

PROPOSED ROUTE NO. IM - 7

Changwat : Udon Thani

B. Khok Lat (J.R.2313) - B. Tha Yom (J.R.2316)

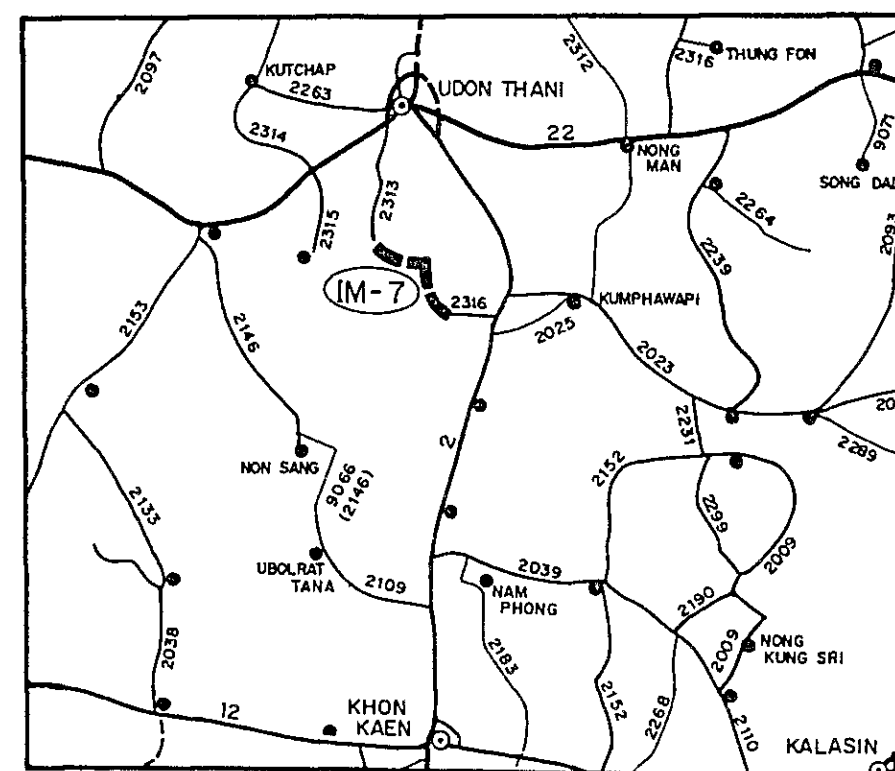
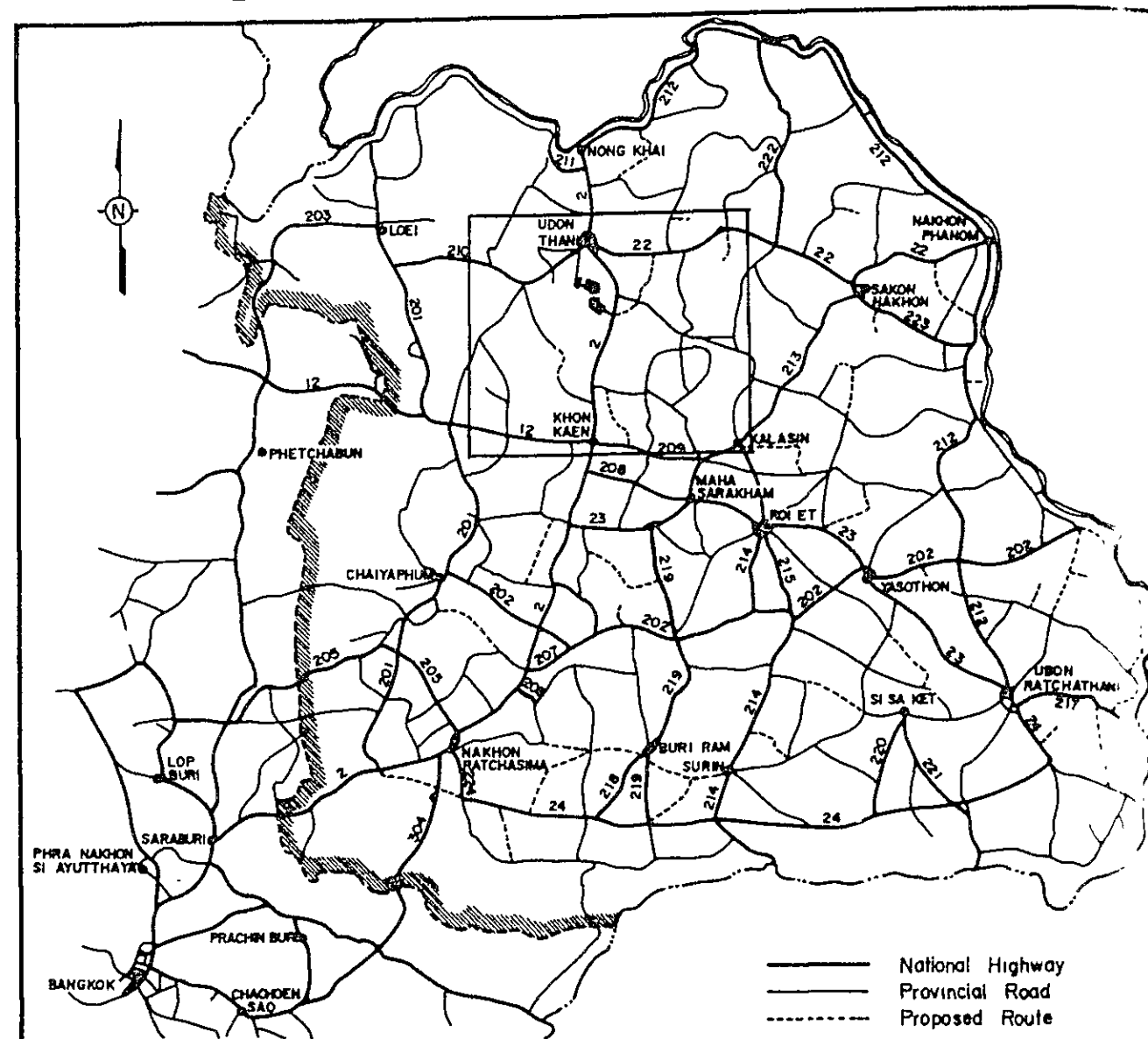
Length : 240 KM.

SUMMARY

PROPOSED ROUTE IM-7

Item	Description
Changwat	Udon Thani
Origin	B. Khok Lat (J.R.2313)
Destination	B. Tha Yom (J.R.2316)
Length	
Total	24.0 km
Improvement Section	24.0 km
DOH Road	0 km
ARD Road	24.0 km
Others	0 km
New Alignment Section	0 km
Surface Type and Condition	Soil Aggregate, Poor
Terrain	Flat and Rolling
Influence Area	
Area	127 km ²
Population (1982)	9900
Principal Crops	Paddy
Traffic (ADT)	
Existing	27
1993	543
2001	735
Proposed Standard	F4 (DBST)
Construction Cost	
Financial	45,751 . 10 ³ ฿
Economic	41,689 . 10 ³ ฿
IRR	8.1 %
B/C	0.70
Social Impact	High
Recommendation	For immediate implementation

LOCATION OF PROPOSED ROUTE



1. GENERAL

1.1 Characteristics of the Route

The proposed route is located in the south part of Changwat Udon Thani.

The route starting at Ban Khok Lat, the end point of Route 2313, runs southward passing through Ban Lup Wai, Ban Sam Lian and Ban Khum Wa Thong and ends at Ban Tha Yom, the termination of Route 2316. Its total length is 24.0 km (Figure 7.5.2).

The terrain is almost rolling. In the influence area, there exists several villages with total population 9,900. There is only one medical center.

The proposed route, upon completion, will form an important part of road network to connect two artery highways, Route 210 and 2 through the paved sections of Route 2313 and 2316.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route is summarized in Table 7.1.1. The details are shown as the results of inventory survey in Table 7.1.2.

2. TRAFFIC

2.1. Method

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

2.2 Zoning and Road Links

The related area of proposed route was divided into two traffic zones and two Amphoe of Muang Udon Thani and Kumphawapi were chosen as the major destinations of transport demand originated in the area. The proposed route together with surrounding roads concerned were divided into seven road links, one links in the proposed roads and six links in the surrounding roads.

Zoning map and characteristics of zone and links are shown in Figure 7.2.1, Table 7.2.1 and 7.2.2.

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.

<u>Zone</u>	<u>1</u>	<u>2</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>
1	0	267	533	0	0	0
2	0	0	0	130	72	299
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0

Grand Total = 1300

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	242

2) Freight

The freight movement in terms of tonnage per day on proposed route was estimated 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	1.55	1.36	1.20

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	7	5	12

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	1.6	1.4	1.3
PASSENGER MOVEMENT	5.7	5.8	5.9

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 - 1987	1987 - 1993	1993 - 2001
NON-AGRI. AGRICULTURE	7.3 0.0	7.5 0.0	7.6 0.0
FREIGHT	4.7	5.4	6.2

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	28.4	29.3	30.1
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
1-1	1982	0.0	50.9	0.0	49.1	0.0	7.7	20.5	71.8	0.0
	1987	3.3	47.6	4.7	41.9	2.5	10.1	19.3	62.1	8.4
	1993	7.4	43.5	10.3	33.3	5.5	13.1	17.9	50.5	18.5
	2001	12.7	38.2	17.7	21.8	9.5	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 7.2.3.

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	7	59	4	72	10	32	4	192	249	441
1993	14	20	65	11	92	10	29	10	251	292	543
2001	38	53	66	29	127	12	25	23	373	362	735

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

More than 90% of the cultivated land in the influence area is covered by paddy fields. In the upland field, sugar cane ranks first followed by cassava. There is a large scale sugar factory in Amphoe Muang Kumphawapi. Sugar cane is transported via Route 2316 and 2023 to the plant. Unused cultivable land still remains widely especially for upland field. Land use and capability conditions in the area of influence are shown in Table 7.3.1 and Figure 7.3.1. A typical cropping calendar in Udon Thani area is shown in Figure 7.3.2.

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 7.3.2.

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 7.3.3.

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 7.3.4. 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									
		Without Project				With Project			
Link No.	Terrain	Length (km)	/1		Length (km)	/1		Nos. of Wooden Narrow Bridge	Nos. of Wooden Bridge
			Road Class	Nos. of Wooden C.Bridge		Case 1	Case 2		
1	Rolling	24.0	3	2	24.0	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)	2,989	5,204	10,014
2A(F5)	1,484	3,323	7,394

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

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_{>80%} : 15.0cm

Soil Aggregate Subbase CBR_{>20%} : 15.0cm

Selected Material CBR_{>6%} : 20.0cm

In case of F5 Standard

Soil Aggregate Surface CBR_{>20%} : 15.0cm

Selected Material CBR_{>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 7.5.2

Alignment of the route is shown in Figure 7.5.2.

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 7.5.1.

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

Financial and Economic Construction Cost

<u>Road Class</u>	<u>Length (km)</u>	<u>Construction Cost (10³ ₱)</u>		<u>Remark</u>
		<u>Financial Cost</u>	<u>Economic Cost</u>	
F4 (DBST)	24.0	45,951	41,689	
F5 (Soil Aggregate)	24.0	24,199	21,903	

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits and the calculated economic indicators for evaluation are given in Table 7.6.1 and 7.6.2.

The result indicates 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 7.7.1. Social impacts of the proposed route are considerably high.

Table 7.1.1 SUMMARY OF ROAD INVENTORY

Item	Description	
Origin	B. Khok Lat (J.R. 2313)	
Destination	B. Tha Yoh (J.R. 2316)	
Length		
Total	24.0 km	
Improvement Section	24.0 km	
DOH Road	0 km	
ARD Road	24.0 km	
Others	0 km	
New Alignment Section	0 km	
Terrain	Flat and Rolling	
Alignment (Hori./Vert.)	Fair / Good	
Formation Width	5.5 m - 7.5 m, 6.0 m (Weighted average)	
Embankment Section		
Length	24.0 km	
Height	0.4 m - 0.7 m	
Cut Section		
Length	0 km	
Depth	m - m	
Surface Type and Condition		
SBST or DBST	0 km	
Soil Aggregate	Poor	24.0 km
Earth	0 km	
Pipe Culvert	3 each	
Box Culvert	0 each	0 m
Bridge		
Permanent Bridge	0 each	0 m
Narrow Concrete Bridge	1 each	20.0 m (4m)
Wooden Bridge	2 each	24.5 m
Overflow Section	0 place	0 km

Table 7.1.2 ROAD INVENTORY

PROPOSED ROUTE NO. IM-7

ROUTE NO. ARD

B. KHOK LAT (J.R. 2313) ~ B. THA YOM (J.R. 2316)

L = 24.0

UDON THANI

STATION (Km)		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30		
VILLAGE																			
- Name																			
- Household (H)																			
- Population (P)																			
TERRAIN		Rolling																	
CROSS SECTION	Formation Width (m)	7.50		6.00						5.50				6.50		5.50			
	Embankment Height (m)	0.50			0.10		0.50		0.70			0.40							
	Cutting Depth (m)																		
PAVEMENT	Type/Length	Laterite																	
	Condition	Poor																	
FLOODING	Overflow Length(Km)/Height(m)																		
LAND USE	Left	Sugar Cane														Paddy			
	Right	Sugar Cane														Paddy			
PIPE CULVERT	Total Number	3 Pipes																	
BOX CULVERT & BRIDGE	Station (Km)	0.9		11.6						18.2				22.9					
	Dimension	C-Br. 4.00 x 29.00		C-Br. 4.00 x 20.00						W-Br. 5.00 x 18.50				W-Br. 4.50 x 6.00					
RIGHT OF WAY (m)																	15.00		
ALIGNMENT	Horizontal	Fair																	
	Vertical	Good																	
ROUTE NO., AGENCIES		ARD																	

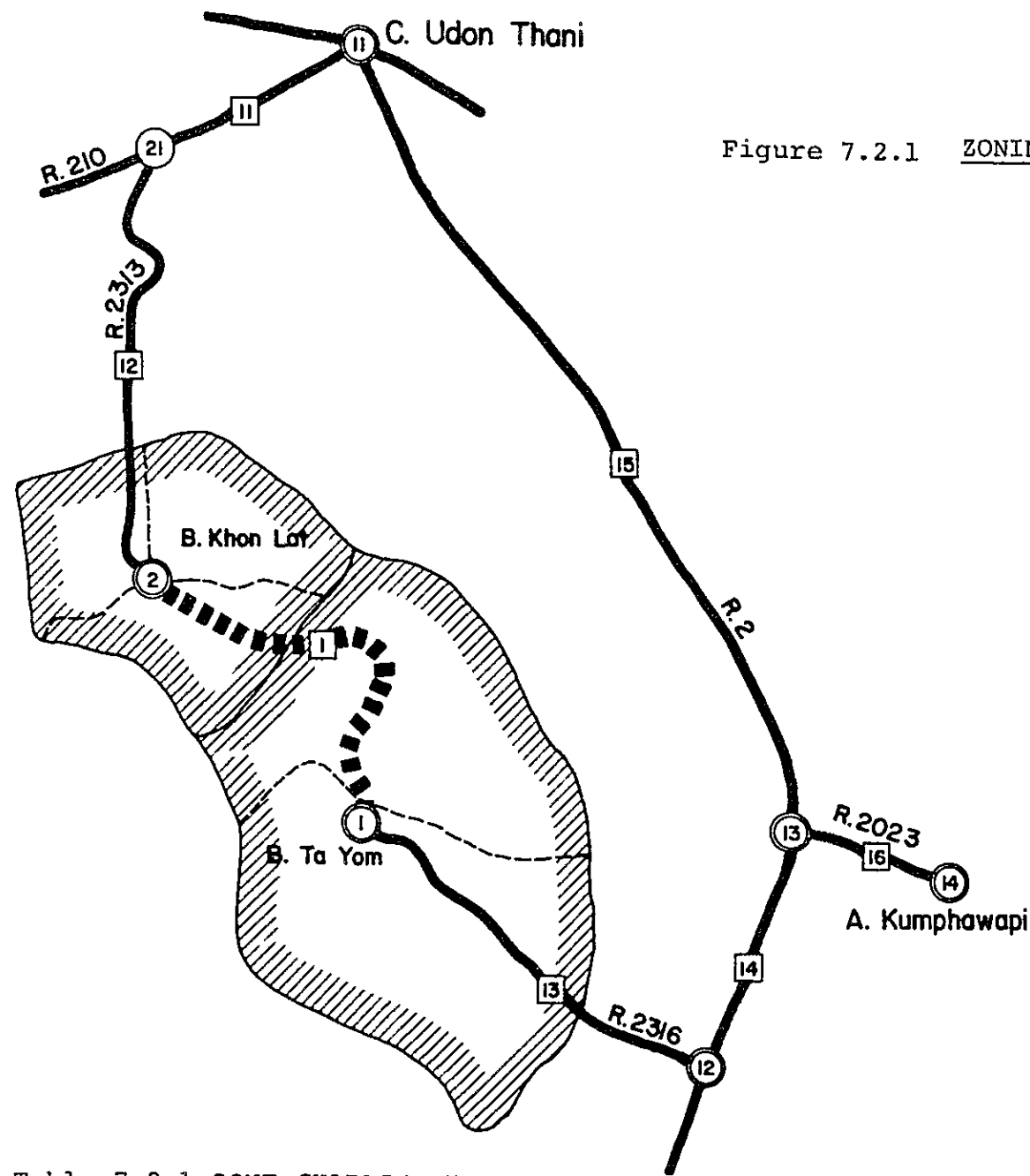


Figure 7.2.1 ZONING AND ROAD NETWORK

PROPOSED ROUTE NO. IM-7

LEGEND

- ① Traffic Zone
- Ⓜ Dummy Node
- ☐ Road Link Code
- ▨▨▨▨ Proposed Road Link
- Other Road

