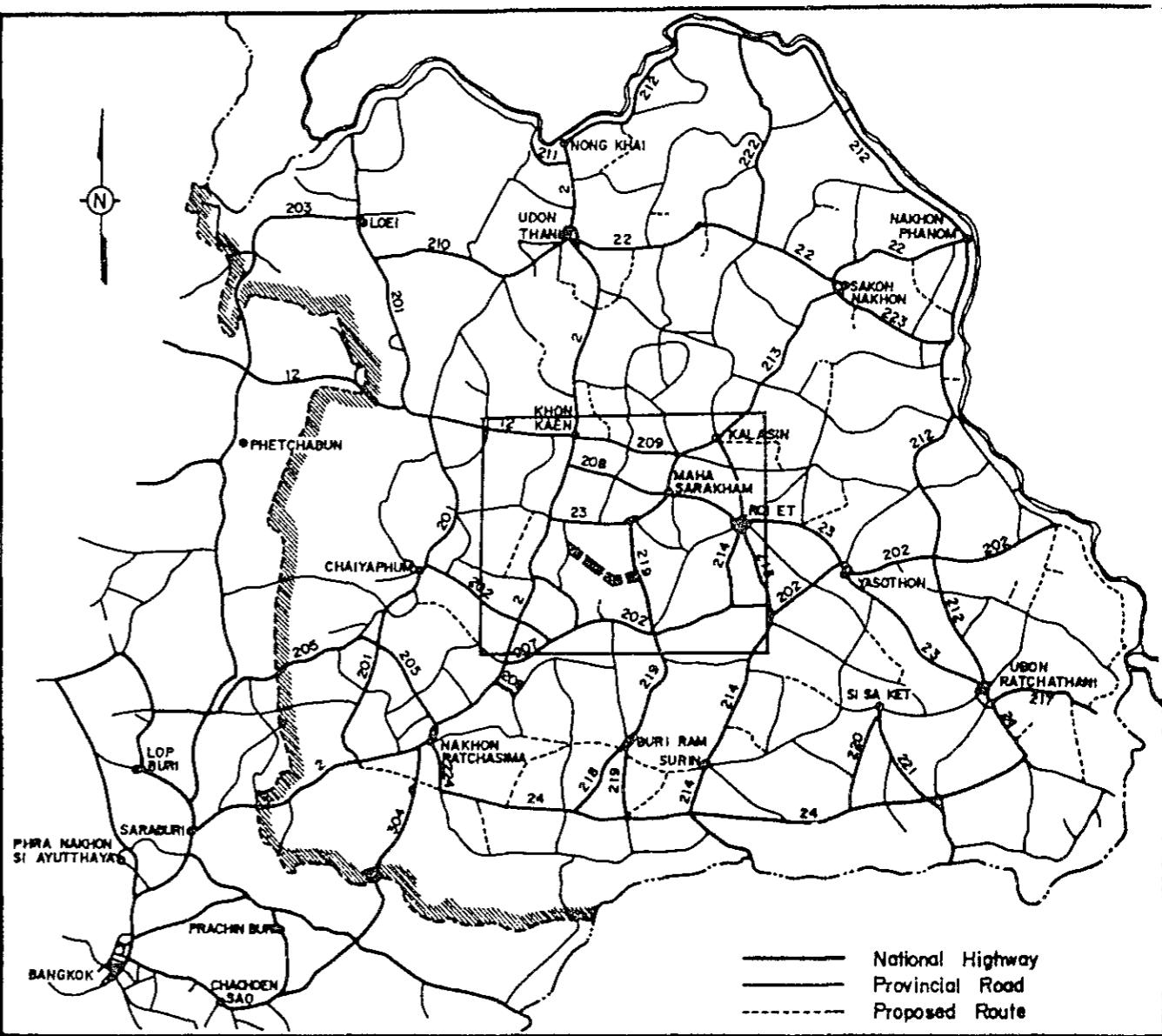
SUMMARY

PROPOSED ROUTE IM- 3

Item	Description		
Changwat	Khon Kaen/Maha Sarakham		
Origin	J.R. 2301		
Destination	A. Na Chuak		
Length			
Total		30.6 km	
Improvement Section		27.6 km	
DOH Road	R.2297	15.0 km	
ARD Road		3.0 km	
Others		0 km	
New Alignment Section		3.0 km	
Surface Type and Condition	Soil Aggregate, Good Poor		
Terrain	Flat and Rolling		
Influence Area			
Area		211 km^2	
Population (1982)		26,000	
Principal Crops		Paddy	
Traffic (ADT)			
Existing		105	
1993		397	
2001		519	
Proposed Standard	F4 (DBST)		
Construction Cost			
Financial		57,753 . 10^3 ฿	
Economic		5꒒,366 . 10^3 ฿	
IRR		7.4 %	
B/C		0.67	
Recommendation	For further consideration		

LOCATION OF PROPOSED ROUTE

National Highway
Provincial Road
Proposed Route
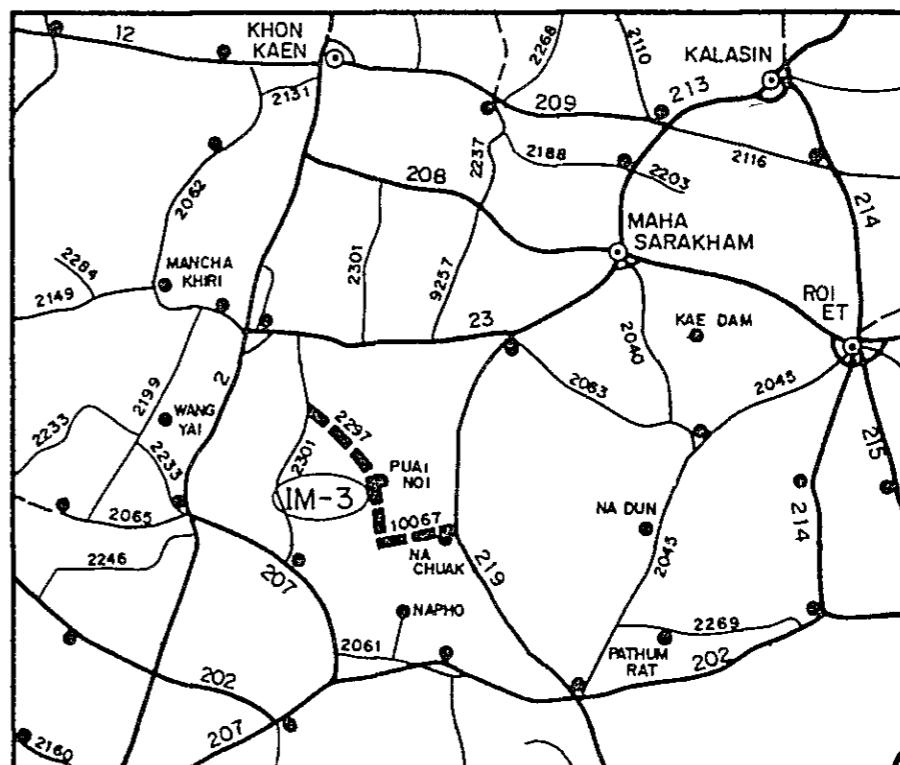
1. GENERAL

1.1 Characteristics of the Route

The proposed route is located in the southeast part of Changwat Khon Kaen.
The route starting at the intersection with Route 2301 runs southeastward
passing through Ban Don Ngoen, King Amphoe Puai Noi and Ban Po Phan and ends
at Amphoe Na Chuak on Route 219.   Its total length is 30.6 km (Fugure 3.5.2).
The terrain is almost rolling, while some sections are flat.   In the influ-
ence area, there exists several villages with total population of 26,000.
There are two medical centers and two secondary schools but no hospital along
the proposed route.
The proposed route, upon completion, will form an important part of road
network to connect two artery highways, Route 23 and 219 through some section
of Route 2301 and also play vital role to connect King Amphoe Puai Noi with
artery highway.
Existing road section at around 20 km post often suffers from flood from
a tributary of the Chi river.   In order to avoid damages due to the flood,
this section was planned with new alignment for about 3.0 km in length.