Table 7.2.1 ZONE CHARACTERISTICS

Zone	Administrative Division			Population			Zone Attraction	
	Changwat	Amphoe	Tambon Code	Tambon	%	Zone		
1	Udon Thani	Kumphawapi	10	8,019	80	6.4		
			12	11,569	100	11.6		
			Total			18.0	-	
2	Udon Thani	Kumphawapi	10	8,019	20	1.6		
			Muang	2	10,848	20	2.2	
			5	21,271	30	6.4		
			Total			10.2	-	
11	Udon Thani	Kumphawapi	1	17,801	100	17.8	138.4	
12	Udon Thani	Kumphawapi	2	18,812	100	18.9		
13	Udon Thani	Kumphawapi	13	9,216	100	9.2		
14	Udon Thani	Kumphawapi	1	63,608	100	63.6	261.4	

Table 7.2.2 LINK CHARACTERISTICS

Link No	Node Pair		Length		Grade		Remark
	Start Node	End Node	\bar{W}	W	\bar{W}	W	
1	1. B. Ta Yom	2. B. Kho Lat	24.0	24.0	8	4	ARD
11	11. C. Udon Thani	21. J.R.210	8.0	8.0	1	1	R.2180
12	2. B. Kho Lat	21. J.R.210	17.0	17.0	4	4	R.201
13	1. B. Ta Yom	12. J.R.2316	18.0	18.0	5	5	R.201
14	12. J.R.2316	13. J.R.2023	9.0	9.0	1	1	R.2
15	11. C. Udon Thani	13. J.R.2023	34.0	34.0	1	1	R.2
16	13. J.R.2023	14. A. Kumphawapi	8.0	8.0	3	3	R.2023

Table 7.2.3 TRAFFIC VOLUME ON ROUTE IM - 7

YEAR	1987		1993		2001		
LINK	1 AVR.		1 AVR.		1 AVR.		
P/C	N+D	4	4	11	11	30	30
	I	1	1	3	3	9	9
	DV	0	0	0	0	0	0
	TOTAL	5	5	14	14	38	38
L/B	N+D	5	5	15	15	41	41
	I	1	1	5	5	12	12
	DV	0	0	0	0	0	0
	TOTAL	7	7	20	20	53	53
M/B	N+D	45	45	50	50	51	51
	I	13	13	15	15	15	15
	DV	0	0	0	0	0	0
	TOTAL	59	59	65	65	66	66
H/B	N+D	3	3	8	8	22	22
	I	1	1	2	2	7	7
	DV	0	0	0	0	0	0
	TOTAL	4	4	11	11	29	29
P/P&T	N+D	56	56	71	71	98	98
	I	16	16	21	21	29	29
	DV	0	0	0	0	0	0
	TOTAL	72	72	92	92	127	127
4/T	N+D	8	8	8	8	9	9
	I	2	2	2	2	3	3
	DV	0	0	0	0	0	0
	TOTAL	10	10	10	10	12	12
6/T	N+D	26	26	22	22	19	19
	I	6	6	6	6	6	6
	DV	0	0	0	0	0	0
	TOTAL	32	32	29	29	25	25
10/T	N+D	3	3	8	8	17	17
	I	1	1	2	2	6	6
	DV	0	0	0	0	0	0
	TOTAL	4	4	10	10	23	23
ADT	N+D	150	150	194	194	287	287
	I	42	42	57	57	86	86
	DV	0	0	0	0	0	0
	TOTAL	192	192	251	251	373	373
M/C	N+D	212	212	250	250	315	315
	I	37	37	42	42	47	47
	DV	0	0	0	0	0	0
	TOTAL	249	249	292	292	362	362
TOTAL	N+D	362	362	444	444	602	602
	I	79	79	99	99	133	133
	DV	0	0	0	0	0	0
	TOTAL	441	441	543	543	735	735

NOTE

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

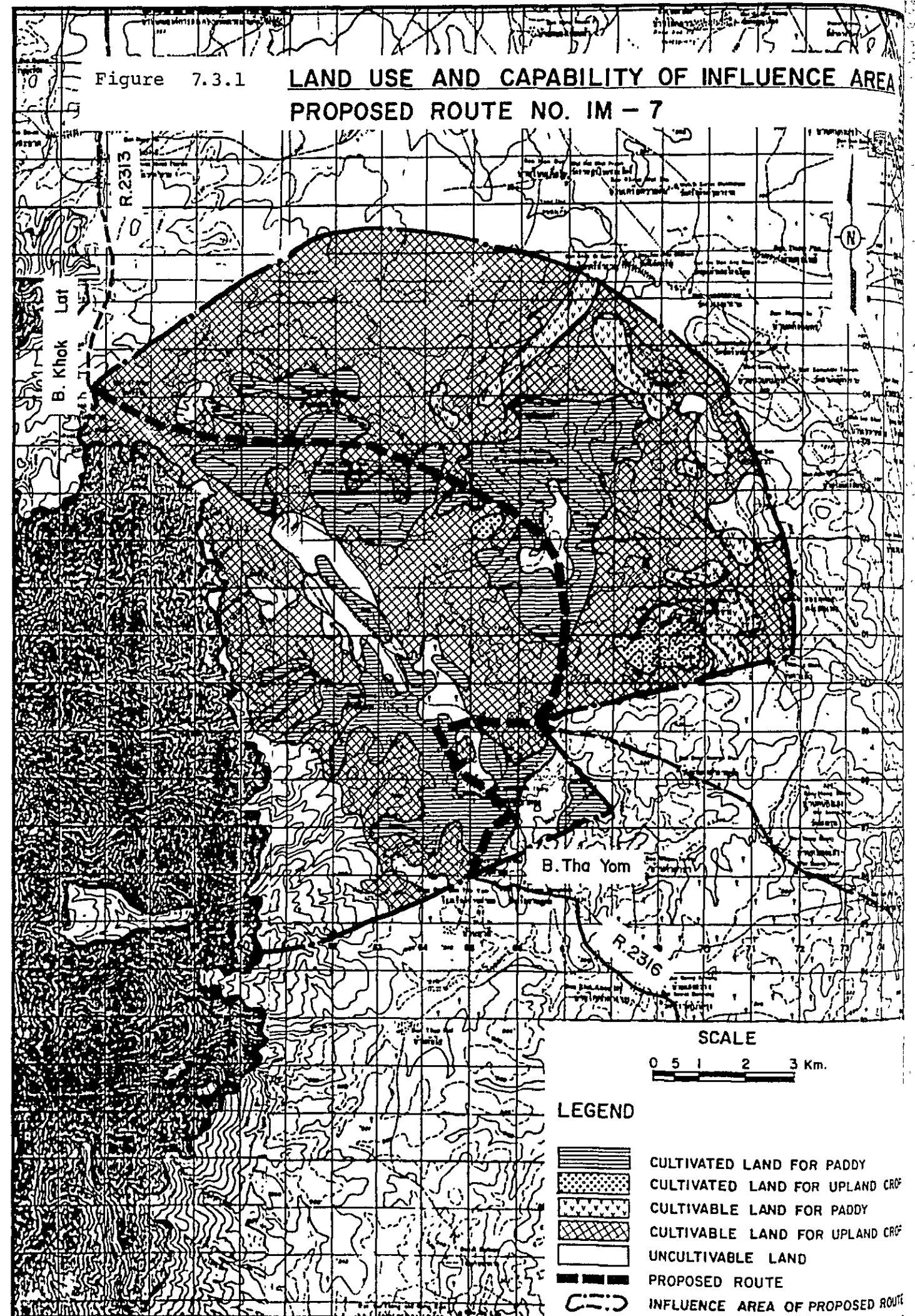
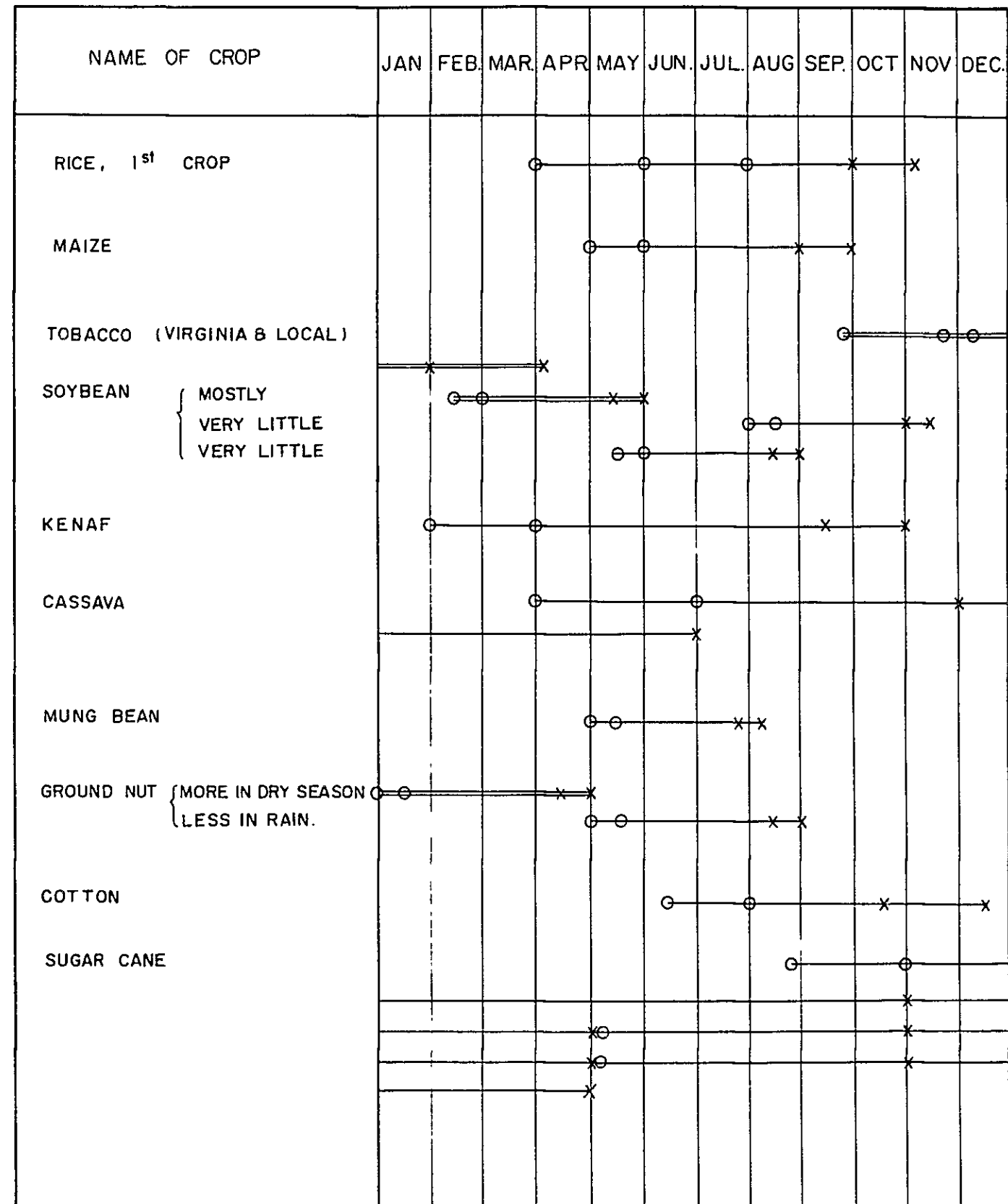


Figure 7.3.2 CROPPING CALENDAR

0200 CHANGWAT _____ UDON THANI _____



Note

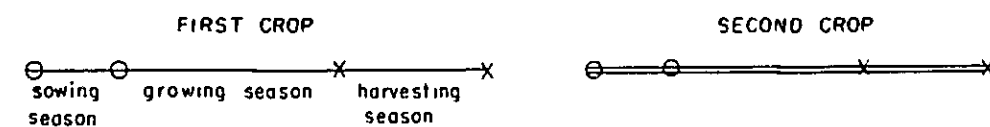


TABLE 7.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM^2)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		14.375 (23.0)	0.938 (1.5)	15.313 (24.5)	4.375 (7.0)	32.500 (52.0)	36.875 (59.0)
0216	KUMPHAWAPI	14.375 (23.0)	0.938 (1.5)	15.313 (24.5)	4.375 (7.0)	32.500 (52.0)	36.875 (59.0)

TABLE 7.3.2 CROP PRODUCTION

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)										
1981	13.92	-	-	-	0.18	0.74	-	-	0.96	14.88
1987	13.92	-	-	-	0.19	0.73	-	-	0.96	14.88
1993	WITHOUT PROJECT	13.92	-	-	0.20	0.73	-	-	0.96	14.88
	WITH PROJECT	13.92	-	-	0.19	0.74	-	-	0.96	14.88
2001	WITHOUT PROJECT	13.92	-	-	0.21	0.72	-	-	0.96	14.88
	WITH PROJECT	13.92	-	-	0.20	0.73	-	-	0.96	14.88
CROP YIELD (KG/RAI)										
1981	238.0	-	-	-	1946.0	6684.0	-	-	-	-
1987	238.0	-	-	-	1957.7	6724.2	-	-	-	-
1993	WITHOUT PROJECT	238.0	-	-	1969.5	6764.6	-	-	-	-
	WITH PROJECT	242.3	-	-	1981.3	6805.3	-	-	-	-
2001	WITHOUT PROJECT	238.0	-	-	1985.3	6819.0	-	-	-	-
	WITH PROJECT	248.2	-	-	2013.2	6914.9	-	-	-	-
CROP PRODUCTION (TON)										
1981	3,313	-	-	-	350	4,951	-	-	5,308	8,620
1987	3,313	-	-	-	370	4,935	-	-	5,311	8,623
1993	WITHOUT PROJECT	3,313	-	-	391	4,915	-	-	5,311	8,624
	WITH PROJECT	3,373	-	-	378	5,033	-	-	5,415	8,788
2001	WITHOUT PROJECT	3,313	-	-	420	4,882	-	-	5,308	8,620
	WITH PROJECT	3,454	-	-	409	5,042	-	-	5,455	8,910

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 7.3.3 FARMGATE PRICE AND PRODUCTION COST

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,887	-	-	-	597	671	-	-
WITH PROJECT (1987 - 2001)	3,984	-	-	-	612	671	-	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	612	-	-	-	759	2,506	-	-
WITH PROJECT (1987 - 2001)	632	-	-	-	779	2,506	-	-

TABLE 7.3.4 NET PRODUCTION VALUE

YEAR	(1000 BAHT)					
	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	4,358	1,555	5,913	4,401	1,559	5,960
1993	4,358	1,564	5,922	4,640	1,612	6,252
2001	4,358	1,577	5,935	4,966	1,653	6,619

Figure 7.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE

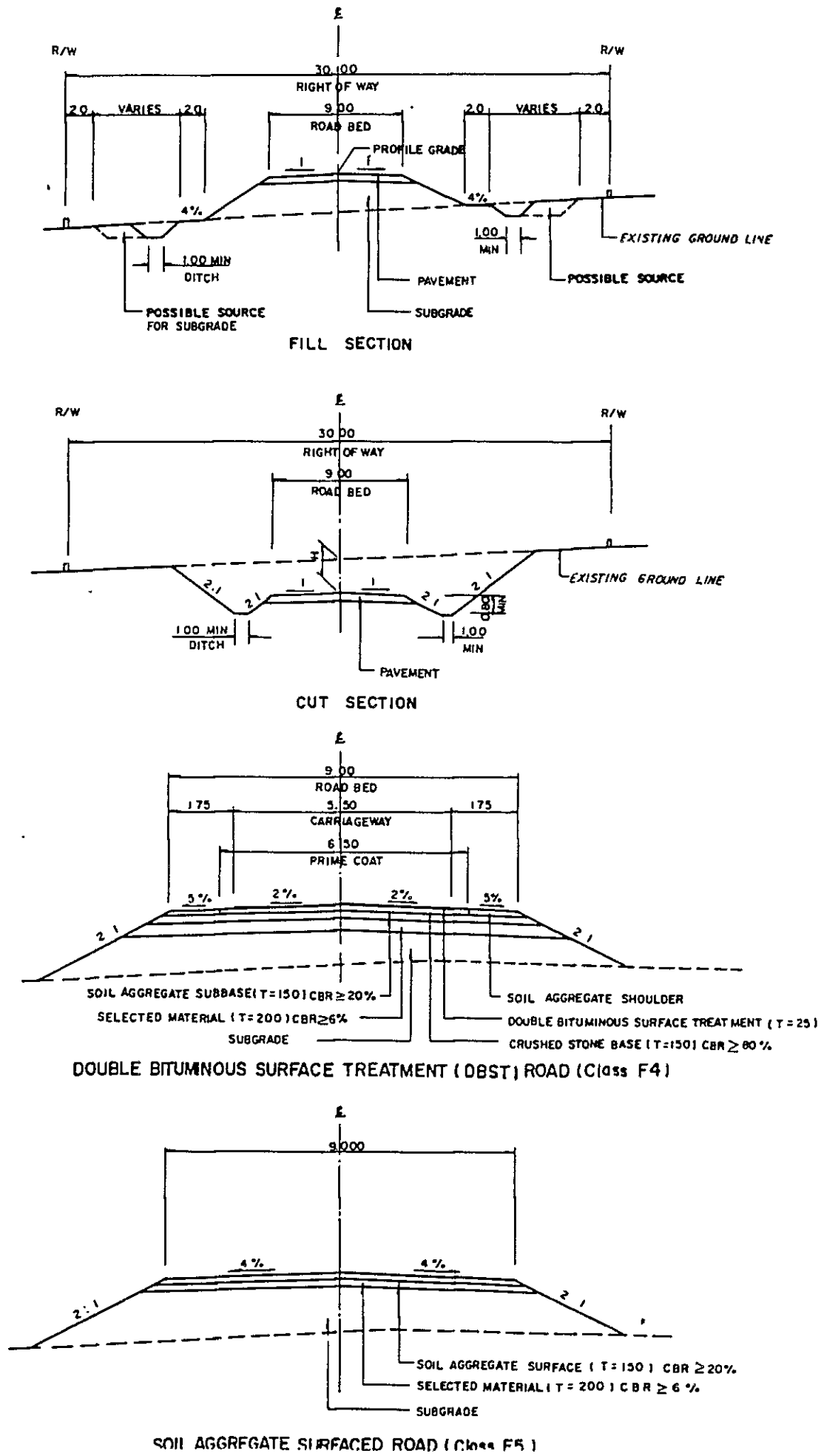
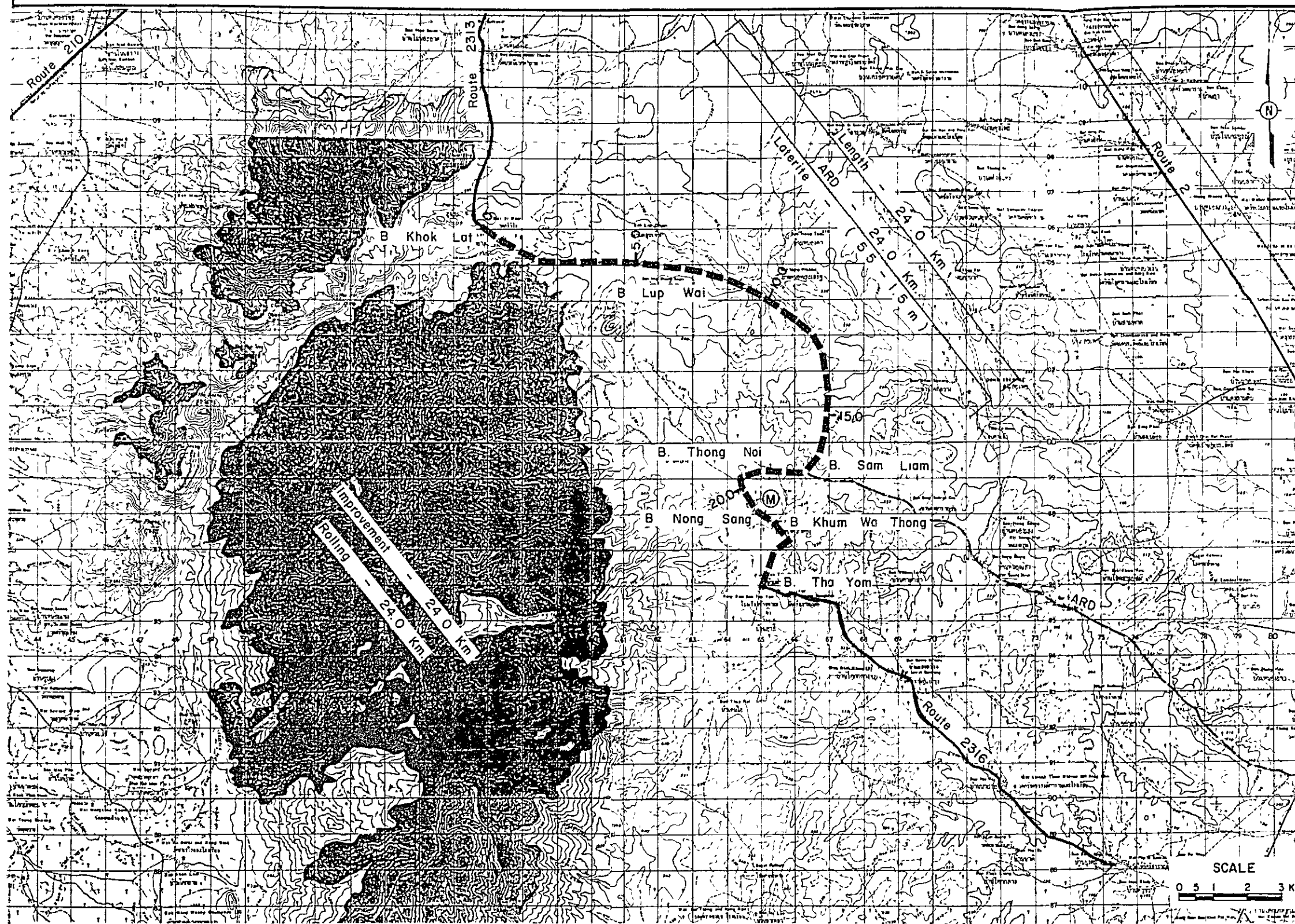


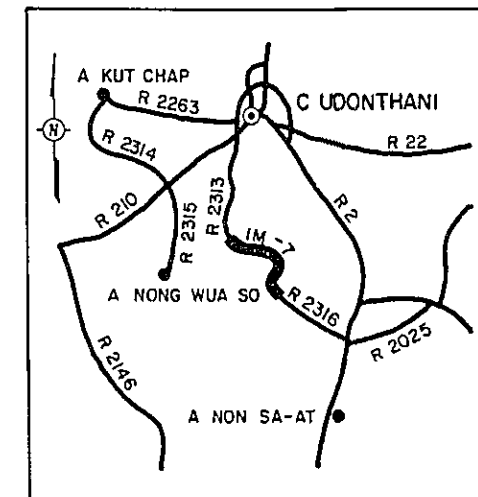
Figure 7.5.2 PROPOSED ROUTE NO. IM-7

C. UDON THANI

B. KHOK LAT (J.R. 2313) - B. THA YOM (J.R. 2316)
ROUTE NO. ARD L = 24.0 Km.



LOCATION MAP



BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	0.9	C-7.00 x 29.00	C-4.00 x 29.00
2	11.6	C-7.00 x 20.00	C-4.00 x 20.00
3	18.2	C-7.00 x 21.00	W-5.00 x 18.50
4	22.9	C-7.00 x 8.00	W-4.50 x 6.00

LEGEND

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

Table 7.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-7 (24.0 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	58	870	791	58	870	791
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	70,700	3,181	2,895	70,700	3,181	2,895
Selected Material	m ³	80	50,900	4,072	3,624	50,900	4,072	3,624
Soil Aggregate Surface or Subbase	m ³	105	35,600	3,738	3,326	35,600	3,728	3,326
Crushed Stone Base	m ³	370	23,400	8,658	7,965	1,000	370	340
Soil Aggregate Shoulder	m ³	105	10,100	1,060	943	400	42	37
Prime Coat and DBST	m ²	55	132,000	7,260	6,534	5,500	303	273
Pipe Culvert	m	2,100	500	1,050	966	500	1,050	966
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	78	3,120	2,776	78	3,120	2,776
Sub Total (a)				33,010	29,823	16,747	15,031	
Miscellaneous Works (a) x 7%				2,311	2,088	1,172	1,052	
Total (b)				35,321	31,911	17,919	16,083	
PHYSICAL CONTEGENCY (b) x 15%				5,298	4,787	2,688	2,412	
ENGINEERING AND								
ADMINISTRATION (b) x 10%				3,532	3,191	1,792	1,608	
Sub Total				8,830	7,978	4,480	4,020	
LAND ACQUISITION								
Highly Developed Land	ha	50,000	36	1,800	1,800	36	1,800	1,800
Less Developed Land	ha	15,000	0	0	0	0	0	0
Sub Total				1,800	1,800	1,800	1,800	
GRAND TOTAL				45,951	41,689	24,199	21,903	

Table 7.6.1 COST AND BENEFITS
(F4 STANDARD)

YEAR	COST		BENEFITS			DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
	(1000 BAHT)						
1984	0	0	0	0	0	0	0
1985	16,675	0	0	0	0	20,917	0
1986	25,014	0	0	0	0	28,016	0
1987	0	47	2,989	-229	2,807	0	2,506
1988	0	94	3,358	-225	3,227	0	2,572
1989	0	141	3,727	-222	3,647	0	2,596
1990	0	189	4,096	-218	4,067	0	2,585
1991	0	236	4,466	-214	4,487	0	2,546
1992	0	283	4,835	-211	4,907	0	2,486
1993	0	330	5,204	-207	5,327	0	2,410
1994	11,616	374	5,806	-202	5,978	5,254	2,414
1995	0	419	6,407	-196	6,629	0	2,390
1996	0	463	7,008	-191	7,280	0	2,344
1997	0	507	7,609	-185	7,931	0	2,280
1998	0	551	8,210	-180	8,582	0	2,203
1999	0	596	8,812	-174	9,233	0	2,116
2000	0	640	9,413	-168	9,884	0	2,022
2001	-20,149	684	10,014	-163	10,535	-3,681	1,925
TOTAL	33,156	5,553	91,953	-2,985	94,521	50,506	35,396

DISCOUNTED ECONOMIC COSTS :	50,506
DISCOUNTED ECONOMIC BENEFITS :	35,396
AGRICULTURAL DEVELOPMENT BENEFIT	1,894
VOC SAVING	34,921
RMC SAVING	-1,419
NET PRESENT VALUE :	-15,110
BENEFIT COST RATIO :	0.70
INTERNAL RATE OF RETURN :	8.1 %

Table 7.6.2 COST AND BENEFITS
(F5 STANDARD)

YEAR	COST		BENEFITS			DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
	(1000 BAHT)						
1984	0	0	0	0	0	0	0
1985	8,761	0	0	0	0	10,990	0
1986	13,142	0	0	0	0	14,719	0
1987	0	47	1,484	-163	1,368	0	1,222
1988	0	94	1,790	-163	1,722	0	1,373
1989	0	141	2,097	-163	2,075	0	1,477
1990	0	189	2,403	-164	2,428	0	1,543
1991	0	236	2,710	-164	2,782	0	1,578
1992	0	283	3,017	-164	3,135	0	1,588
1993	0	330	3,323	-165	3,488	0	1,578
1994	484	374	3,832	-165	4,041	219	1,632
1995	0	419	4,341	-166	4,593	0	1,656
1996	0	463	4,850	-167	5,146	0	1,657
1997	0	507	5,358	-167	5,698	0	1,638
1998	0	551	5,867	-168	6,251	0	1,604
1999	0	596	6,376	-168	6,803	0	1,559
2000	0	640	6,885	-169	7,356	0	1,505
2001	-11,048	684	7,394	-170	7,908	-2,018	1,445
TOTAL	11,339	5,553	61,728	-2,485	64,795	23,909	23,056

DISCOUNTED ECONOMIC COSTS :	23,909
DISCOUNTED ECONOMIC BENEFITS :	23,056
AGRICULTURAL DEVELOPMENT BENEFIT	1,894
VOC SAVING	22,283
RMC SAVING	-1,121
NET PRESENT VALUE :	-853
BENEFIT COST RATIO :	0.96
INTERNAL RATE OF RETURN :	11.6 %

Table 7.7.1 SOCIAL INDICATORS
(Proposed Route IM-7)

Population (1,000)		Education	
1982	: 9.9	Access to Secondary School	
1993	: 11.7	Number of Student in 1993 (1,000) ^{2/}	: 2.0
Average travelling speed, without (kph)		Average distance to school (km)	: 12.0
	: 40	Per capita time savings (10 ⁻⁴)	: 0.667
Isolation		Score	: 361
Access to Amphoe		Teacher Intensity	
Average distance to Amphoe (km) ^{1/}	: 12.0	Number of teachers ^{3/}	
Per capita time savings (10 ⁻⁴)	: 0.114	University graduate	: -
Score	: 335	Total	: 21
Access to Artery Highway		Number of Student	: 530
Average distance to highway (km) ^{1/}	: -	Indicators	
Per capita time savings (10 ⁻⁴)	: -	E1 ^{4/}	: -
Score	: 100	E2 ^{5/}	: 39.6
Impassability		E ^{6/}	: 39.6
Impassable week a year	: 4	Degree of Improvement ^{7/}	: 1.73
Impassability per year	: 0.077	Score	: 110
Impassability per capita (10 ⁻⁴)	: 0.066	Disparity	
Score	: 550	G.P.V. in 1993 (Mn B) ^{8/}	
Health		With project	: 17.1
Access to Hospital		Without project	: 16.4
Average distance to Hospital (km) ^{1/}	: 12.0	Per capita G.P.V. in 1993 (B)	
Per capita time savings (10 ⁻⁴)	: 0.114	With project (W)	: 1,462
Score	: 265	Without project (w)	: 1,402
Access to Medical Facilities		Degree of Disparity	
Average distance to facilities (km) ^{1/}	: 11.0	(A/W) - (A/w) ^{9/}	: 0.09
Per capita time savings (10 ⁻⁴)	: 0.104	Score	: 161
Score	: 416	Total Score	: 3,432

Note:

- 1/ () shows the length or distance in without project case. Unless otherwise, lengths 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 - 8

Changwat : Udon Thani

B. Huai Koeng (J.R.2) - A. Kumphawapi (J.R.2023)

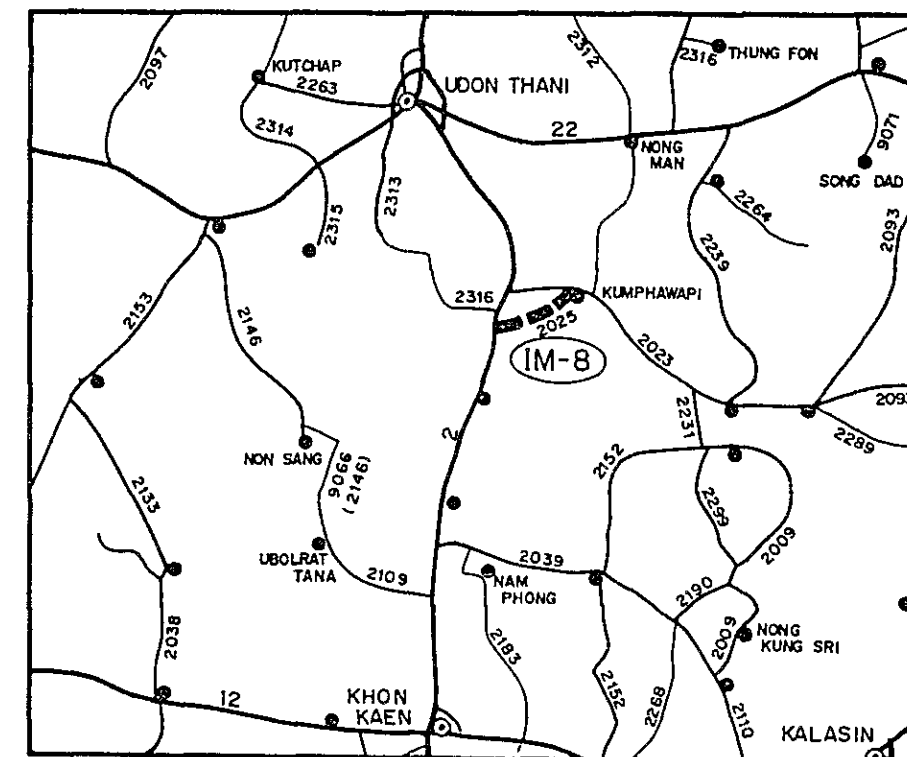
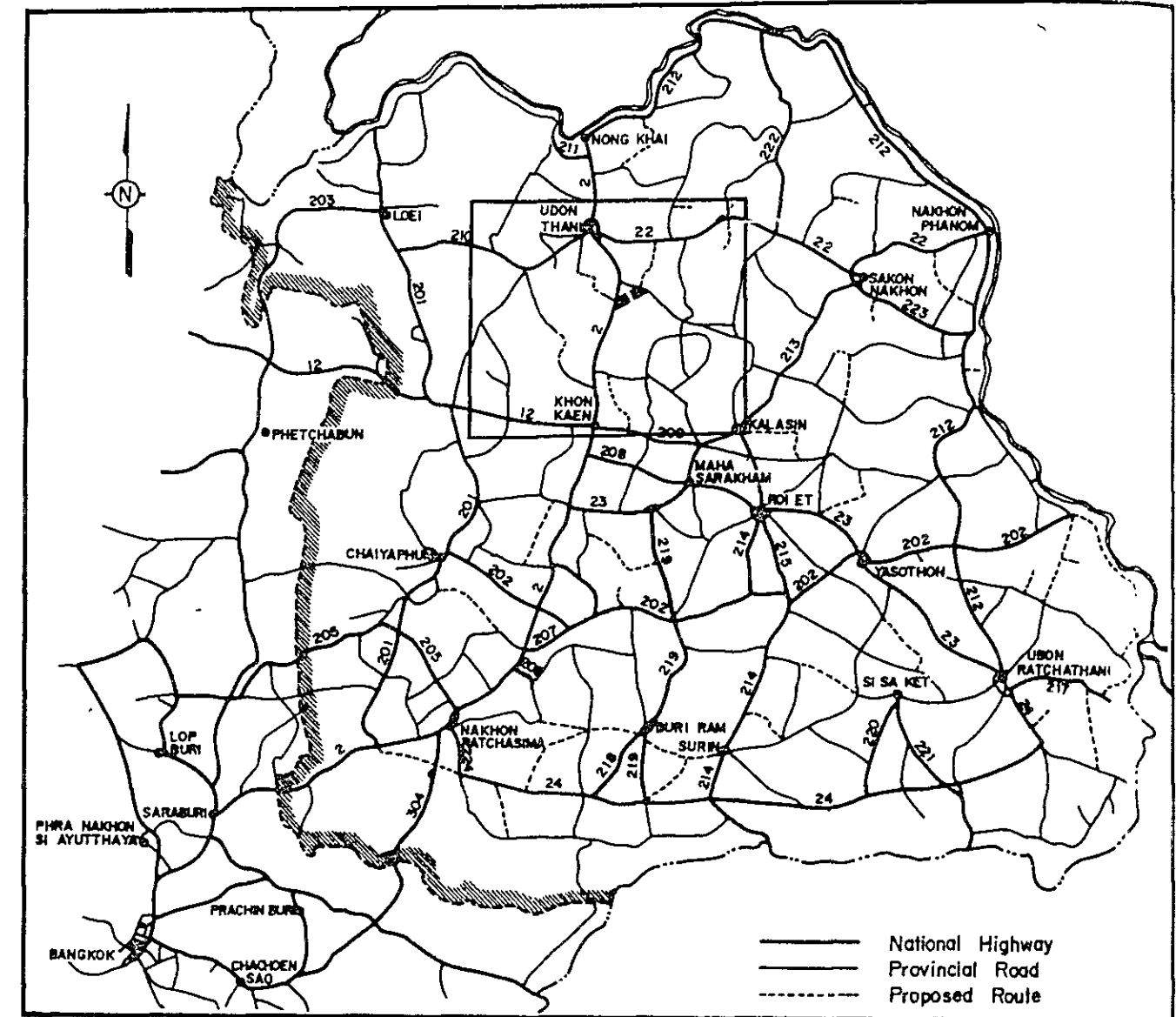
Length : 16.7 KM.