1.2 Condition of Existing Road

Condition of existing road to be utilized for the proposed route is sum-
marized in Table 3.1.1.
The details are shown as the results of inventory survey in Table 3.1.2.

2. TRAFFIC

2.1 Method

Growth Rate Method was employed for traffic forecasting as no diverted
traffic is expected after improvement of the subject road.

2.2 Base Year Traffic

The base year traffic by road link by vehicle type was estimated referring
to the DOHs traffic records and manual clasified counts as shown below:
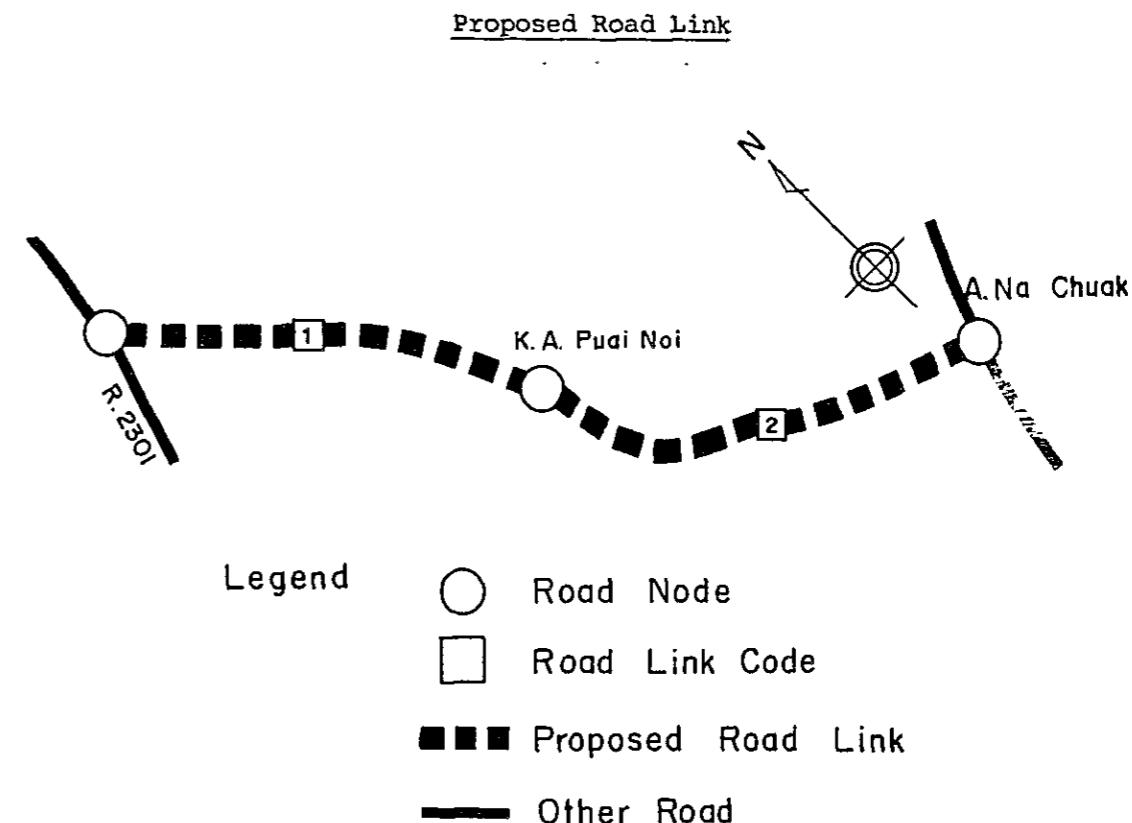
Proposed Road Link

Legend   ○ Road Node
          □ Road Link Code
          ■■■ Proposed Road Link
          ━━ Other Road

Source (base year)	Link No.	Vehicle Type									
		P/C	P/P	L/B	M/B	H/B	P/T	4/T	6/T	10/T	ADT
DOH (1981)	1 /1	44	62	34	41	7	10	32	16	11	259
	2	N.A.									
Manual Counts (1982)	1	-	21	7	38	-	2	28	16	-	112
	2	-	16	-	19	-	2	10	-	1	48

Note: /1   Route 2297, Section 0100, Station Km 1 + 175

2.3 Transport Movement

Passenger movement in terms of trips per day and freight movement in terms of tonnage per day on the proposed road links were estimated multiplying traffic volume in base year by the occupancy or average load obtained from roadside interview, as shown below:

PASSENGER MOVEMENT (1982)

PROPOSED ROAD LINK	TRIPS PER DAY
1	1509
2	452

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	38	74	112
2	6	11	17

2.4 Future Growth of Transport Movement

The growth rates of passenger and freight movement for the periods of 1981 - 1987, 1987 - 1993 and 1993 - 2001 were predicted by the formula described in 7.3.3-2) of the Main Report. The basis for the prediction is shown in the following tables:

GROWTH RATE OF PASSENGER MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
PER CAPITA INCOME	4.2	4.5	4.7
TRANS. PRICE INCREASE	4.5	4.5	4.5
POPULATION	1.5	1.2	1.1
PASSENGER MOVEMENT	5.5	5.6	5.7

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
NON-AGRI.	7.1	7.2	7.3
AGRICULTURE	1.2	0.9	0.1
FREIGHT	3.2	3.0	2.6

2.5 Induced and Developed Traffic

The following ratios are used for the estimation of induced and developed traffic described in 7.3.3-3) of the Main Report:

RATE OF INDUCED AND DEVELOPED TRAFFIC

(%)

ITEM	YEAR		
	1987	1993	2001
INDUCED	15.0	15.0	15.0
DEVELOPED	0.0	0.0	0.0

2.6 Future Traffic

1) Traffic Composition

The movements of passenger and freight transport were transformed into traffic volume by vehicle type applying future traffic composition as shown in the following table:

TRAFFIC COMPOSITION

(UNIT : %)

LINK NO.	YEAR	PASSENGER					FREIGHT			
		P/C	P/P	L/B	M/B	H/B	P/T	4/T	6/T	10/T
1	1982	17.1	32.6	16.3	31.0	3.1	10.3	51.7	27.6	10.3
	1987	15.8	33.8	16.8	28.7	4.9	12.1	42.3	29.5	16.0
	1993	14.4	35.3	17.4	26.0	7.0	14.2	31.0	31.9	22.9
	2001	12.4	37.2	18.2	22.4	9.8	17.0	16.0	35.0	32.0
2	1982	0.0	45.7	0.0	54.3	0.0	15.4	76.9	0.0	7.7
	1987	3.0	42.7	5.2	46.3	2.8	15.8	60.9	9.2	14.1
	1993	6.6	39.1	11.3	36.8	6.1	16.3	41.7	20.3	21.8
	2001	11.4	34.3	19.6	24.1	10.6	17.0	16.0	35.0	32.0

2) Forecasted ADT

The average of the forecasted traffic on proposed road links is shown in the following table and details by road link by traffic type are shown in Table 3.2.1.

AVERAGE FUTURE TRAFFIC ON PROPOSED ROUTE

YEAR	TYPE OF VEHICLE								ADT	M/C	TOTAL
	P/C	L/B	M/B	H/B	P/P&T	4/T	6/T	10/T			
1987	15	16	38	5	46	16	9	6	150	198	348
1993	19	25	45	10	61	11	10	8	188	229	417
2001	28	43	53	23	91	5	11	10	266	279	544

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

Around 85% of cultivated land in the influence area is covered by paddy fields, and there is no unused cultivable land for paddy. In the upland fields, cassava ranks first followed by kenaf and sugar cane.

Land use and capability conditions in the area of influence are shown in Table 3.3.1. and Figure 3.3.1.

Typical cropping calendars in the Khon Kaen and Maha Sarakham areas are shown in Figure 3.3.2.