LOCATION OF PROPOSED ROUTE

SUMMARY

PROPOSED ROUTE IM- 8

Item	Description
Changwat	Udon Thani
Origin	B. Huai Kaeng (J.R.2)
Destination	A. Kumphawapi (J.R.2023)
Length	
Total	16.7 km
Improvement Section	16.7 km
DOH Road	R.2025 16.7 km
ARD Road	0 km
Others	0 km
New Alignment Section	0 km
Surface Type and Condition	Soil Aggregate, Good
Terrain	Flat
Influence Area	
Area	74 km ²
Population (1982)	17,900
Principal Crops	Paddy
Traffic (ADT)	
Existing	268
1993	905
2001	1,170
Proposed Standard	F4 (DBST)
Construction Cost	
Financial	27,361 . 10 ³ ฿
Economic	24,778 . 10 ³ ฿
IRR	18.1 %
B/C	1.53
Recommendation	For further consideration



1. GENERAL

1.1 Characteristics of the Route

The proposed route is located in the southeast part of Changwat Udon Thani. The route starting at Ban Huai Koeng on Route 2 runs northeastward passing through Ban Pho Sawang and Ban Nong Noeng and ends at Amphoe Kumphawapi on Route 2023. Its total length is 16.7 km. (Figure 8.5.2).

The terrain is mostly flat. In the influence area, there exists several villages with total population of 17,900. There are only one medical center, one hospital and one secondary school along the proposed route.

The proposed route, upon completion, will form an important part of road network to make shortcut between two artery highway, Route 2 and 2023 in the agriculturally developed area.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route is summarized in Table 8.1.1. The details are shown as the results of inventory survey in Table 8.1.2.

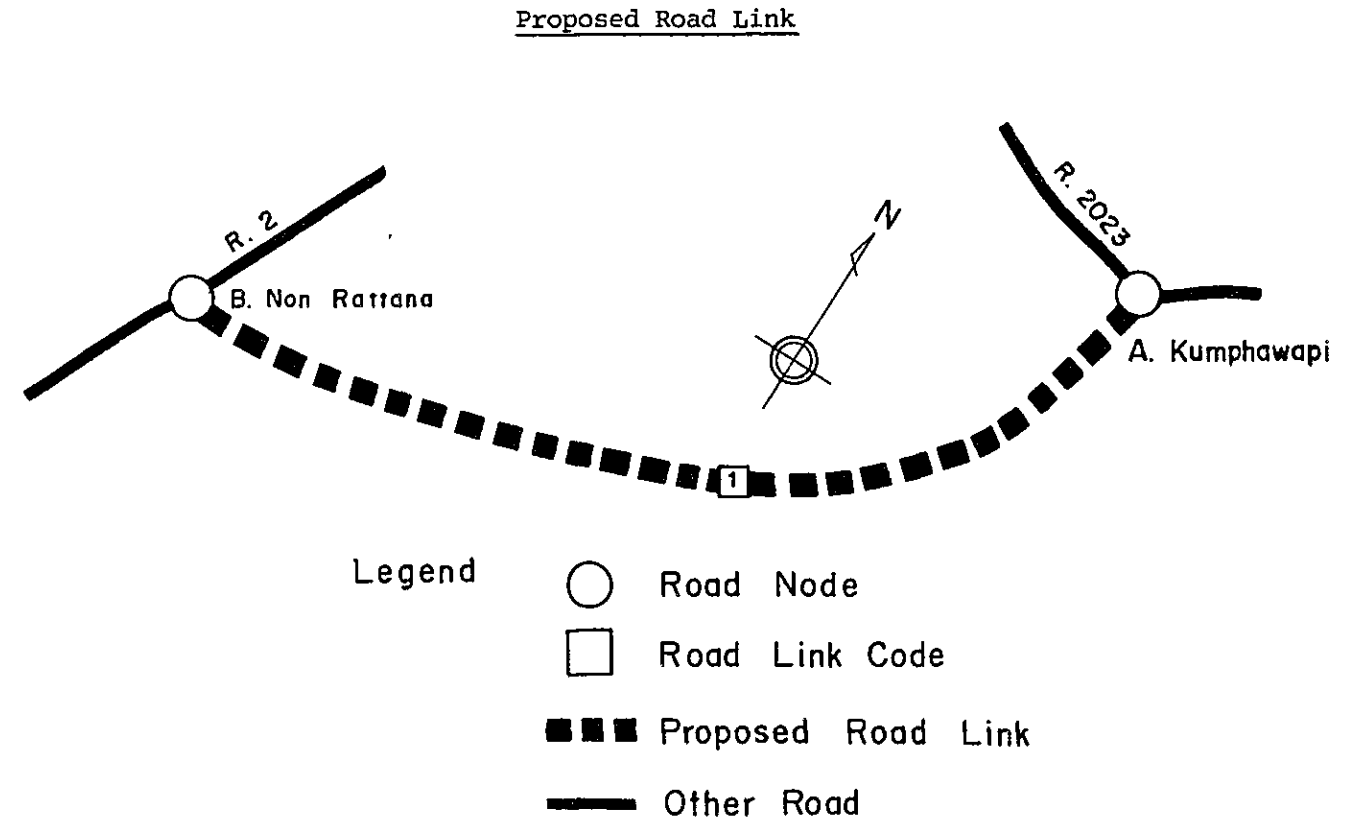
2. TRAFFIC

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 classified count as shown below:



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
DOH (1981)	1 /1	72	72	5	6	1	12	36	63	28	295
Manual Counts (1982)	1	-	77	83	13	-	9	6	25	24	237
Estimated	1	36	75	44	10	1	11	21	44	26	268

Note: /1 Route 2025 Station 0100 Station km 2+500

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 link was 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	1276

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	161	180	341

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 of the prediction is shown in the following tables:

GROWTH RATE OF PASSENGER MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981	1987	1993
	1987	1993	2001
PER CAPITA INCOME	4.2	4.5	4.7
TRANS. PRICE INCREASE	4.5	4.5	4.5
POPULATION	2.6	2.1	1.8
PASSENGER MOVEMENT	6.6	6.5	6.4

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981	1987	1993
	1987	1993	2001
NON-AGRI. AGRICULTURE	8.5	8.3	8.3
FREIGHT	4.0	3.9	3.9

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	21.7	45.2	26.5	6.0	0.6	10.8	20.6	43.1	25.5
	1987	20.4	46.5	22.7	8.3	2.1	12.4	19.4	41.0	27.2
	1993	18.8	48.1	18.1	11.1	4.0	14.4	17.9	38.4	29.3
	2001	16.7	50.2	12.0	14.7	6.4	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 8.2.1.

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	50	56	20	5	132	27	57	38	385	359	744
1993	63	60	37	13	185	30	65	49	502	403	905
2001	84	60	74	32	289	35	77	70	720	449	1170

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

Around 85% of cultivated land in the influence area is covered by paddy fields. In the upland field, sugar cane ranks first followed by cassava, kenaf and groundnut. A large sugar cane factory of 5,300 t/day capacity is located in Muang Kumphawapi adjacent to the area.

Land use and capability conditions in the area of influence are shown in Table 8.3.1 and Figure 8.3.1.

A typical cropping calendar in Udon Thani area is shown in Figure 8.3.2.

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 8.3.2.

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 8.3.3.

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 8.3.4. 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 effect the calculation of additional costs of VOC of each link, are shown below.

Road Condition

Link No.	Terrain	Length (km)	Without Project			With Project		
			1) Road Class	Nos. of Wooden Bridge	Nos. of Narrow C. Bridge	1) Road Class	Nos. of Wooden Bridge	Narrow Bridge
1	Flat	16.7	3	0	0	1 (F4)	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)	4,429	6,139	9,467

5. ENGINEERING

5.1 Preliminary Design

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

Design Standard : F4 (feasible)
 Geometric Design : AASHTO (Rural Highways)
 Typical Cross Section : as shown in Figure 8.5.1

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>80% : 15.0cm
 Soil Aggregate Subbase CBR>20% : 15.0cm
 Selected Material CBR> 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 8.5.2.

Alignment of the route is shown in Figure 8.5.2.

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 8.5.1.

Total financial and economic construction costs by applied road class F4 are as given below.

F4 Standard (DBST)	L = 16.7 km
Financial cost	27,361 . 10 ³ ₪
Economic Cost	24,778 . 10 ³ ₪

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits and the calculated economic indicators for evaluation are given in Table 8.6.1.

The result indicates that the proposed project seems to be feasible under F4 Standard (DBST).

7. SOCIAL IMPACTS

Detailed data and results of quantification of indication of social impacts are tabulated in Table 8.7.1.

Table 8.1.1 SUMMARY OF ROAD INVENTORY

Item	Description	
Origin	B. Huai Koeng (J.R. 2)	
Destination	A. Kumphawapi (J.R. 2023)	
Length		
Total		16.7 km
Improvement Section		16.7 km
DOH Road	R. 2025	16.7 km
ARD Road		0 km
Others		0 km
New Alignment Section		0 km
Terrain	Flat	
Alignment (Hori./Vert.)	Fair / Fair	
Formation Width	5.0 m - 10.0m, 6.9 m (Weighted average)	
Embankment Section		
Length		16.7 km
Height	0.3 m -	2.3m
Cut Section		
Length		0 km
Depth	m -	m
Surface Type and Condition		
SBST or DBST	Good	1.8 km
Soil Aggregate	Good	14.9 km
Earth		0 km
Pipe Culvert	5 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	4.5 m
Overflow Section	1 place	0.7 km

Table 8.1.2 ROAD INVENTORY

PROPOSED ROUTE NO. IM-8

ROUTE NO. 2025

B. HUAI KOENG (J.R. 2) ~ A. KUMPHAWAPI (J.R. 2023)

L = 16.7 Km

UDON THANI

STATION (Km)		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	
VILLAGE		B. HUAI KOENG B. NON RATANF H = 37 P = 285 B. PHO SAWANG H = 160 P = 1600 B. NONG WAENG H = 80 P = 640																
TERRAIN		Flat																
CROSS SECTION	Formation Width (m)	6.50	7.00	10.00	4.50		5.00		10.00									
	Embankment Height (m)	0.50	0.30	0.30	2.30	0.30	0.20		0.40	0.50								
	Cutting Depth (m)																	
PAVEMENT	Type/Length	DT		Laterite														
	Condition	Good																
FLOODING	Overflow Length(Km)/Height(m)						I=0.7 H=0.2											
LAND USE	Left	Paddy					Kanaf	Sugar Cane	Bush	Paddy								
	Right	Paddy					Sugar Cane		Bush	Paddy								
PIPE CULVERT	Total Number	5 Pipes																
BOX CULVERT & BRIDGE	Station (Km)	6.6																
	Dimension	W-Br. 3.50 x 4.50																
RIGHT OF WAY (m)																		
ALIGNMENT	Horizontal	Fair																
	Vertical	Fair																
ROUTE NO., AGENCIES		DOH 2025																

Table 8.2.1 TRAFFIC VOLUME ON ROUTE IM - 8

YEAR	1987		1993		2001	
LINK	1 AVR.		1 AVR.		1 AVR.	
P/C	N+D	44 44	55 55	73 73		
	I	7 7	8 8	11 11		
	DV	0 0	0 0	0 0		
	TOTAL	50 50	63 63	84 84		
L/B	N+D	49 49	52 52	52 52		
	I	7 7	8 8	8 8		
	DV	0 0	0 0	0 0		
	TOTAL	56 56	60 60	60 60		
M/B	N+D	18 18	32 32	64 64		
	I	3 3	5 5	10 10		
	DV	0 0	0 0	0 0		
	TOTAL	20 20	37 37	74 74		
H/B	N+D	5 5	12 12	28 28		
	I	1 1	2 2	4 4		
	DV	0 0	0 0	0 0		
	TOTAL	5 5	13 13	32 32		
P/P&T	N+D	115 115	160 160	251 251		
	I	17 17	24 24	38 38		
	DV	0 0	0 0	0 0		
	TOTAL	132 132	185 185	289 289		
4/T	N+D	23 23	26 26	31 31		
	I	4 4	4 4	5 5		
	DV	0 0	0 0	0 0		
	TOTAL	27 27	30 30	35 35		
6/T	N+D	49 49	56 56	67 67		
	I	7 7	8 8	10 10		
	DV	0 0	0 0	0 0		
	TOTAL	57 57	65 65	77 77		
10/T	N+D	33 33	43 43	61 61		
	I	5 5	6 6	9 9		
	DV	0 0	0 0	0 0		
	TOTAL	38 38	49 49	70 70		
ADT	N+D	335 335	437 437	626 626		
	I	50 50	66 66	94 94		
	DV	0 0	0 0	0 0		
	TOTAL	385 385	502 502	720 720		
M/C	N+D	335 335	380 380	434 434		
	I	24 24	23 23	16 16		
	DV	0 0	0 0	0 0		
	TOTAL	359 359	403 403	449 449		
TOTAL	N+D	670 670	817 817	1060 1060		
	I	74 74	88 88	110 110		
	DV	0 0	0 0	0 0		
	TOTAL	744 744	905 905	1170 1170		

NOTE

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

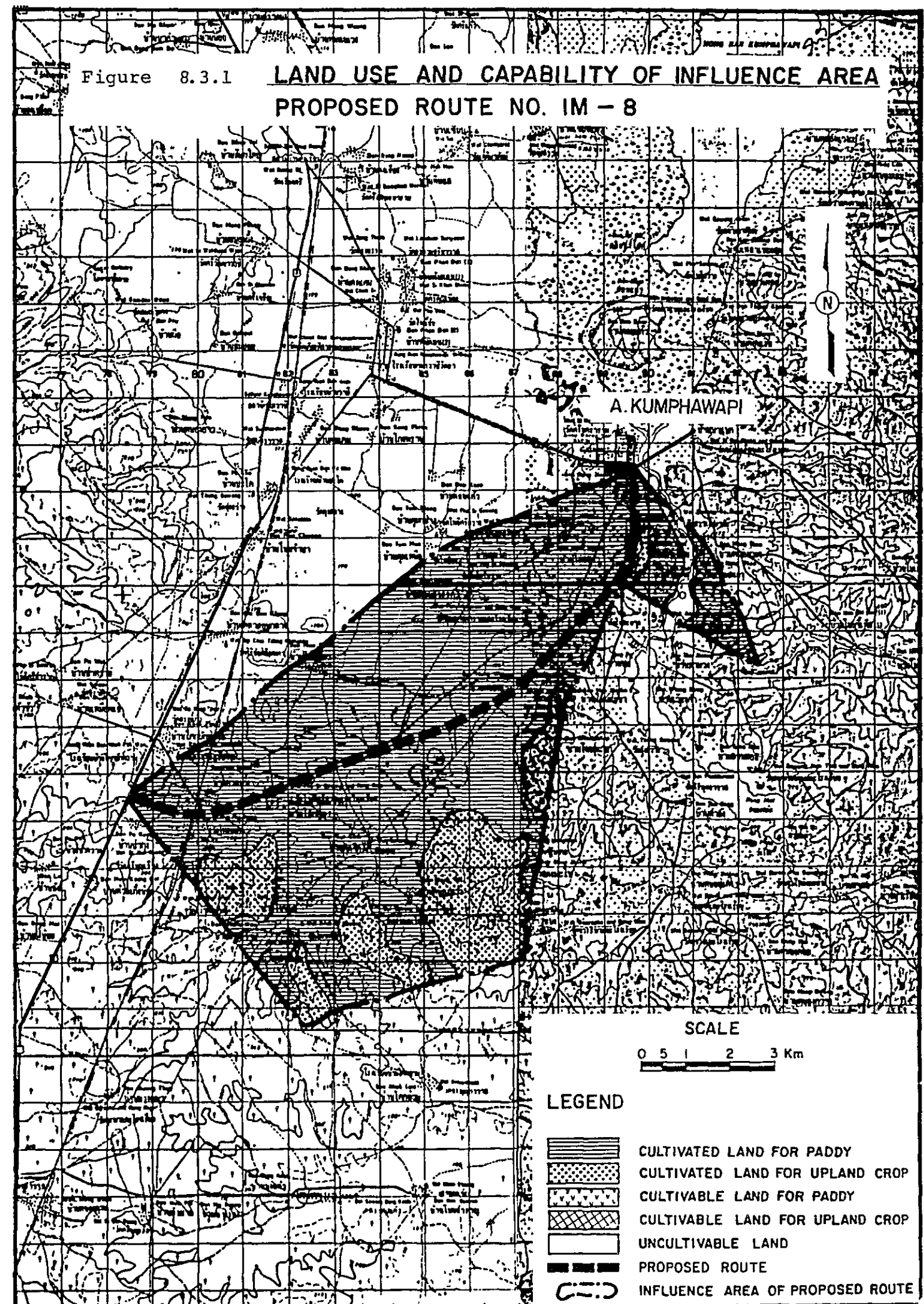
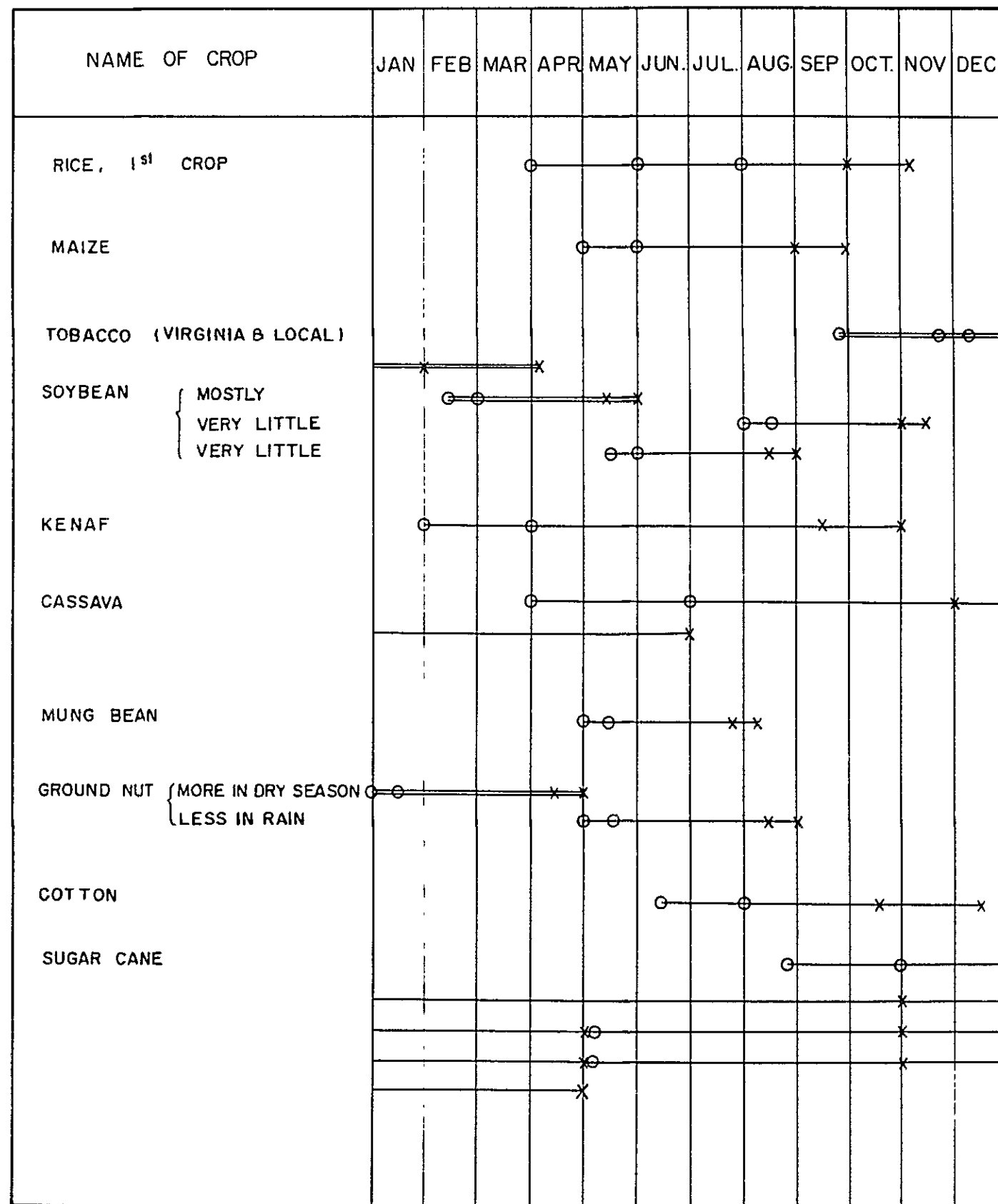


Figure 8.3.2 CROPPING CALENDAR

0200 CHANGWAT UDON THANI



Note

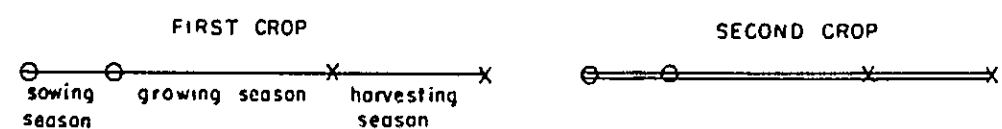


TABLE 8.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM²)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		38.750 (62.0)	6.875 (11.0)	45.625 (73.0)	-	-	-
0216	KUMPHAWAPI	38.750 (62.0)	6.875 (11.0)	45.625 (73.0)	-	-	-

TABLE 8.3.2 CROP PRODUCTION

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL	
PLANTED AREA (1000 RAI)											
1981	37.37	-	-	0.09	1.29	5.31	0.14	-	6.88	44.24	
1987	37.37	-	-	0.08	1.36	5.26	0.13	-	6.88	44.24	
1993	WITHOUT PROJECT	37.37	-	-	0.08	1.42	5.21	0.12	-	6.88	44.24
	WITH PROJECT	37.37	-	-	0.07	1.43	5.22	0.11	-	6.88	44.24
2001	WITHOUT PROJECT	37.37	-	-	0.07	1.52	5.13	0.11	-	6.88	44.24
	WITH PROJECT	37.37	-	-	0.06	1.52	5.14	0.10	-	6.88	44.24
CROP YIELD (KG/RAI)											
1981	238.0	-	-	128.0	1946.0	6684.0	167.0	-	-	-	
1987	238.0	-	-	128.0	1957.7	6724.2	167.0	-	-	-	
1993	WITHOUT PROJECT	238.0	-	-	128.0	1969.5	6764.6	167.0	-	-	
	WITH PROJECT	242.3	-	-	129.5	1981.3	6805.3	167.0	-	-	
2001	WITHOUT PROJECT	238.0	-	-	128.0	1985.3	6819.0	167.0	-	-	
	WITH PROJECT	248.2	-	-	131.6	2013.2	6914.9	167.0	-	-	
CROP PRODUCTION (TON)											
1981	8,894	-	-	11	2,509	35,483	23	-	38,036	46,930	
1987	8,894	-	-	10	2,653	35,364	21	-	38,058	46,952	
1993	WITHOUT PROJECT	8,894	-	-	10	2,803	35,220	20	-	38,062	46,956
	WITH PROJECT	9,055	-	-	9	2,824	35,509	19	-	38,370	47,425
2001	WITHOUT PROJECT	8,894	-	-	9	3,013	34,990	18	-	38,039	46,933
	WITH PROJECT	9,275	-	-	9	3,060	35,554	17	-	38,649	47,923

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 8.3.3 FARMGATE PRICE AND PRODUCTION COST

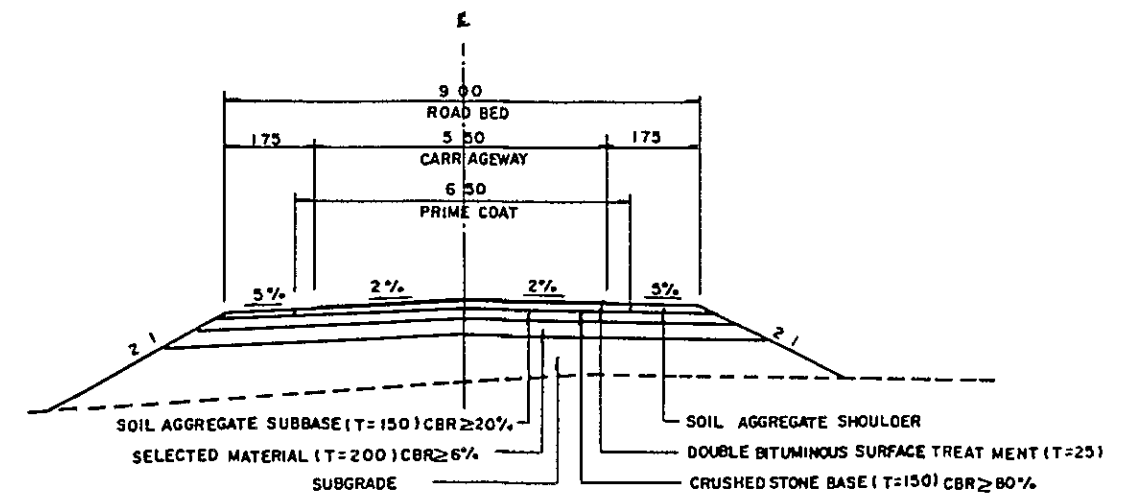
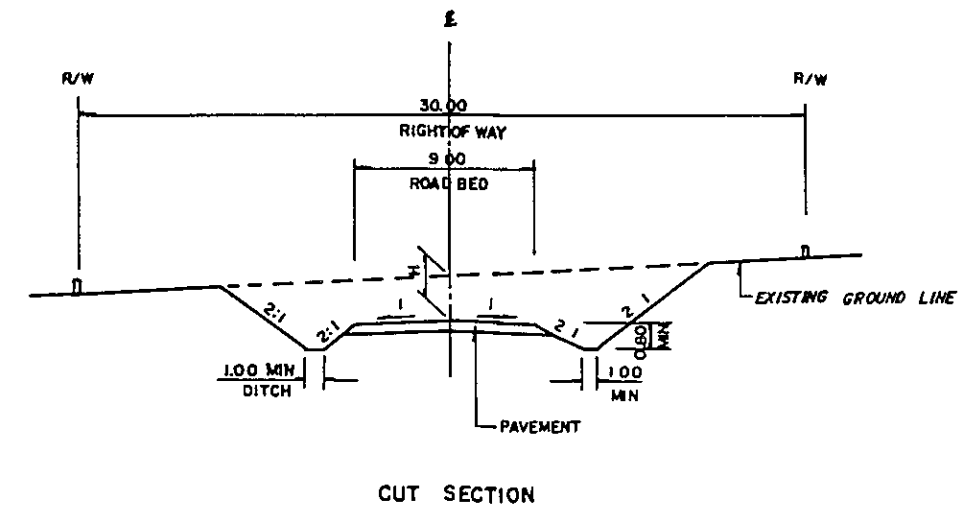
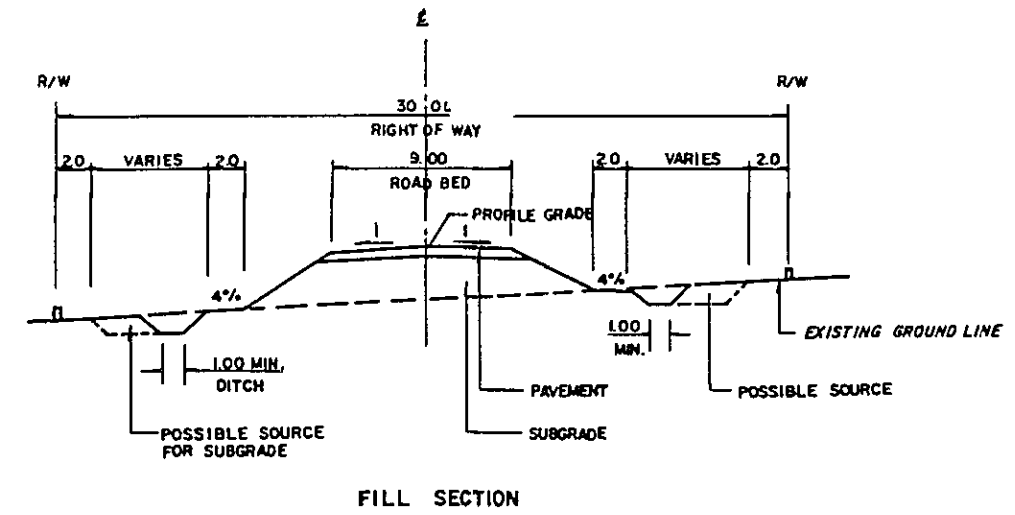
ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,887	-	-	9,641	597	671	4,511	-
WITH PROJECT (1987 - 2001)	3,984	-	-	9,641	612	671	4,624	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	612	-	-	1,010	759	2,506	631	-
WITH PROJECT (1987 - 2001)	632	-	-	1,010	779	2,506	631	-

TABLE 8.3.4 NET PRODUCTION VALUE

(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	11,700	11,145	22,845	11,816	11,158	22,974
1993	11,700	11,218	22,918	12,458	11,409	23,867
2001	11,700	11,303	23,003	13,333	11,700	25,033

Figure 8.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE



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

Figure 8.5.2

PROPOSED ROUTE NO. IM-8

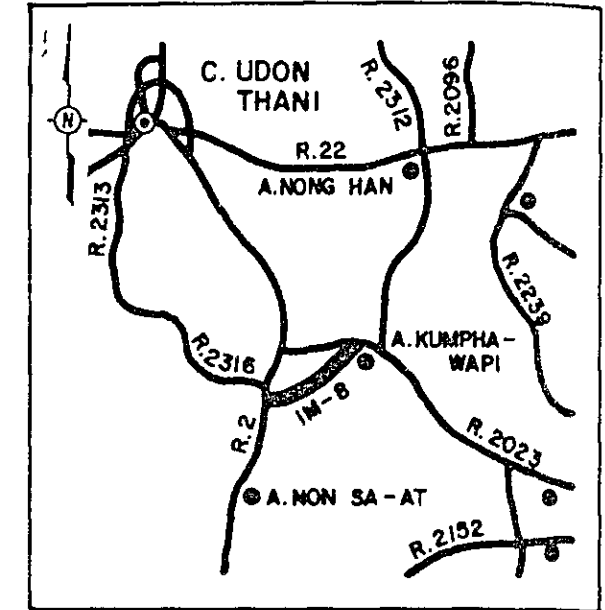
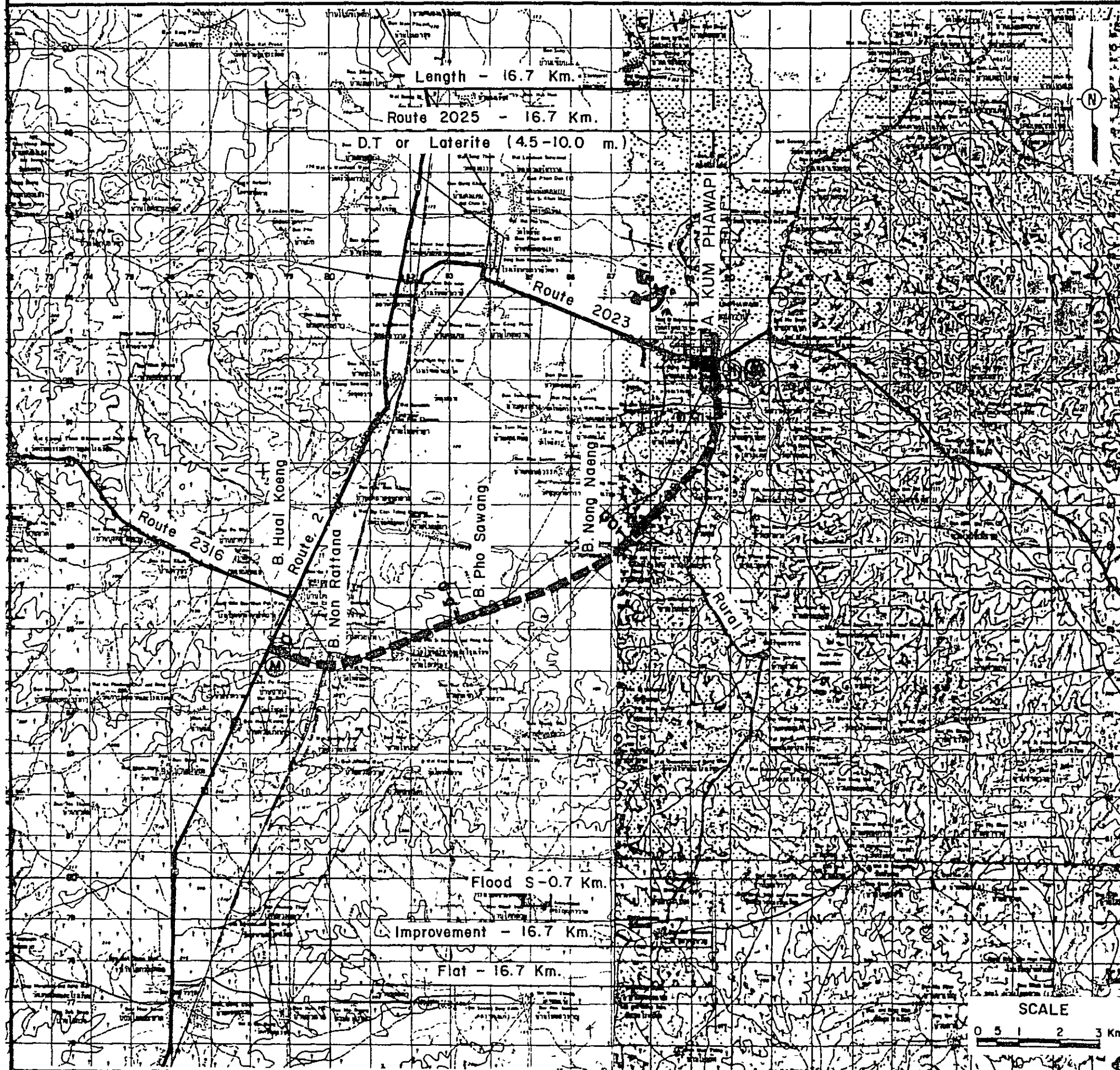
C. UDON THANI

B. HUAI KOENG (J.R. 2) - A. KUMPHAWAPI (J.R. 2023)

ROUTE NO. 2025

L = 16.7 Km.