3.2. Development Projection

Future agricultural development in the area of influence was projected for both cases of without project and with project. The projected planted area, unit yields by crop, and the consequent production volumes are shown in Table 3.3.2.

Farmgate prices and production costs of the selected crops are estimated as follows, referring to the Changwat data and field survey information as shown in Table 3.3.3.

Based on the above projected production volume, farmgate prices, production costs and land preparation cost estimated separately, net production value (NPV) was obtained as shown in Table 3.3.4. The difference between NPV of with project case and NPV of without project case is deemed to be the development benefit of the subject road.

4. VOC SAVINGS

In accordance with the concept and basic data given in Chapter 7 of Vol. 1
Main Report, VOC's on each road link concerned were calculated in both
cases of with project and without project.

Elements of road condition, which affect the calculation of additional
costs of VOC of each link, are shown below.

Road Condition

Link No.	Terrain	Without Project				With Project					
		Length (km)	Road/1 class	Nos. of wooden Bridge	Nos. of Narrow C.Bridge	Length (km)	Road Class/1 case 1	case 2	case 3	case 4	Nos. of Wooden Narrow Bridge
1	Rolling	14.0	2B	0	0	14.0	1	1	1	2A	0
2	Flat & Rolling	20.1	3	1	1	16.0	(F4)	2A	–	(F5)	0

/1 Road 1 : Paved Road

Road 2A : Laterite Road with good surface condition and alignment

Road 2B : Laterite Road with good surface condition but poor alignment

Road 3 : Laterite Road with poor surface condition and alignment

Road 4 : Earth Road

VOC savings, obtained from the difference of total link VOCs in the cases
of with project and those of without project case, were calculated as
follows.

Vehicle Operating Cost Saving

(unit: 1,000 Baht)

Road Class	1987	1993	2001
1 (F4)	3,065	4,449	7,015
1+2A (F4+F5)	2,701	4,005	6,424
1 (F4: only Link 1)	1,421	2,133	3,413
2A (F5)	1,636	2,667	4,561

5. ENGINEERING

5.1 Preliminary Design

Preliminary design was carried out based on the following design criteria.

Design Standard	:	F4 (if not feasible, F5)
Geometric Design	:	AASHTO (Rural Highways)
Typical Cross Section	:	as shown in Figure 3.5.1.
Minimum Height of Embankment		
Ordinary Section	:	1.0m
Approach of Bridge in Flat Area	:	2.0m
Flood Section	:	0.7m (above flood level)
Pavement Structure		
In case of F4 Standard		
DBST	:	2.5cm
Crushed Stone Base CBR$\geq$80%	:	15.0cm
Soil Aggregate Subbase CBR$\geq$20%	:	15.0cm
Selected Material CBR$\geq$ 6%	:	20.0cm

In case of F5 Standard

    Soil Aggregate Surface CBR$\geq$20%   : 15.0cm

    Selected Material   CBR$\geq$ 6% : 20.0cm

Pipe Culvert

    Standard Size   : ϕ 100cm

    Standard Interval

          Paddy Area   :   200 m

          Others   :   500 m

Box Culvert

    Standard Size   : 2.4m x 2.4m

    Location   : as required

Bridge

    Standard Type (width 7.0m)

          Short Span Bridge   : RC – Slab

          Long Span Bridge   : PC – Girder

          Location   : as shown in Bridge List in Figure 3.5.2.

Alignment of the route is shown in Figure 3.5.2.

5.2 Work Quantity and Construction Cost

Work quantities based on the preliminary design and construction cost together with unit rate by work item are shown in Table 3.5.1.

Total financial and economic construction costs by applied road class are as given below:

Financial and Economic Construction Cost

Road Class	Length (km)	Construction Cost (10^3 B)		Remark
		Financial Cost	Economic Cost	
F4 (DBST)	30.6	57,753	52,366	
F5 (Soil Aggregate)	30.6	32,127	29,060	
F4 + F5	30.6	49,995	45,174	Adopted to link $\geq$ 300 in ADT
F4	14.0	28,848	26,000	Adopted to link $\leq$ 300 in ADT
F5	16.6	21,147	19,174	

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits, and the calculated economic indicators for evaluation are given in Table 3.6.1, 3.6.2, 3.6.3 and 3.6.4. The result indicates that the proposed project seems to be not feasible under F4 Standard but feasible in case of F5 Standard.

7. SOCIAL IMPACTS

Detailed data and results of quantification of indicators of social impacts are tabulated in Table 3.7.1.

Table 3.1.1 SUMMARY OF ROAD INVENTORY

Item	Description		
Origin	J.R. 2301		
Destination	A. Na Chuak		
Length		.	
Total			30.6 km
Improvement Section			27.6 km
.DOH Road	R. 2297		15.0 km
ARD Road			3.0 km
Others			0 km
New Alignment Section			3.0 km
Terrain	Flat and Rolling		
Alignment (Hori./Vert.)	Fair / Fair		
Formation Width	4.0 m - 8.0 m, 6.2 m (Weighted average)		
Embankment Section			
Length			30.6 km
Height	0.6 m - 2.5 m		
Cut Section			
Length			0 km
Depth	m - m		
Surface Type and Condition			
SBST or DBST			0 km
Soil Aggregate	Good - Poor		30.6 km
Earth			0 km
Pipe Culvert	42 each		
Box Culvert	2 each	14.7 m	
Bridge			
Permanent Bridge ·	1 each	22.5 m	
Narrow Concrete Bridge	1 each	7.7 m (4m)	
Wooden Bridge	1 each	22,5 m	
Overflow Section	1 place	3.0 km	

Table 3.1.2 ROAD INVENTORY

PROPOSED ROUTE NO. IM-3   ROUTE NO. 2297 ARD   (J.R. 2301) ∿ A. NA CHUAK (J.R. 219)   L = 30.6 Km.
KHON KAEN/MAHA SARAKHAM

STATION (Km)	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
VILLAGE – Name / Household (H) / Population (P)				B. DON NGOEN H=30 P=170		B. SOM POI NOI H=50 P=600	B. NON LUAM H=58 P=348	B. HUA KHUA H=120 P=960 / K.A. PUAI NOI				B. PO PHAN H=400 P=3200				A. NA CHUAK
TERRAIN	Rolling											Flat		Rolling		
CROSS SECTION – Formation Width (m)	8.00						9.00	8.00	6.00 / 4.00			4.50	4.80	5.20	6.00	
CROSS SECTION – Embankment Height (m)	1.20	0.70	1.80	1.00	0.70	1.20	1.70	2.50	0.60			0.20	0.80	0.40	1.00	
CROSS SECTION – Cutting Depth (m)																
PAVEMENT – Type/Length	Laterite											Laterite				
PAVEMENT – Condition	Good											Bad				
FLOODING – Overflow Length(Km)/Height(m)																
LAND USE – Left	Paddy											Paddy				
LAND USE – Right	Paddy											Paddy				
PIPE CULVERT – Total Number	42 Pipes															
BOX CULVERT & BRIDGE – Station (Km)	1.2						11.8		18.0						28.8 / 30.1	
BOX CULVERT & BRIDGE – Dimension	C-Box 1.70 x 4.50						C-Br. 8.20 x 22.50		W-Br. 4.80 x 26.00						C-Br. 4.00 x 7.70 / C-Box 1.50 x 0.75 x 10.20	
RIGHT OF WAY (m)								16.0					16.00			
ALIGNMENT – Horizontal	Fair											Fair				
ALIGNMENT – Vertical	Fair											Fair				
ROUTE NO., AGENCIES	DOH 2297							ARD					ARD			

Table 3.2.1 <u>TRAFFIC VOLUME ON ROUTE IM - 3</u>

YEAR		1987			1993			2001		
LINK		1	2	AVR.	1	2	AVR.	1	2	AVR.
P/C	N+D	26	1	13	32	4	17	41	11	25
	I	4	0	2	5	1	3	6	2	4
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	30	2	15	37	5	19	47	12	28
L/B	N+D	28	2	14	39	7	21	60	18	38
	I	4	0	2	6	1	3	9	3	6
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	32	3	16	44	8	25	70	21	43
M/B	N+D	47	21	33	58	23	39	74	23	46
	I	7	3	5	9	3	6	11	3	7
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	54	24	38	66	26	45	86	26	53
H/B	N+D	8	1	4	15	4	9	33	10	20
	I	1	0	1	2	1	1	5	1	3
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	9	1	5	18	4	10	37	11	23
P/P&T	N+D	62	21	40	86	26	53	132	34	79
	I	9	3	6	13	4	8	20	5	12
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	72	24	46	98	29	61	152	39	91
4/T	N+D	23	6	14	16	4	9	8	1	4
	I	3	1	2	2	1	1	1	0	1
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	27	7	16	19	4	11	9	1	5
6/T	N+D	16	1	8	17	2	9	18	3	10
	I	2	0	1	3	0	1	3	0	1
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	19	1	9	19	2	10	21	3	11
10/T	N+D	9	1	5	12	2	7	16	3	9
	I	1	0	1	2	0	1	2	0	1
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	10	2	6	14	2	8	19	3	10
ADT	N+D	219	56	130	274	71	164	384	102	231
	I	33	8	20	41	11	25	58	15	35
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	252	64	150	315	81	188	441	118	266
M/C	N+D	270	107	181	308	127	210	368	165	258
	I	23	12	17	25	14	19	25	17	21
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	294	118	198	333	141	229	393	182	279
TOTAL	N+D	489	162	312	583	198	374	752	267	489
	I	56	20	37	66	24	43	83	32	55
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	546	182	348	649	222	417	835	300	544

NOTE
N : NORMAL TRAFFIC   D : DIVERTED TRAFFIC
DV : DEVELOPED TRAFFIC   I : INDUCED TRAFFIC

Figure 3.3.1 **LAND USE AND CAPABILITY OF INFLUENCE AREA**
PROPOSED ROUTE NO. IM — 3

LEGEND

(pattern)	CULTIVATED LAND FOR PADDY
(pattern)	CULTIVATED LAND FOR UPLAND CRC
(pattern)	CULTIVABLE LAND FOR PADDY
(pattern)	CULTIVABLE LAND FOR UPLAND CRC
(blank)	UNCULTIVABLE LAND
(pattern)	PROPOSED ROUTE
(pattern)	INFLUENCE AREA OF PROPOSED ROUTE

SCALE

0 .5 1 2 3 Km

Figure 3.3.2 **CROPPING CALENDAR (1)**

0600 CHANGWAT ___ KHON KAEN ___
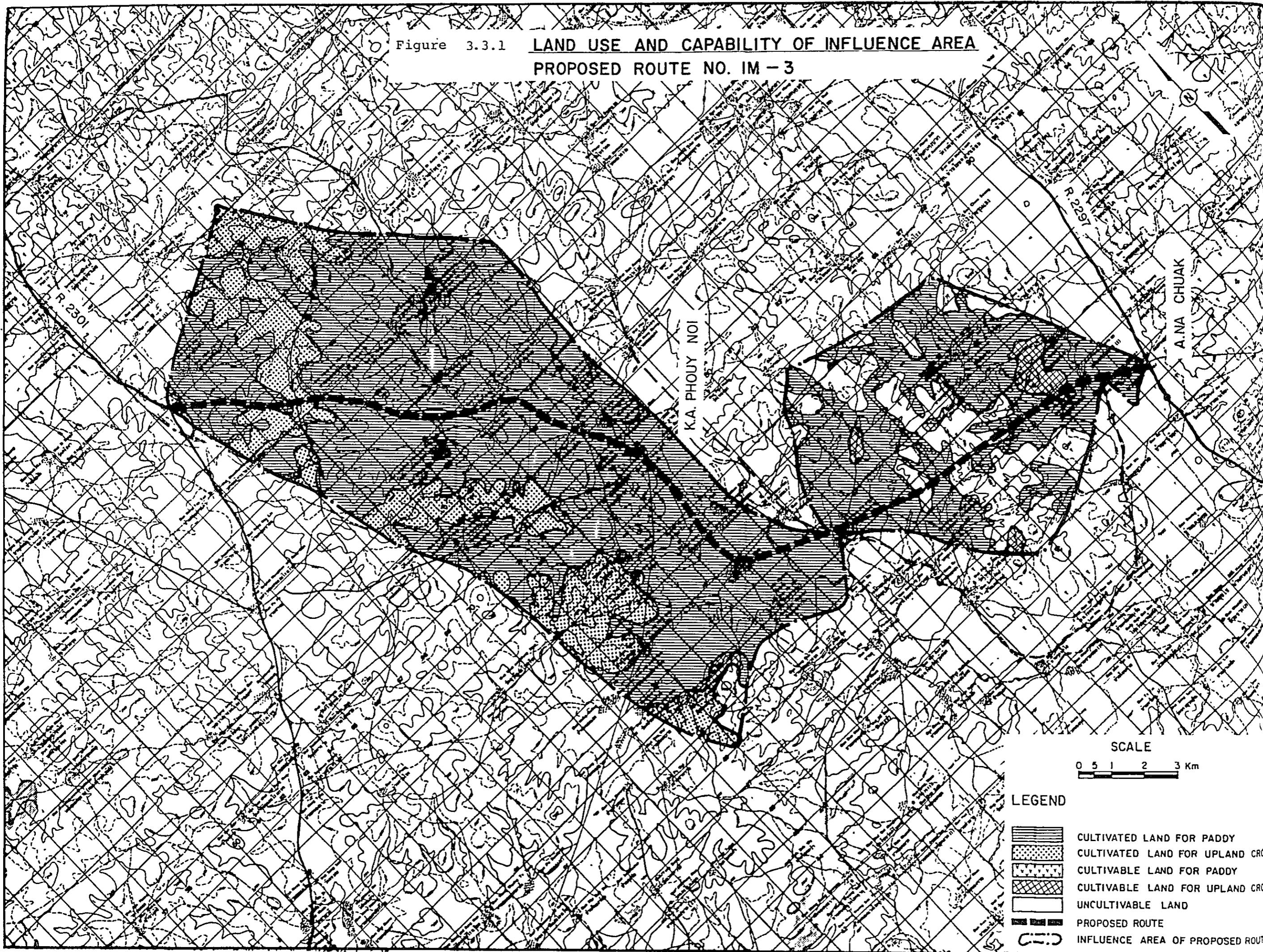
NAME OF CROP	JAN.	FEB.	MAR.	APR	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
RICE, 1st CROP						⊖———⊕———⊕———×———×						
RICE, 2nd CROP	⊖——⊕————×——×											
SUGAR CANE								⊖————⊕				
TOBACCO (TURKISH & LOCAL)				⊕———×————× ※⊕ ※⊕ ⊖—×					⊖————⊕—⊕—			
GROUND NUT	⊖—⊕————×——×											
KENAF				⊖————⊕————————×——×								
CASSAVA				⊖———⊕————× ×								
MAIZE					⊖——⊕————×—×							
MUNG BEAN					⊖—⊖————×—×							
SOY BEAN				⊖—⊕———×—×								

CROPPING CALENDAR (2)

0700 CHANGWAT ___ MAHA SARAKHAM ___

| NAME OF CROP	JAN.	FEB.	MAR	APR.	MAY.	JUN.	JUL	AUG	SEP.	OCT.	NOV	DEC
RICE, 1st CROP					⊖———⊕———⊕———×—×							
2nd CROP	⊖—⊕————×—×											
TOBACCO (TURKISH & LOCAL)										⊖——————⊕—⊕—		
	⊖——×————×											
KENAF		⊖————⊕————————×——×										
CASSAVA		⊖———————⊕————×										
GROUND NUT { MORE IN DRY SEASON { LESS IN RAIN	⊖—⊕————×—×					⊖—⊖————×—×						
SUGAR CANE									⊖————⊕			
						×————×						
						×						
						×						
			⊖————×									