LOCATION MAP



BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	6.6	(BOX CULVERT)	W - 3 50 x 4 50

LEGEND

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

SCALE



Table 8.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-8 (16.7 km)

Items	Unit of Q'ty	Financial Unit Rate ₪	(DBST)	
			Q'ty	Economic Cost (10 ³ ₪)
DIRECT CONSTRUCTION COST				
Clearing and Grubbing	ha	15,000	39	585
Excavation - Soil	m ³	20	0	0
Excavation - Hard Rock	m ³	160	0	0
Embankment	m ³	45	66,300	2,983
Selected Material	m ³	80	31,600	2,528
Soil Aggregate Surface or Subbase	m ³	105	22,100	2,320
Crushed Stone Base	m ³	370	14,500	5,365
Soil Aggregate Shoulder	m ³	105	6,300	661
Prime Coat and DBST	m ²	55	82,000	4,510
Pipe Culvert	m	2,100	640	1,344
Box Culvert	m	16,000	10	160
Long Span Bridge	m	80,000	0	0
Short Span Bridge	m	40,000	0	0
Sub Total (a)				20,457
Miscellaneous Works (a) x 7%				1,432
Total (b)				21,889
PHYSICAL CONTINGENCY (b) x 15%				3,283
ENGINEERING AND ADMINISTRATION (b) x 10%				2,189
Sub Total				5,472
LAND ACQUISITION				
Highly Developed Land	ha	50,000	0	0
Less Developed Land	ha	15,000	0	0
Sub Total				0
GRAND TOTAL				27,361

Table 8.6.1 COST AND BENEFITS (F4 STANDARD)

YEAR	COST				BENEFITS		DISCOUNTED (12%)	
	CONST. COST	AGRI. BENEFIT	VDC SAVING	RMC SAVING	TOTAL	COST	BENEFIT	
1984	0	0	0	0	0	0	0	
1985	9,911	0	0	0	0	12,432	0	
1986	14,867	0	0	0	0	16,651	0	
1987	0	129	4,429	24	4,582	0	4,091	
1988	0	266	4,714	33	5,012	0	3,996	
1989	0	402	4,999	42	5,443	0	3,874	
1990	0	539	5,284	51	5,874	0	3,733	
1991	0	676	5,569	60	6,304	0	3,577	
1992	0	812	5,854	69	6,735	0	3,412	
1993	0	949	6,139	77	7,165	0	3,241	
1994	8,083	1,084	6,555	91	7,730	3,656	3,122	
1995	0	1,219	6,971	105	8,295	0	2,991	
1996	0	1,354	7,387	118	8,860	0	2,853	
1997	0	1,490	7,803	132	9,424	0	2,709	
1998	0	1,625	8,219	145	9,989	0	2,564	
1999	0	1,760	8,635	159	10,554	0	2,419	
2000	0	1,895	9,051	172	11,118	0	2,275	
2001	-11,398	2,030	9,467	186	11,683	-2,082	2,134	
TOTAL	21,463	16,230	101,077	1,462	118,768	30,657	46,991	
DISCOUNTED ECONOMIC COSTS :					30,657			
DISCOUNTED ECONOMIC BENEFITS :					46,991			
AGRICULTURAL DEVELOPMENT BENEFIT					5,501			
VDC SAVING					40,984			
RMC SAVING					506			
NET PRESENT VALUE :					16,334			
BENEFIT COST RATIO :					1.53			
INTERNAL RATE OF RETURN :					18.1 %			

Table 8.7.1 SOCIAL INDICATORS
(Proposed Route IM-8)

Population (1,000)		Education		Health		Note:
1982	: 17.9	Access to Secondary School		Access to Hospital		
1993	: 23.0	Number of Student in 1993 (1,000) 2/	: 3.9	Average distance to Hospital (km) 1/	: 8.5	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.
Average travelling speed, without (kph)	: 48	Average distance to school (km)	: 8.5	Per capita time savings (10 ⁻⁴)	: 0.026	
Isolation		Per capita time savings (10 ⁻⁴)	: 0.151	Score	: 76	4/ (Number of University Graduate Teachers)/(Total Number of Student) x 1,000
Access to Amphoe		Score	: 82	Access to Artery Highway		
Average distance to Amphoe (km) 1/	: 8.5	Teacher Intensity		Average distance to highway (km) 1/	: 0	6/ Sum of 4/ and 5/
Per capita time savings (10 ⁻⁴)	: 0.026	Number of teachers 3/		Per capita time savings (10 ⁻⁴)	: 0	
Score	: 76	University graduate	: 1	Score	: 0	8/ Estimated gross value of crop production in the areas of influence
Access to Artery Highway		Total	: 8	Impassability		
Average distance to highway (km) 1/	: 0	Number of Student	: 206	Impassable week a year	: -	
Per capita time savings (10 ⁻⁴)	: 0	Indicators		Impassability per year	: 0	
Score	: 0	E1 4/	: 4.9	Impassability per capita (10 ⁻⁴)	: 0	
Impassability		E2 5/	: 38.8	Score	: 0	
Impassable week a year	: -	E 6/	: 43.7			
Impassability per year	: 0	Degree of Improvement 7/	: 1.57			
Impassability per capita (10 ⁻⁴)	: 0	Score	: 100			
Score	: 0	Disparity				
Health		G.P.V. in 1993 (Mn B) 8/				
Access to Hospital		With project	: 61.8			
Average distance to Hospital (km) 1/	: 8.5	Without project	: 60.1			
Per capita time savings (10 ⁻⁴)	: 0.026	Per capita G.P.V. in 1993 (B)				
Score	: 60	With project (W)	: 2,687			
Access to Medical Facilities		Without project (w)	: 2,613			
Average distance to facilities (km) 1/	: 5.0	Degree of Disparity				
Per capita time savings (10 ⁻⁴)	: 0.015	(A/W) - (A/w) 9/	: 0.03			
Score	: 60	Score	: 54			
Total Score		Total Score	: 432			

PROPOSED ROUTE NO. IM - 9

Changwat : Udon Thani

A. Nong Han (J.R.22) - A. Kumphawapi (J.R.2023)

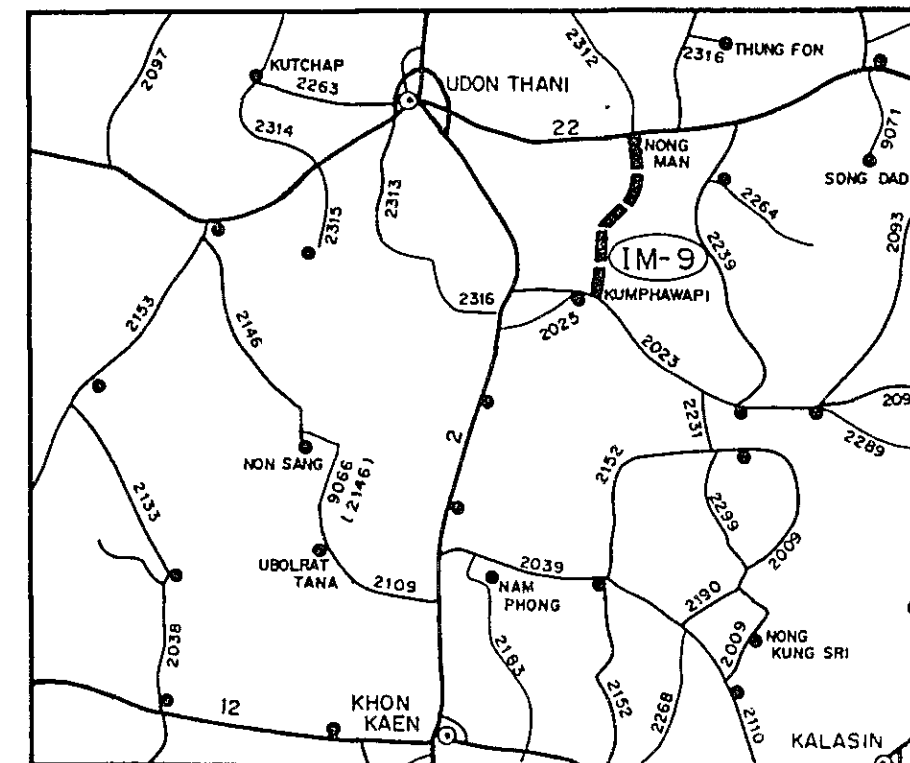
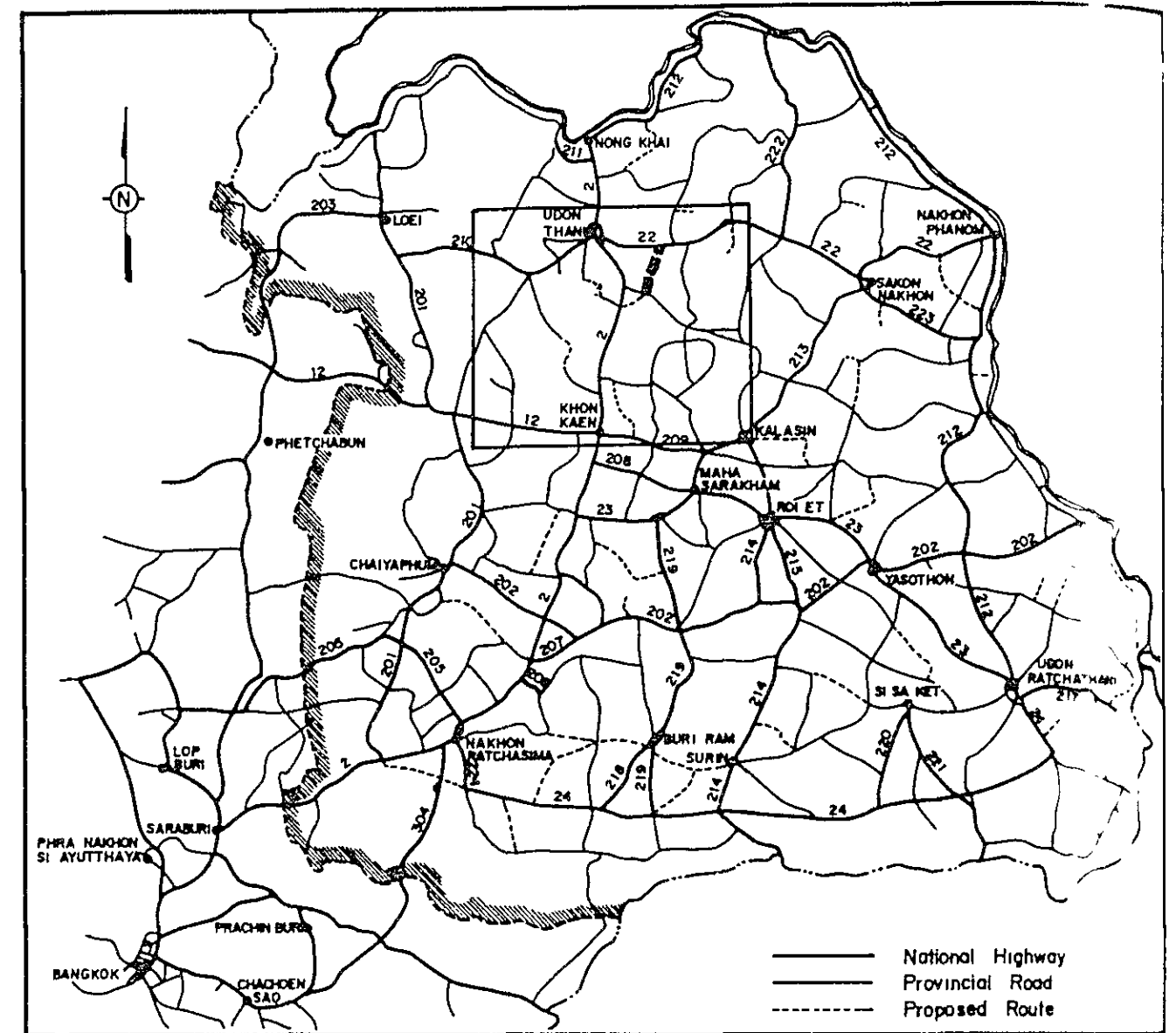
Length : 33.4 KM.

LOCATION OF PROPOSED ROUTE

SUMMARY

PROPOSED ROUTE IM-9

Item	Description
Changwat	Udon Thani
Origin	A. Nong Han (J.R.22)
Destination	A. Kumphawapi (J.R.2)
Length	
Total	33.4 km
Improvement Section	33.4 km
DOH Road	0 km
ARD Road	33.4 km
Others	0 km
New Alignment Section	0 km
Surface Type and Condition	Soil Aggregate, Poor
Terrain	Flat
Influence Area	
Area	213 km ²
Population (1982)	27,900
Principal Crops	Paddy
Traffic (ADT)	
Existing	218
1993	713
2001	898
Proposed Standard	F4 (DBST)
Construction Cost	
Financial	72,564 . 10 ³ ฿
Economic	65,760 . 10 ³ ฿
IRR	1.1 %
B/C	0.93
Recommendation	For further consideration



1. GENERAL

1.1 Characteristics of the Route

The proposed route is located in the east part of Changwat Udon Thani. The route, starting at Amphoe Nong Han on Route 22, runs southward passing through Ban Phung Ngu, Ban Muang Phrub and Ban Don Yang and ends at Amphoe Kumphawapi on Route 2023. Its total length is 33.4 km. (Figure 9.5.2)

The terrain is almost flat. In the influence area, there exists several villages with total population of 27,900. There are three medical centers, one hospital and two secondary schools along the proposed route.

The proposed route, upon completion, will form an important part of road network to connect two artery highways, Route 21 and 2023 in the agriculturally developed area.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route is summarized in Table 9.1.1. The details are shown as the results of inventory survey in Table 9.1.2.

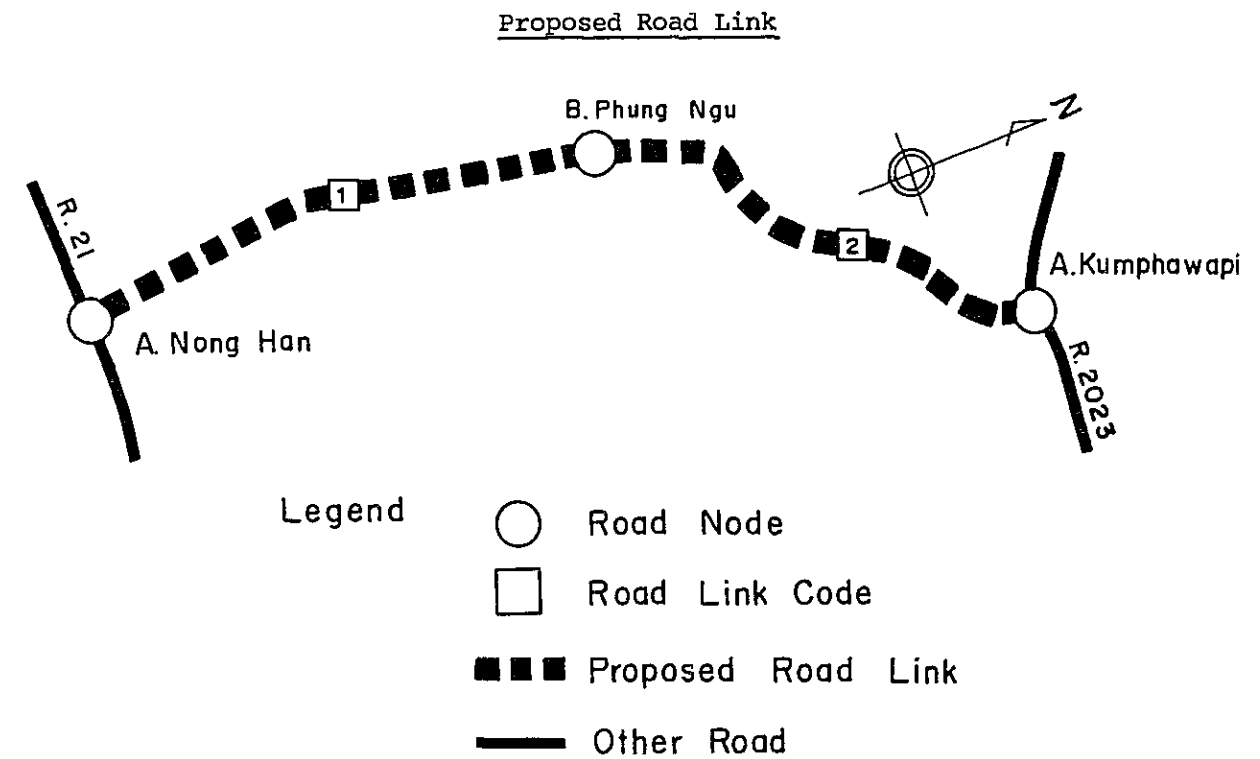
2. TRAFFIC

2.1 Method

Growth Rate Method was employed for traffic forecasting as no diverted traffic is expected after improvement of the proposed 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:



Traffic Volume in Base Year

Source (base year)	Link No.	Vehicle Type									
		P/C	P/P	L/C	M/B	H/B	P/T	4/T	S/T	10/T	ADT
Manual Counts (1982)	1	5	77	41	26	2	9	32	20	6	218
	2	-	45	87	14	-	5	33	24	10	218

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	1515
2	1721

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	55	70	124
2	73	93	166

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	1993
	1987	1993	2001
PER CAPITA INCOME	4.2	4.5	4.7
TRANS. PRICE INCREASE	4.5	4.5	4.5
POPULATION	1.5	1.3	1.1
PASSENGER MOVEMENT	5.6	5.7	5.8

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981	1987	1993
	1987	1993	2001
NON-AGRI. AGRICULTURE	7.2	7.3	7.5
FREIGHT	3.2	3.3	3.3

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
DEVELOPED	0.0	0.0	0.0

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

LINK NO.	YEAR	PASSENGER					FREIGHT			
		P/C	P/P	L/B	M/B	H/B	P/T	4/T	6/T	10/T
		(UNIT : %)								
1	1982	3.3	51.0	27.2	17.2	1.3	13.4	47.8	29.9	9.0
	1987	6.0	48.3	24.3	18.0	3.3	14.4	39.4	31.2	15.0
	1993	9.3	45.1	21.0	19.0	5.7	15.5	29.4	32.8	22.3
	2001	13.6	40.7	16.5	20.3	8.9	17.0	16.0	35.0	32.0
2	1982	0.0	30.8	59.6	9.6	0.0	6.9	45.8	33.3	13.9
	1987	2.7	30.8	49.5	14.0	3.0	9.6	38.0	33.8	18.7
	1993	5.9	30.8	37.4	19.2	6.6	12.8	28.6	34.3	24.4
	2001	10.2	30.8	21.3	26.2	11.5	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 9.2.1.

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	9	83	33	7	89	30	26	14	290	320	610
1993	20	85	53	17	112	23	27	19	357	357	713
2001	47	78	96	42	155	14	30	27	487	411	898

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

The area of influence divided into two parts: Kumphawapi side and Nong Han side. Paddy field cover around 80% in Kumphawapi side and around 93% in Nong Han side of cultivated land.

Sugar cane occupies around a half of the upland field. Other crops in the area are cassava, kenaf, maize and beans. Two large sugar factories of 5,300 ton/day and 1900 ton/day capacity of sugar cane are located in Amphoe Muang Kumphawapi and near Nong Han. They gather sugar cane of around 1.4 million ton in total in the season from November to June every year. Unused cultivable land for upland field remains some in Nong Han side, but not for paddy field.

Land use and capability conditions in the area of influence are shown in Table 9.3.1, and Figure 9.3.1. A typical cropping calendar in Changwat Udon Thani is shown in Figure 9.3.2.

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 9.3.2.

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 9.3.3.

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 9.3.4. 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

No	Link Terrain	Without Project			With Project		
		Length (km)	1) Nos. of Road class	Nos. of Wooden C.Bridge	Length (km)	1) Nos. of Road Class Case 1 Case 2	Nos. of Wooden Narrow Bridge
1	Flat	13.4	2B	5	13.4	1(F4) 2A(F5)	0
2	Flat	20.0	2B	9	20.0		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)	6,393	8,782	13,198
2A (F5)	3,666	5,245	8,008

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 9.5.1

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_>80% : 15.0cm

Soil Aggregate Subbase CBR_>20% : 15.0cm

Selected Material CBR_> 6% : 20.0cm

In case of F5 Standard

Soil Aggregate Surface CBR_>20% : 15.0cm

Selected Material CBR_> 6% : 20.0cm

Pipe Culvert

Standard Size : ø 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 9.5.2

Alignment of the route is shown in Figure 9.5.2.

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 9.5.1.

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)	33.4	72,564	65,760	
F5 (Soil Aggregate)	33.4	45,218	40,887	

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits, and the calculated economic indicators for evaluation are given in Table 9.6.1.

The result indicates that the proposed project seems to be feasible under F4 standard (DBST).

7. SOCIAL IMPACTS

Detailed data and results of quantification of indicators of social impacts are tabulated in Table 9.7.1.

Table 9.1.1 SUMMARY OF ROAD INVENTORY

Item	Description	
Origin	A. Nong Han (J.R. 22)	
Destination	A. Kumhawapi (J.R. 2)	
Length		
Total		33.4 km
Improvement Section		33.4 km
DOH Road		0 km
ARD Road		33.4 km
Others		0 km
New Alignment Section		0 km
Terrain	Flat	
Alignment (Hori./Vert.)	Fair/Fair	
Formation Width	5.0 m - 9.0 m, 7.7 m (Weighted average)	
Embankment Section		
Length		33.4 km
Height	0.2 m - 1.5 m	
Cut Section		
Length		0 km
Depth	m - m	
Surface Type and Condition		
SBST or DBST		0 km
Soil Aggregate	Poor	33.4 km
Earth		0 km
Pipe Culvert	33 each	
Box Culvert	0 each	m
Bridge		
Permanent Bridge	0 each	m
Narrow Concrete Bridge	0 each	m (4m)
Wooden Bridge	14 each	186.0 m
Overflow Section	0 place	0 km

Table 9.1.2 ROAD INVENTORY (1)

PROPOSED ROUTE NO. IM-9

ROUTE No. ARD

A. NONG HAN (J.R. 22) ~ A. KUMPHAWAPI (J.R. 2023)

L = 33.4 Km

UDON THANI

STATION (Km)		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30				
VILLAGE		A. NONG HAN																			
- Name																					
- Household (H)																					
- Population (P)																					
TERRAIN		Flat																			
CROSS SECTION	Formation Width (m)	7.00			9.00			7.00		5.00		7.00		6.00		9.00		0.80 5.50		10.00 9.00	
	Embankment Height (m)	0.20	0.40	0.20	0.40	0.20	0.30	0.50	0.80	0.50		0.30		0.50		1.50					
	Cutting Depth (m)																				
PAVEMENT	Type/Length	Laterite																			
	Condition	Good										Poor		Good							
FLOODING	Overflow Length(Km)/Height(m)																				
LAND USE	Left	Paddy	Bush															Paddy			
	Right	Paddy	Bush															Paddy			
PIPE CULVERT	Total Number	30 Pipes																			
BOX CULVERT & BRIDGE	Station (Km)	1.1	3.0				10.7	12.7	12.9	13.9	16.0		17.4	19.2	19.4	19.9	27.1		29.0		
	Dimension	W-BI. 4.50 x 15.00	W-BI. 4.50 x 5.00				W-BI. 4.50 x 10.00	W-BI. 4.50 x 9.50	W-BI. 4.50 x 15.50	W-BI. 4.50 x 10.00	W-BI. 4.50 x 30.00		W-BI. 4.50 x 25.50	W-BI. 4.50 x 10.00	W-BI. 4.50 x 9.00	W-BI. 4.50 x 5.50	W-BI. 4.50 x 16.00		W-BI. 4.00 x 9.00		
RIGHT OF WAY (m)		15.0																			
ALIGNMENT	Horizontal	Fair																			
	Vertical	Fair																			
ROUTE NO., AGENCIES		ARD																			

ROAD INVENTORY (2)

PROPOSED ROUTE NO. IM-9

ROUTE NO. ARD

A. NONG HAN (J.R. 22) ~ A. KUMPHAWAPI (J.R. 2023) (Cont'd)

L = 33.4 Km.

UDON THANI

STATION (Km)		30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
VILLAGE - Name - Household (H) - Population (P)		B. DON NGOEN H = 300 P = 1500		A. KUMPHAWAPI													
TERRAIN		Flat															
CROSS SECTION	Formation Width (m)	8.00	7.50														
	Embankment Height (m)	1.00	0.50														
	Cutting Depth (m)																
PAVEMENT	Type/Length	Laterite															
	Condition	Good															
FLOODING	Overflow Length(Km)/Height(m)																
LAND USE	Left	Paddy															
	Right	Paddy															
PIPE CULVERT	Total Number																
BOX CULVERT & BRIDGE	Station (Km)			33.3													
	Dimension			W-Br. 4.50 x 16.00													
RIGHT OF WAY (m)		15.0															
ALIGNMENT	Horizontal	Fair															
	Vertical	Fair															
ROUTE NO., AGENCIES		ARD															

Figure 9.3.1 LAND USE AND CAPABILITY OF INFLUENCE AREA
PROPOSED ROUTE NO. IM - 9

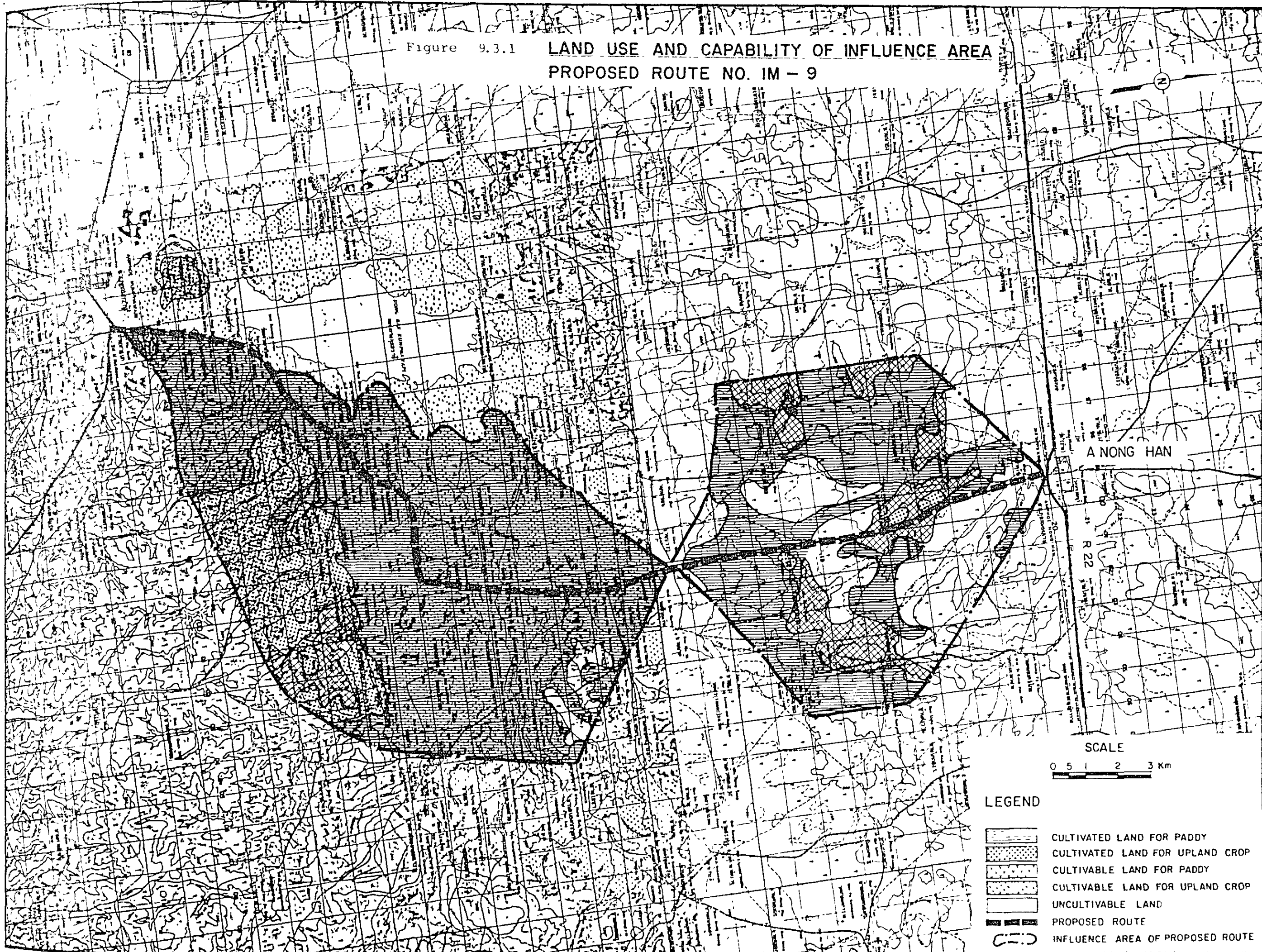
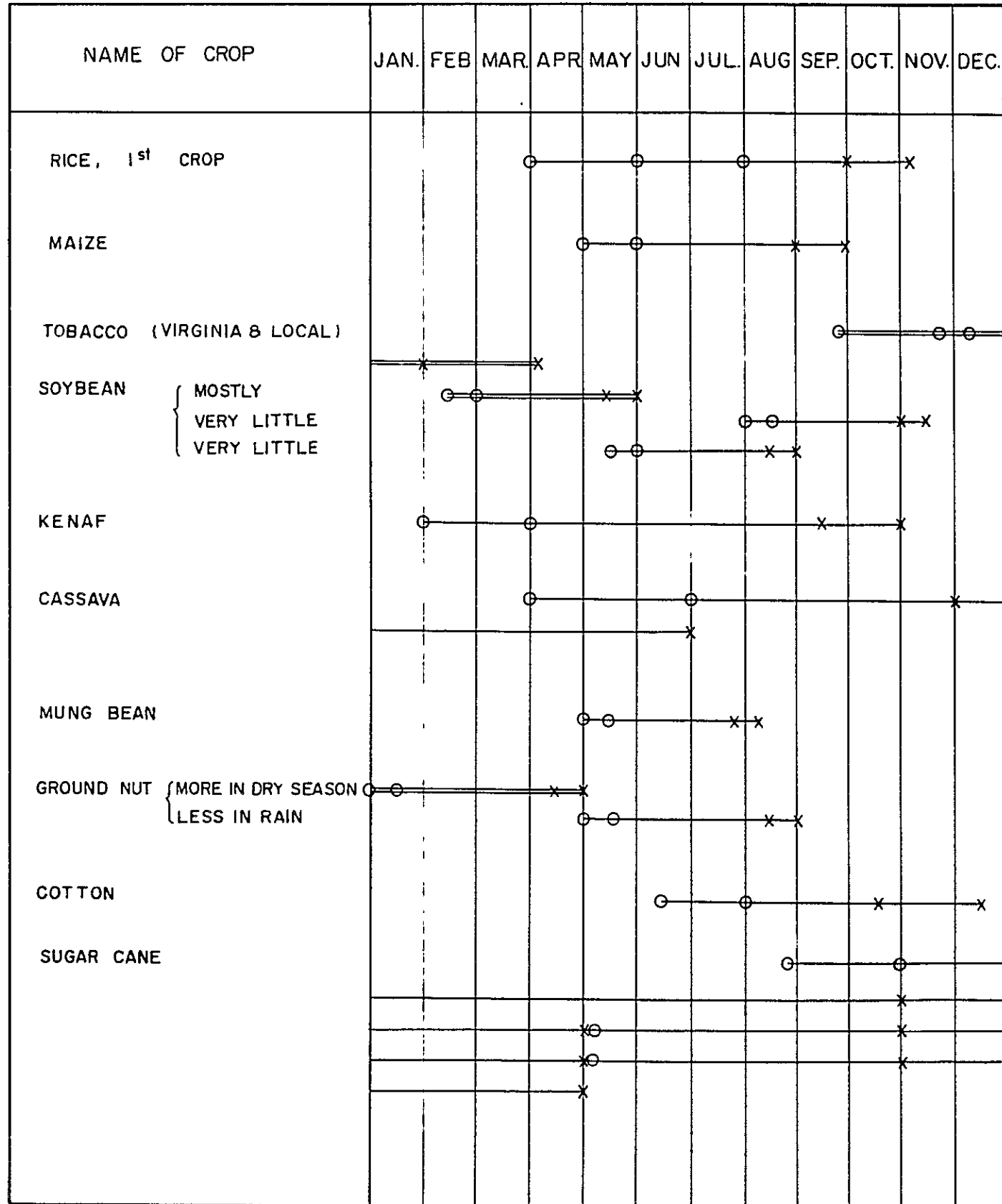


Figure 9.3.2 CROPPING CALENDAR

0200 CHANGWAT UDON THANI



Note

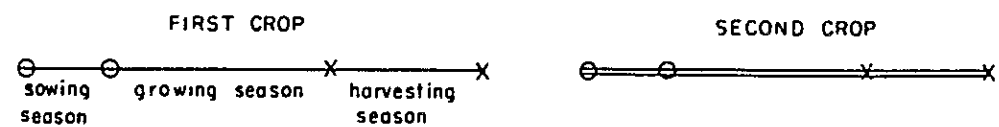


TABLE 9.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM²)]

AMPHOE	AMPHOE	CULTIVATED LAND			UNUSED CULTIVABLE LAND				
		CODE	NAME	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
				89.375 (143.0)	11.875 (19.0)	101.250 (162.0)	-	10.500 (16.8)	10.500 (16.8)
0216	KUMPHAWAPI			26.250 (42.0)	6.875 (11.0)	33.125 (53.0)	-	-	-
0217	NONG HAN			63.125 (101.0)	5.000 (8.0)	68.125 (109.0)	-	10.500 (16.8)	10.500 (16.8)

TABLE 9.3.2 CROP PRODUCTION

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)										
1981	95.12	0.05	-	0.13	3.02	6.54	2.22	-	11.97	107.09
1987	95.12	0.05	-	0.12	3.19	6.51	2.08	-	11.97	107.09
1993 WITHOUT PROJECT	95.12	0.05	-	0.11	3.36	6.48	1.95	-	11.97	107.09
WITH PROJECT	95.12	0.05	-	0.10	3.29	6.72	1.80	-	11.97	107.09
2001 WITHOUT PROJECT	95.12	0.05	-	0.10	3.60	6.41	1.78	-	11.97	107.09
WITH PROJECT	95.12	0.05	-	0.09	3.52	6.65	1.64	-	11.97	107.09
CROP YIELD (KG/RAI)										
1981	262.2	233.6	-	128.3	1975.8	6555.5	134.1	-		
1987	262.2	235.0	-	128.3	1975.8	6595.0	134.1	-		
1993 WITHOUT PROJECT	262.2	236.4	-	128.3	1975.8	6634.6	134.1	-		
WITH PROJECT	265.4	240.7	-	129.9	1987.7	6674.5	134.1	-		
2001 WITHOUT PROJECT	262.2	238.3	-	128.3	1975.8	6687.9	134.1	-		
WITH PROJECT	269.7	248.5	-	132.0	2003.6	6782.0	134.1	-		
CROP PRODUCTION (TON)										
1981	24,943	13	-	16	5,962	42,849	297	-	49,139	74,082
1987	24,943	13	-	15	6,300	42,939	279	-	49,547	74,490
1993 WITHOUT PROJECT	24,943	13	-	14	6,647	42,961	261	-	49,898	74,841
WITH PROJECT	25,244	12	-	13	6,538	44,828	241	-	51,633	76,877
2001 WITHOUT PROJECT	24,943	13	-	13	7,122	42,887	239	-	50,275	75,218
WITH PROJECT	25,651	12	-	12	7,058	45,086	220	-	52,390	78,041

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 9.3.3 FARMGATE PRICE AND PRODUCTION COST