TABLE 3.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM^2)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		100.000 (160.0)	18.750 (30.0)	118.750 (190.0)	–	2.188 (3.5)	2.188 (3.5)
0613	BAN PHAI	12.500 (20.0)	8.125 (13.0)	20.625 (33.0)	–	–	–
0618	NONG SONG HONG	5.625 (9.0)	3.750 (6.0)	9.375 (15.0)	–	0.438 (0.7)	0.438 (0.7)
0619	PHOUY NOI	51.250 (82.0)	6.875 (11.0)	58.125 (93.0)	–	–	–
0705	BORABU	8.125 (13.0)	–	8.125 (13.0)	–	–	–
0707	NA CHUAK	22.500 (36.0)	–	22.500 (36.0)	–	1.750 (2.8)	1.750 (2.8)

TABLE 3.3.2 CROP PRODUCTION

ITEM		PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)											
1981		93.89	–	–	–	15.67	0.19	3.01	–	18.97	112.86
1987		93.89	–	–	–	17.65	0.19	3.01	–	20.95	114.84
1993	WITHOUT PROJECT	93.89	–	–	–	19.29	0.19	2.92	–	22.50	116.39
	WITH PROJECT	93.89	–	–	–	19.43	0.20	2.78	–	22.50	116.39
2001	WITHOUT PROJECT	93.89	–	–	–	19.70	0.17	2.55	–	22.50	116.39
	WITH PROJECT	93.89	–	–	–	19.83	0.18	2.42	–	22.50	116.39
CROP YIELD (KG/RAI)											
1981		228.8	–	–	–	1992.2	7256.1	165.3	–		
1987		228.8	–	–	–	1992.2	7299.8	165.3	–		
1993	WITHOUT PROJECT	228.8	–	–	–	1992.2	7343.7	165.3	–		
	WITH PROJECT	231.6	–	–	–	2004.2	7387.8	165.3	–		
2001	WITHOUT PROJECT	228.8	–	–	–	1992.2	7402.6	165.3	–		
	WITH PROJECT	235.3	–	–	–	2020.3	7506.8	165.3	–		
CROP PRODUCTION (TON)											
1981		21,483	–	–	–	31,224	1,382	498	–	33,116	54,599
1987		21,483	–	–	–	35,163	1,415	498	–	37,088	58,571
1993	WITHOUT PROJECT	21,483	–	–	–	38,437	1,407	483	–	40,340	61,823
	WITH PROJECT	21,742	–	–	–	38,951	1,488	459	–	40,909	62,651
2001	WITHOUT PROJECT	21,483	–	–	–	39,250	1,266	421	–	40,947	62,430
	WITH PROJECT	22,092	–	–	–	40,055	1,348	400	–	41,813	63,905

NOTE : SYMBOL "–" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 3.3.3   FARMGATE PRICE AND PRODUCTION COST

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,605	-	-	-	608	652	4,621	-
WITH PROJECT (1987 - 2001)	3,695	-	-	-	623	652	4,737	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	553	-	-	-	724	2,879	685	-
WITH PROJECT (1987 - 2001)	564	-	-	-	752	2,920	685	-

TABLE 3.3.4   NET PRODUCTION VALUE

(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	25,525	9,214	34,739	26,431	9,288	35,719
1993	25,525	10,009	35,534	27,389	10,307	37,696
2001	25,525	10,145	35,670	28,683	10,637	39,320

Figure 3.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE

FILL SECTION

CUT SECTION

DOUBLE BITUMINOUS SURFACE TREATMENT (DBST) ROAD (Class F4)

SOIL AGGREGATE SURFACED ROAD (Class F5)
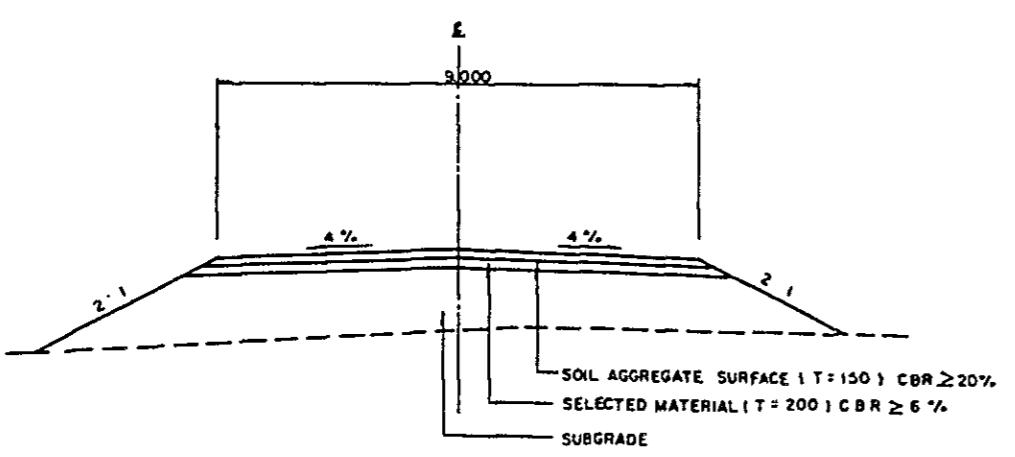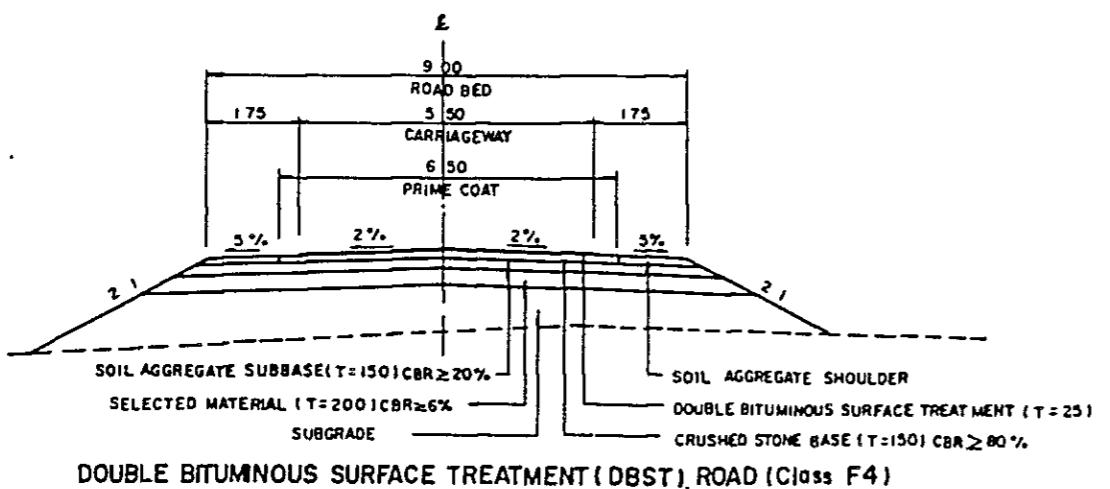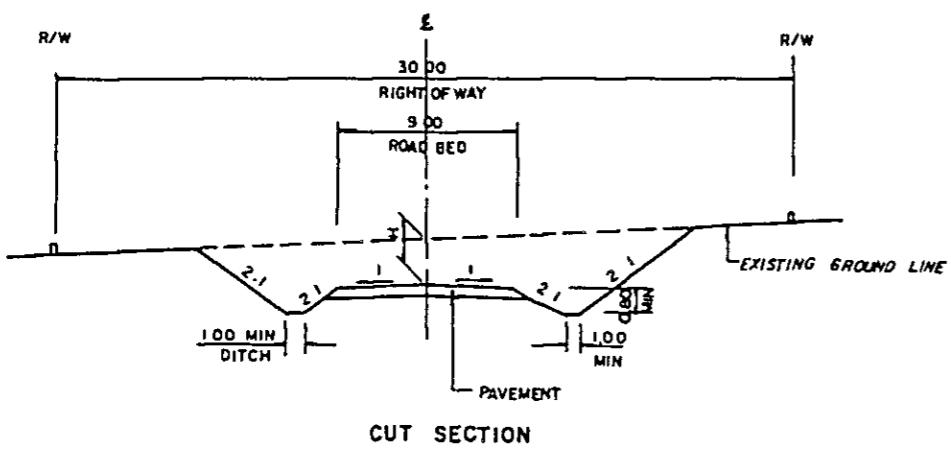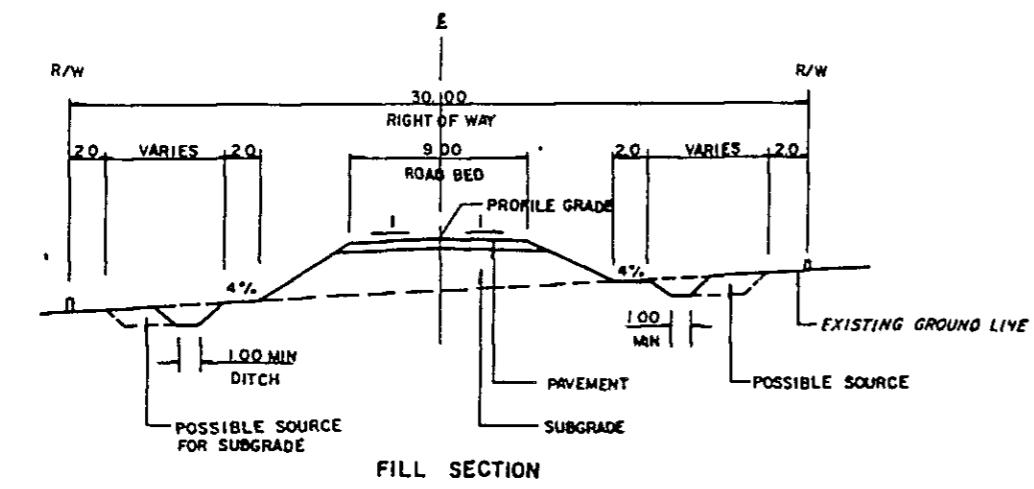
Figure 3.5.2 **PROPOSED ROUTE NO. IM-3**

C. KHON KAEN
C. MAHA. SARAKHAM

J.R. 2301 – A. NA CHUAK (J.R. 219)
ROUTE NO. 2297 + ARD   L = 30.6 Km.

LOCATION MAP

Length – 30.6 Km.

Route 2297 – 15.0 Km. ARD – 3.0 Km.   ARD – 9.6 Km.
Laterite – (8.0 – 9.0 m.)   (4.0 – 3.0 m.)   Laterite – (4.5 – 6.0 m.)

Improvement – 18.0 Km.   New Const 3.0 Km.   Improvement – 9.6 Km.
Rolling – 18.0 Km.   Flat 3.0 Km.   Rolling – 9.6 Km.
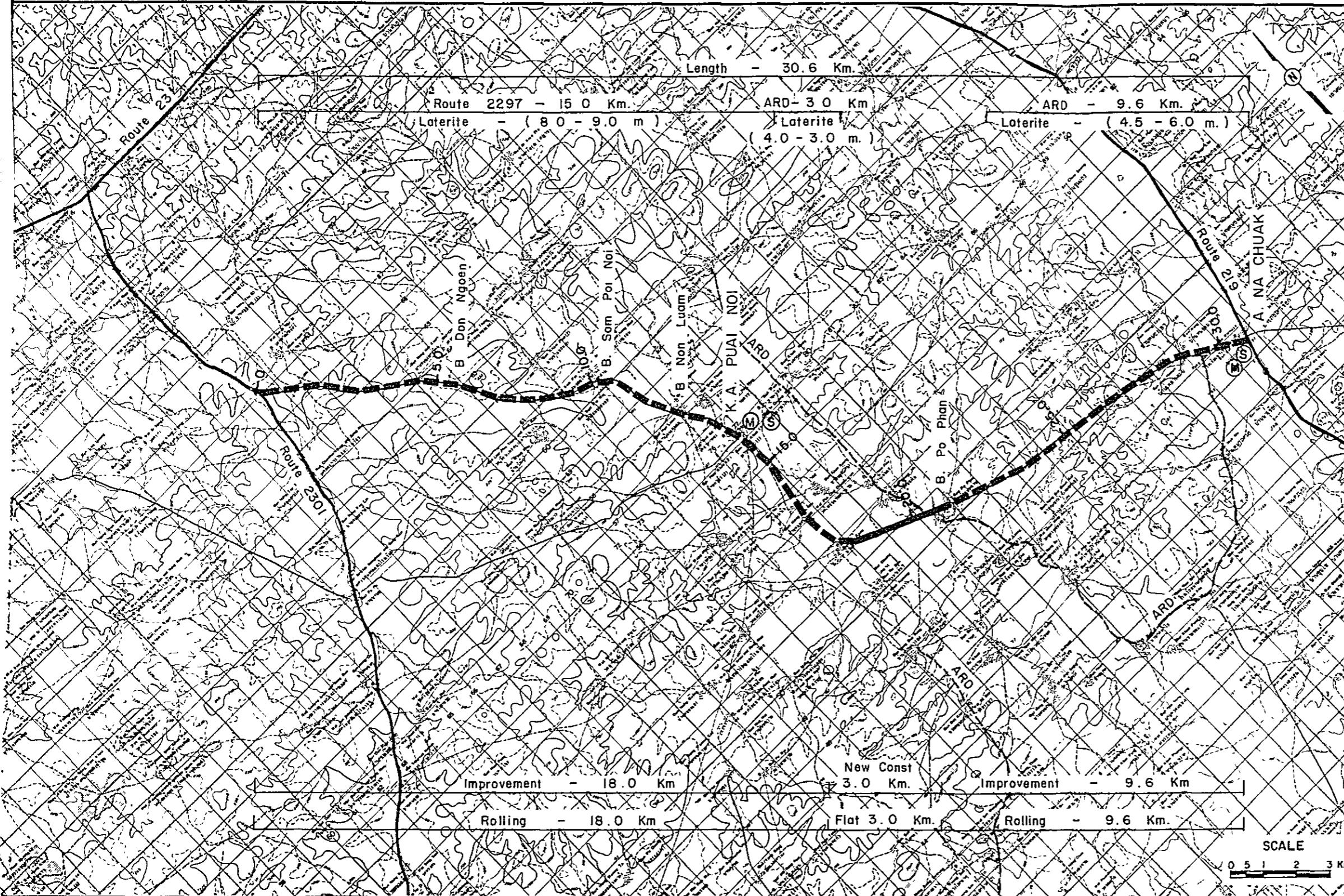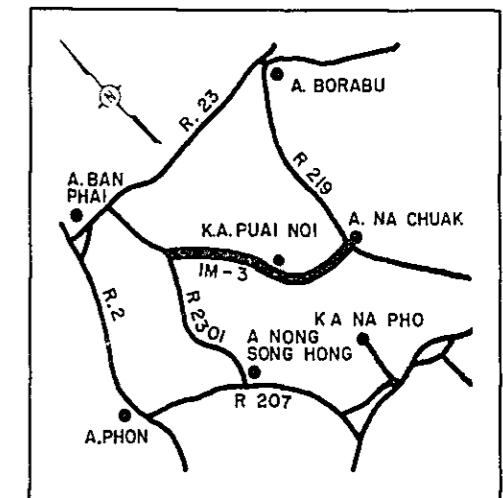
BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	11.8	–	C – 6 20 x 22 50
2	18.0	C-7 00 x 28 00	W – 4 80 x 26 00
3	19.5	C-7 00 x 30 00	–
4	28.8	C-7 00 x 7 70	C – 4 00 x 7 70

SCALE
0 5 1 2 3 Km.

LEGEND

	PROPOSED ROUTE (IMPROVEMENT)
	PROPOSED ROUTE (NEW CONSTRUCTION)
	PAVED ROUTE
	UNPAVED ROUTE
	INVENTORY SURVEY ROUTE
(H)	HOSPITAL
(M)	MEDICAL CENTER
(S)	SECONDARY SCHOOL

Table 3.5.1   CONSTRUCTION QUANTITIES AND COSTS   IM-3 (35.3 km) (1)

Items	Unit of Q'ty	Financial Unit Rate ฿	(DBST)			(Soil Aggregate Surface)		
			Q'ty	Financial Cost (10³฿)	Economic Cost (10³฿)	Q'ty	Financial Cost (10³฿)	Economic Cost (10³฿)
DIRECT CONSTRUCTION COST								
Clearing and Grubbing	ha	15,000	82	1,230	1,119	82	1,230	1,119
Excavation - Soil	m³	20	0	0	0	0	0	0
Excavation - Hard Rock	m³	160	0	0	0	0	0	·0
Embankment	m³	45	86,300	3,883	3,533	86,300	3,883	3,533
Selected Material	m³	80	64,900	5,192	4,620	64,900	5,192	4,620
Soil Aggregate Surface or Subbase	m³	105	45,400	4,767	4,242	45,400	4,767	4,242
Crushed Stone Base	m³	370	29,800	11,026	10,143	3,400	1,258	˙1,157
Soil Aggregate Shoulder	m³	105	12,900	· 1,354	1,205	1,500	157	140
Prime Coat and DBST	m²	55	168,300	9,257	8,331	19,300	1,062	956
Pipe Culvert	m	2,100	1,280	2,688	2,472	1,280	2,688	2,472
Box Culvert	m	16,000	6	96	86	6	96	86
Long Span Bridge	m	80,000	0	0	0	0	0	0
Short Span Bridge	m	40,000	66	2,640	2,340	66	2,640	2,349
Sub Total (a)				42,134	38,106		22,974	20,680
Miscellaneous Works (a) x 7%				2,949	2,667		1,608	1,448
Total (b)				45,083	40,773		24,582	22,128
PHYSICAL CONTENGENCY (b) x 15%				6,762	6,116		3,687	3,319
ENGINEERING AND								
ADMINISTRATION (b) x 10%				4,508	4,077		2,458	2,213
Sub Total				11,270	10,193		6,145	5,532
LAND ACQUISITION								
Highly Developed Land	ha	50,000	28	1,400	1,400	28	1,400	1,400
Less Developed Land	ha	15,000	0	0	0	0	0	0
Sub Total				1,400	1,400		1,400	1,400
GRAND TOTAL				57,753	52,366		32,127	29,060

CONSTRUCTION QUANTITIES AND COSTS (DBST + Soil Aggregate Surface) (2)

Items	Unit of Q'ty	Financial Unit Rate ฿	Proposed Route Number								
			IM-3 (1-2) (14.0 km) 1/			IM-3 (1-2) (16.6 km) 2/			IM-3 (T) (30.6 km) 3/		
			Q'ty	Financial Cost (10³฿)	Economic Cost (10³฿)	Q'ty	Financial Cost (10³฿)	Economic Cost (10³฿)	Q'ty	Financial Cost (10³฿)	Economic Cost(10³฿)
DIRECT CONSTRUCTION COST											
Clearing and Grubbing	ha	15,000	31	465	423	51	765	696	82	1,230	1,119
Excavation - Soil	m³	20	0	0	0	0	0	0	0	0	0
Excavation - Hard Rock	m³	160	0	0	0	0	0	0	0	0	0
Embankment	m³	45	3,600	162	147	82,700	3,721	3,386	86,300	3,883	3,533
Selected Material	m³	80	29,700	2,376	2,114	35,200	2,816	2,506	64,900	5,192	4,620
Soil Aggregate Surface or Subbase	m³	105	70,800	7,434	6,616	24,100	2,530	2,252	94,900	9,964	8,868
Crushed Stone Base	m³	370	13,700	5,069	4,663	1,000	370	340	14,700	5,439	5,003
Soil Aggregate Shoulder	m³	105	5,900	619	551	400	42	37	6,300	661	588
Prime Coat and DBST	m²	55	77,000	4,235	3,812	5,500	303	272	82,500	4,538	4,084
Pipe Culvert	m	2,100	560	1,176	1,081	720	1,512	1,391	1,280	2,688	2,472
Box Culvert	m	16,000	2	32	28	4	64	57	6	96	86
Long Span Bridge	m	80,000	0	0	0	0	0	9	0	0	0
Short Span Bridge	m	40,000	0	0	0	66	2,640	2,349	66	2,640	2,349
Sub Total (a)				21,568	19,439		14,764	13,289		36,333	32,728
Miscellaneous Works (a) x 7%				1,510	1,361		1,033	930		2,543	2,291
Total (b)				23,078	20,800		15,797	14,219		38,876	35,019
PHYSICAL CONTENGENCY (b) x 15%				3,462	3,120		2,370	2,133		5,831	5,253
ENGINEERING AND ADMINISTRATION (b) x 10%				2,308	2,080		1,580	1,422	3,888	3,888	3,502
Sub Total				5,763	5,200		3,950	3,555		9,719	8,755
LAND ACQUISITION											
Highly Developed Land	ha	50,000	0	0	0	28	1,400	1,400	28	1,400	1,400
Less Developed Land	ha	15,000	0	0	0	0	0	0	0	0	0
Sub Total				0	0		1,400	1,400		1,400	1,400
GRAND TOTAL				28,848	26,000		21,147	19,174		49,995	45,174

Note: 1/ = DBST Link

2/ = Soil Aggregate Surface Link

3/ = Total Link

Table 3.6.1 COST AND BENEFITS

(F4 STANDARD)

(1000 BAHT)

YEAR	COST CONST. COST	BENEFITS AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	DISCOUNTED(12%) COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	20,946	0	0	0	0	26,275	0
1986	31,420	0	0	0	0	35,190	0
1987	0	980	3,065	-78	3,967	0	3,542
1988	0	1,177	3,296	-70	4,403	0	3,510
1989	0	1,374	3,527	-62	4,838	0	3,444
1990	0	1,571	3,757	-54	5,274	0	3,352
1991	0	1,768	3,988	-46	5,709	0	3,240
1992	0	1,965	4,219	-38	6,145	0	3,113
1993	0	2,162	4,449	-31	6,581	0	2,977
1994	14,810	2,348	4,770	-19	7,099	6,699	2,867
1995	0	2,534	5,091	-8	7,617	0	2,747
1996	0	2,720	5,411	3	8,135	0	2,619
1997	0	2,906	5,732	14	8,652	0	2,487
1998	0	3,092	6,053	26	9,170	0	2,354
1999	0	3,278	6,374	37	9,688	0	2,220
2000	0	3,464	6,694	48	10,206	0	2,088
2001	-24,844	3,650	7,015	59	10,724	-4,539	1,959
TOTAL	42,332	34,989	73,441	-222	108,208	63,625	42,519

DISCOUNTED ECONOMIC COSTS :   63,625

DISCOUNTED ECONOMIC BENEFITS :   42,519

AGRICULTURAL DEVELOPMENT BENEFIT 13,260
VOC SAVING   29,493
RMC SAVING   -235

NET PRESENT VALUE :   -21,107

BENEFIT COST RATIO :   0.67

INTERNAL RATE OF RETURN :   7.4 %

Table 3.6.2 COST AND BENEFITS

(F4&F5 COMBINED)

(1000 BAHT)

YEAR	COST CONST. COST	BENEFITS AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	DISCOUNTED(12%) COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	18,069	0	0	0	0	22,666	0
1986	27,105	0	0	0	0	30,358	0
1987	0	980	2,701	2	3,683	0	3,288
1988	0	1,177	2,918	9	4,105	0	3,272
1989	0	1,374	3,136	16	4,526	0	3,222
1990	0	1,571	3,353	24	4,948	0	3,144
1991	0	1,768	3,570	31	5,369	0	3,047
1992	0	1,965	3,788	38	5,791	0	2,934
1993	0	2,162	4,005	45	6,212	0	2,810
1994	7,260	2,348	4,307	55	6,710	3,284	2,710
1995	0	2,534	4,610	65	7,209	0	2,599
1996	0	2,720	4,912	75	7,707	0	2,481
1997	0	2,906	5,215	85	8,205	0	2,359
1998	0	3,092	5,517	94	8,703	0	2,234
1999	0	3,278	5,819	104	9,202	0	2,109
2000	0	3,464	6,122	114	9,700	0	1,985
2001	-21,536	3,650	6,424	124	10,198	-3,935	1,863
TOTAL	30,898	34,989	66,397	880	102,266	52,373	40,057

DISCOUNTED ECONOMIC COSTS :   52,373

DISCOUNTED ECONOMIC BENEFITS :   40,057

AGRICULTURAL DEVELOPMENT BENEFIT 13,260
VOC SAVING   26,516
RMC SAVING   281

NET PRESENT VALUE :   -12,316

BENEFIT COST RATIO :   0.76

INTERNAL RATE OF RETURN :   9.0 %

Table 3.6.3 <u>COST AND BENEFITS</u>

(F4,SECTION 1)

(1000 BAHT)

YEAR	COST CONST. COST	BENEFITS AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	DISCOUNTED(12%) COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	10,400	0	0	0	0	13,046	0
1986	15,600	0	0	0	0	17,472	0
1987	0	780	1,421	-13	2,188	0	1,954
1988	0	937	1,540	-9	2,468	0	1,967
1989	0	1,093	1,658	-4	2,747	0	1,955
1990	0	1,250	1,777	0	3,027	0	1,924
1991	0	1,407	1,896	4	3,307	0	1,876
1992	0	1,563	2,014	9	3,586	0	1,817
1993	0	1,720	2,133	13	3,866	0	1,749
1994	6,776	1,868	2,293	19	4,180	3,065	1,688
1995	0	2,016	2,453	25	4,494	0	1,621
1996	0	2,164	2,613	31	4,808	0	1,548
1997	0	2,312	2,773	38	5,122	0	1,472
1998	0	2,459	2,933	44	5,436	0	1,395
1999	0	2,607	3,093	50	5,750	0	1,318
2000	0	2,755	3,253	56	6,064	0	1,241
2001	-11,960	2,903	3,413	62	6,378	-2,185	1,165
TOTAL	20,816	27,834	35,263	325	63,421	31,398	24,690

DISCOUNTED ECONOMIC COSTS :   31,398

DISCOUNTED ECONOMIC BENEFITS :   24,690

   AGRICULTURAL DEVELOPMENT BENEFIT   10,549
   VOC SAVING   14,067
   RMC SAVING   74

NET PRESENT VALUE :   -6,707

BENEFIT COST RATIO :   0.79

INTERNAL RATE OF RETURN :   9.2 %

Table 3.6.4 <u>COST AND BENEFITS</u>

(F5 STANDARD)

(1000 BAHT)

YEAR	COST CONST. COST	BENEFITS AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	DISCOUNTED(12%) COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	11,624	0	0	0	0	14,581	0
1986	17,436	0	0	0	0	19,528	0
1987	0	980	1,636	24	2,640	0	2,357
1988	0	1,177	1,808	28	3,013	0	2,402
1989	0	1,374	1,980	33	3,386	0	2,410
1990	0	1,571	2,152	37	3,760	0	2,389
1991	0	1,768	2,323	42	4,133	0	2,345
1992	0	1,965	2,495	46	4,506	0	2,283
1993	0	2,162	2,667	51	4,880	0	2,207
1994	1,694	2,348	2,904	57	5,308	766	2,144
1995	0	2,534	3,140	63	5,737	0	2,069
1996	0	2,720	3,377	69	6,166	0	1,985
1997	0	2,906	3,614	75	6,594	0	1,896
1998	0	3,092	3,850	81	7,023	0	1,803
1999	0	3,278	4,087	86	7,452	0	1,708
2000	0	3,464	4,324	92	7,880	0	1,612
2001	-14,124	3,650	4,561	98	8,309	-2,580	1,518
TOTAL	16,630	34,989	44,918	881	80,787	32,295	31,129

DISCOUNTED ECONOMIC COSTS :   32,295

DISCOUNTED ECONOMIC BENEFITS :   31,129

   AGRICULTURAL DEVELOPMENT BENEFIT   13,260
   VOC SAVING   17,542
   RMC SAVING   327

NET PRESENT VALUE :   -1,166

BENEFIT COST RATIO :   0.96

INTERNAL RATE OF RETURN :   11.6 %

Table 3.7.1 SOCIAL INDICATORS

(Proposed Route IM-3)

Population (1,000)			
1982	: 26.0		
1993	: 30.0		
Average travelling speed, without (kph)	: 43		

Isolation

Access to Amphoe

Average distance to Amphoe (km)$\underline{1}$/	: 5.9 (6.3)
Per capita time savings (10^{-4})	: 0.022
Score	: 65

Access to Artery Highway

Average distance to highway (km)$\underline{1}$/	: 14 (14)
Per capita time savings (10^{-4})	: 0.044
Score	: 96

Impassability

Impassable week a year	: 2
Impassability per year	: 0.038
Impassability per capita (10^{-4})	: 0.013
Score	: 108

Health

Access to Hospital

Average distance to Hospital (km)$\underline{1}$/	: 15.5 (17.0)
Per capita time savings (10^{-4})	: 0.060
Score	: 140

Access to Medical Facilities

Average distance to facilities (km)$\underline{1}$/	: 5.5 (5.8)
Per capita time savings (10^{-4})	: 0.019
Score	: 76

Education

Access to Secondary School

Number of Student in 1993 (1,000)$\underline{2}$/	: 5.7
Average distance to school (km)	: 5.5 (5.8)
Per capita time savings (10^{-4})	: 0.103
Score	: 56

Teacher Intensity

Number of teachers$\underline{3}$/	
University graduate	: 3
Total	: 18
Number of Student	: 195
Indicators	
E1 $\underline{4}$/	: 15.4
E2 $\underline{5}$/	: (51.0)
E $\underline{6}$/	: 66.4
Degree of Improvement$\underline{7}$/	: 1.03
Score	: 66

Disparity

G.P.V. in 1993 (Mn B)$\underline{8}$/

With project	: 107.8
Without project	: 104.1

Per capita G.P.V. in 1993 (B)

With project (W)	: 3,593
Without project (w)	: 3,470

Degree of Disparity

(A/W) – (A/w)$\underline{9}$/	: 0
Score	: 0

Total Score	: 608

Note:

$\underline{1}$/ ( ) shows the length or distance in without project case. Unless otherwise, lengthes are same both in with project case and without project case.

$\underline{2}$/ Number of secondary school student estimated based on the projected population of the areas of influence applying ratios of secondary school students to the total population in the sample area.

$\underline{3}$/ Numbers of the sample areas

$\underline{4}$/ (Number of University Graduate Teachers)/(Total Number of Student) x 1,000

$\underline{5}$/ (Total of Teachers)/(Total Number of Student) x 1,000

$\underline{6}$/ Sum of $\underline{4}$/ and $\underline{5}$/

$\underline{7}$/ Ratio of E value of each route to an average value of the same indicator E in case of the sample areas, 33 in number, along paved road near the proposed routes.
The average value of E in case of paved roads were calculated at 68.4 from the following data:
Number of university graduate teachers 438
Number of Teachers 1,285
Number of student 25,196

$\underline{8}$/ Estimated gross value of crop production in the areas of influence

$\underline{9}$/ "A" indicates an average per capita value of crop production in the Northeastern Region, which is estimated assuming that:
- GRP per capita of the Northeast is estimated at 11,897 Baht in 1993,
- Agricultural sector shares 40% of GRP, and
- Crop production shares 80% of agricultural production.