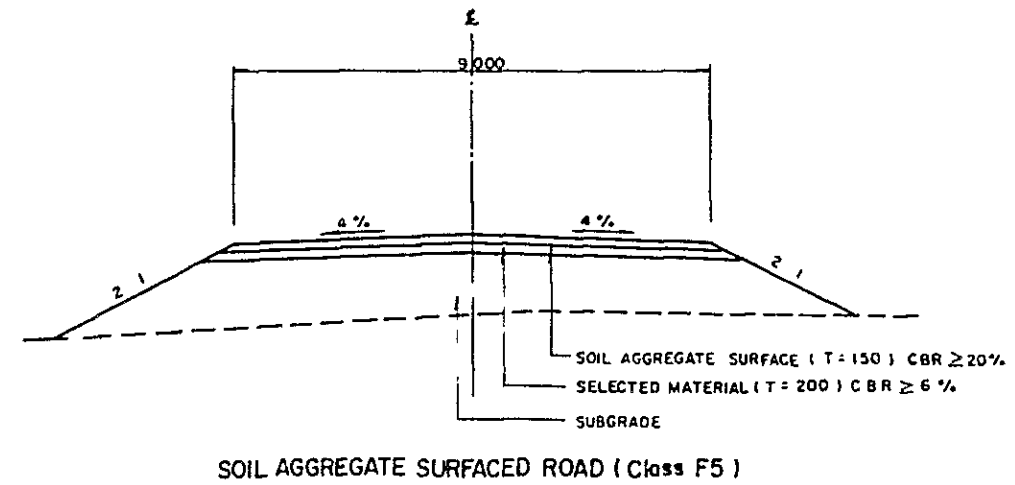
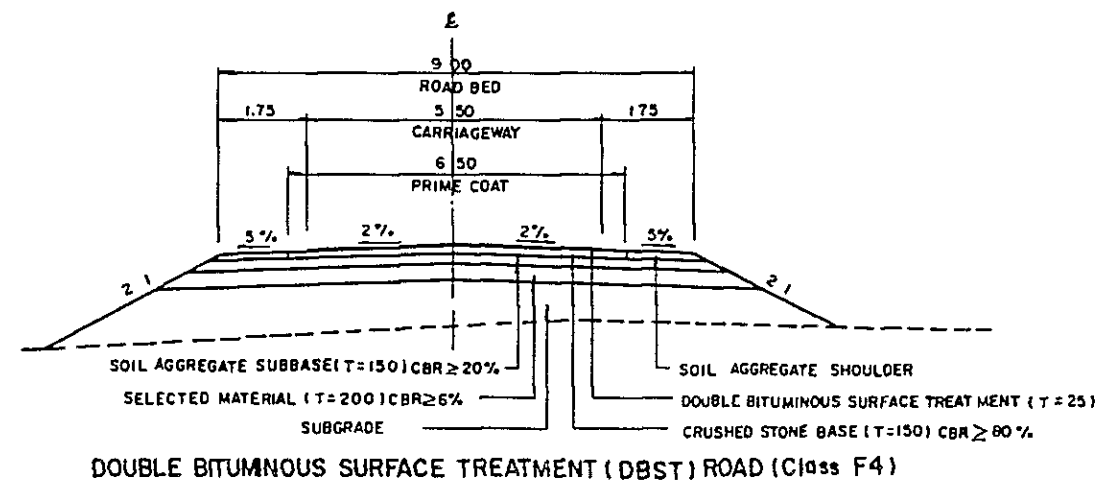
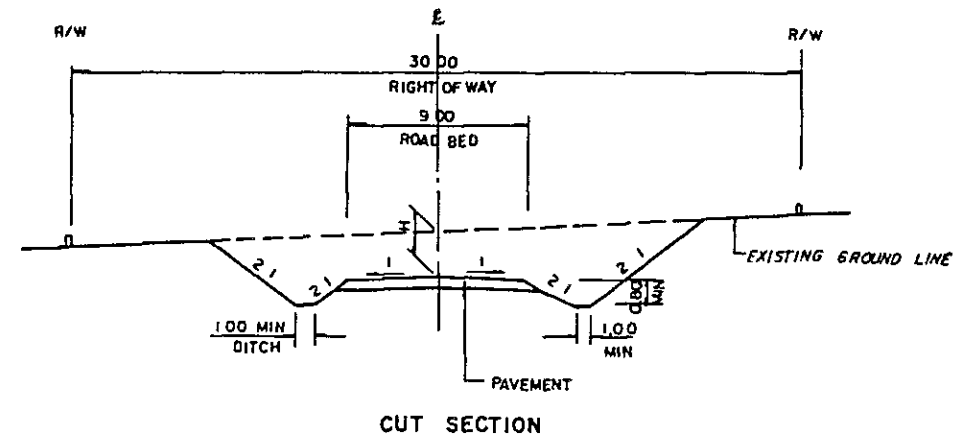
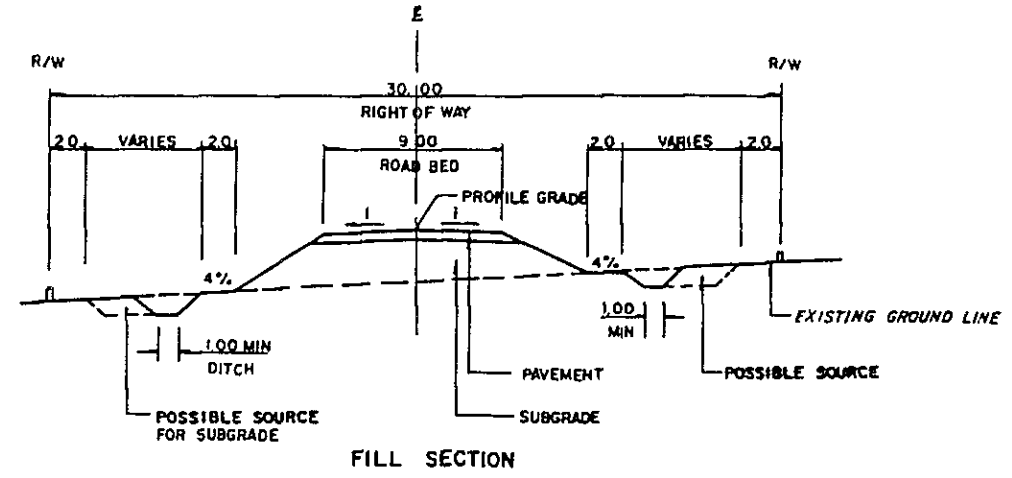
ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,887	2,750	-	9,641	597	671	4,511	-
WITH PROJECT (1987 - 2001)	3,984	2,819	-	9,641	612	671	4,624	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	612	438	-	1,010	759	2,506	509	-
WITH PROJECT (1987 - 2001)	625	458	-	1,010	788	2,506	509	-

TABLE 9.3.4 NET PRODUCTION VALUE

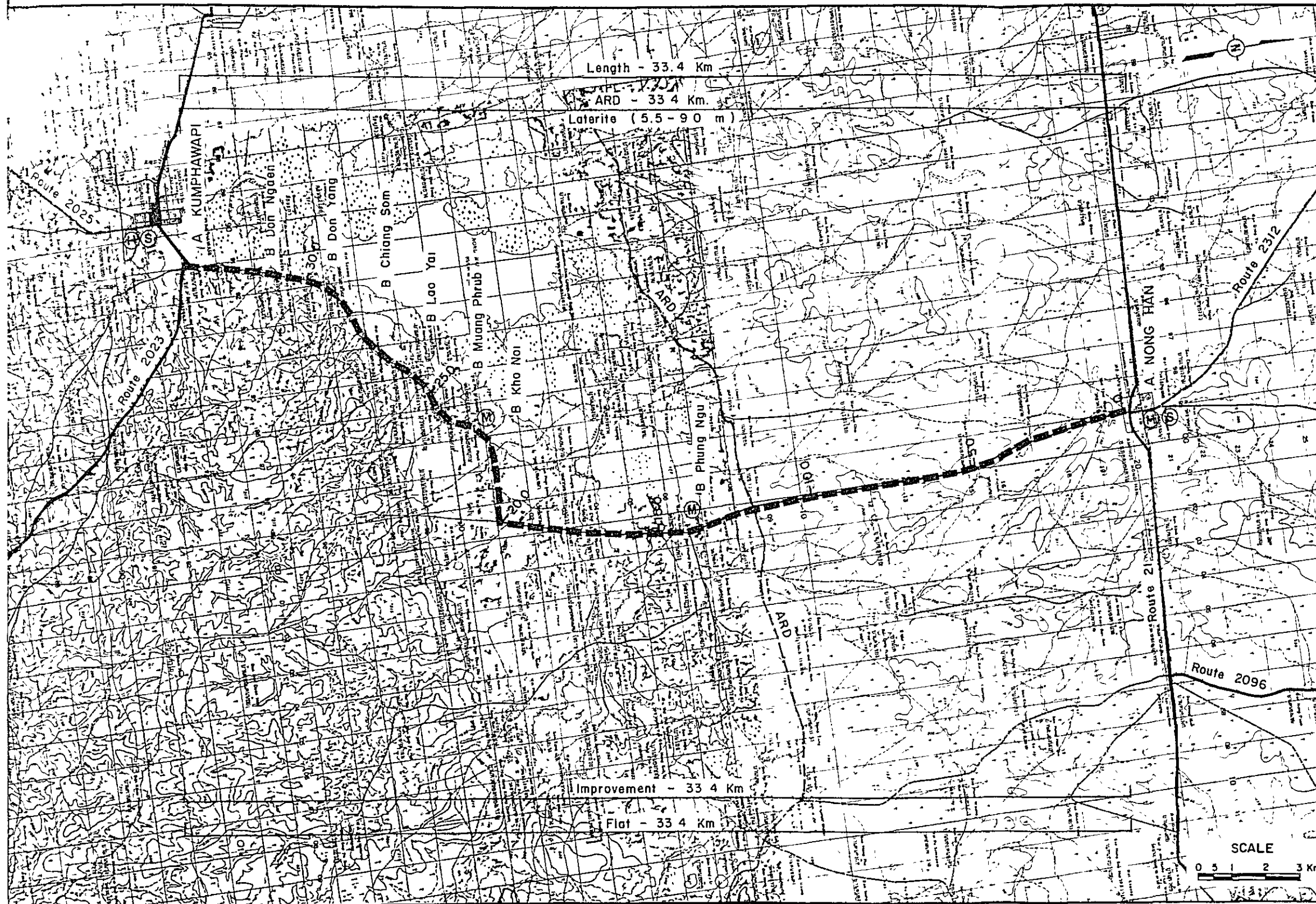
(1000 BAHT)

YEAR	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	38,738	14,076	52,814	39,953	14,111	54,064
1993	38,738	14,240	52,978	41,151	14,896	56,047
2001	38,738	14,432	53,170	42,772	15,360	58,132

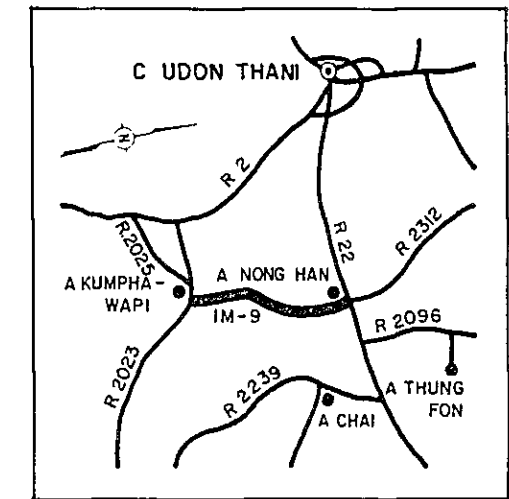
Figure 9.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE



PROPOSED ROUTE NO. IM-9 C. UDON THANI - A. NONG HAN (J.R. 22) - A. KUMPHAWAPI (J.R. 2023)
 ROUTE NO. ARD L = 33.4 Km.



LOCATION MAP



BRIDGE LIST

No	Station Km.	Proposed Bridge	Existing Bridge
1	1.1	C-7 00 x 18 00	W-4 50 x 15 00
2	3.0	C-7 00 x 7 00	W-4 50 x 5 00
3	10.7	C-7 00 x 12 00	W-4 50 x 10 00
4	12.7	C-7 00 x 12 00	W-4 50 x 9 50
5	12.9	C-7 00 x 18 00	W-4 50 x 15 50
6	13.9	C-7 00 x 12 00	W-4 50 x 10 00
7	16.0	C-7 00 x 32 00	W-4 50 x 30 00
8	17.4	C-7 00 x 28 00	W-4 50 x 25 50
9	19.2	C-7 00 x 12 00	W-4 50 x 10 00
10	19.4	C-7 00 x 12 00	W-4 50 x 9 00
11	19.9	C-7 00 x 8 00	W-4 50 x 5 50
12	27.1	C-7 00 x 18 00	W-4 50 x 16 00
13	29.0	C-7 00 x 12 00	W-4 00 x 9 00
14	33.3	C-7 00 x 18 00	W-4 50 x 16 00

LEGEND

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

Table 9.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-9 (33.4 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	74	1,110	1,010	74	1,110	1,010
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	110,700	4,981	4,523	110,700	4,981	4,533
Selected Material	m ³	80	70,800	5,664	5,040	70,800	5,664	5,040
Soil Aggregate Surface or Subbase	m ³	105	49,600	5,208	4,635	49,600	5,208	4,635
Crushed Stone Base	m ³	370	32,600	12,062	11,097	4,400	1,628	1,497
Soil Aggregate Shoulder	m ³	105	14,000	1,470	1,308	1,900	199	177
Prime Coat and DBST	m ²	55	183,700	10,104	9,094	24,800	1,364	1,227
Pipe Culvert	m	2,100	1,440	3,024	2,782	1,440	3,024	2,782
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	219	8,760	7,796	219	8,760	7,796
Sub Total (a)				52,384	47,297	31,939	28,700	
Miscellaneous Works (a) x 7%				3,667	3,311	2,235	2,009	
Total (b)				56,051	50,608	34,174	30,709	
PHYSICAL CONTINGENCY (b) x 15%				8,408	7,591	5,126	4,606	
ENGINEERING AND ADMINISTRATION (b) x 10%								
Sub Total				14,013	12,652	8,543	7,676	
LAND ACQUISITION								
Highly Developed Land	ha	50,000	50	2,500	2,500	50	2,500	2,500
Less Developed Land	ha	15,000	0	0	0	0	0	0
Sub Total				2,500	2,500	2,500	2,500	
GRAND TOTAL				72,564	65,760	45,218	40,887	

Table 9.6.1 COST AND BENEFITS

(F4 STANDARD)

(1000 BAHT)

YEAR	COST		BENEFITS			DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
1984	13,152	0	0	0	0	13,152	0
1985	32,880	0	0	0	0	32,880	0
1986	19,728	0	0	0	0	19,728	0
1987	0	1,250	6,393	1	7,644	0	6,825
1988	0	1,553	6,791	15	8,359	0	6,664
1989	0	1,856	7,189	29	9,075	0	6,459
1990	0	2,160	7,588	43	9,790	0	6,222
1991	0	2,463	7,986	57	10,506	0	5,961
1992	0	2,766	8,384	71	11,221	0	5,685
1993	0	3,069	8,782	86	11,937	0	5,400
1994	16,166	3,306	9,334	107	12,747	7,313	5,148
1995	0	3,542	9,886	128	13,557	0	4,889
1996	0	3,779	10,438	150	14,367	0	4,626
1997	0	4,016	10,990	171	15,177	0	4,363
1998	0	4,252	11,542	193	15,987	0	4,104
1999	0	4,489	12,094	214	16,797	0	3,850
2000	0	4,725	12,646	236	17,607	0	3,603
2001	-31,600	4,962	13,198	257	18,418	-5,773	3,365
TOTAL	50,326	48,187	143,242	1,758	193,188	83,357	77,162

DISCOUNTED ECONOMIC COSTS :	83,357
DISCOUNTED ECONOMIC BENEFITS :	77,162
AGRICULTURAL DEVELOPMENT BENEFIT	18,212
VOC SAVING	58,401
RMC SAVING	549
NET PRESENT VALUE :	-6,195
BENEFIT COST RATIO :	0.93
INTERNAL RATE OF RETURN :	11.1 %

Table 9.7.1 SOCIAL INDICATORS
(Proposed Route IM-9)

Population (1,000)		Education	
1982	: 27.9	Access to Secondary School	
1993	: 32.5	Number of Student in 1993 (1,000) ^{2/}	: 7.8
Average travelling speed, without (kph)	: 48	Average distance to school (km)	: 8.3
Isolation		Per capita time savings (10 ⁻⁴)	: 0.074
Access to Amphoe		Score	: 40
Average distance to Amphoe (km) ^{1/}	: 9.5	Teacher Intensity	
Per capita time savings (10 ⁻⁴)	: 0.020	Number of teachers ^{3/}	
Score	: 59	University graduate	: -
Access to Artery Highway		Total	: 9
Average distance to highway (km) ^{1/}	: 0	Number of Student	: 264
Per capita time savings (10 ⁻⁴)	: 0	Indicators	
Score	: 0	E1 ^{4/}	: -
Impassability		E2 ^{5/}	: 34.1
Impassable week a year	: 1	E ^{6/}	: 34.1
Impassability per year	: 0.019	Degree of Improvement ^{7/}	: 2.01
Impassability per capita (10 ⁻⁴)	: 0.006	Score	: 128
Score	: 50	Disparity	
Health		G.P.V. in 1993 (Mn B) ^{8/}	
Access to Hospital		With project	: 135.9
Average distance to Hospital (km) ^{1/}	: 8.3	Without project	: 131.1
Per capita time savings (10 ⁻⁴)	: 0.018	Per capita G.P.V. in 1993 (B)	
Score	: 42	With project (W)	: 4,182
Access to Medical Facilities		Without project (w)	: 4,034
Average distance to facilities (km) ^{1/}	: 3.2	Degree of Disparity	
Per capita time savings (10 ⁻⁴)	: 0.007	(A/W) - (A/w) ^{9/}	: 0
Score	: 28	Score	: 0
		Total Score	: 347

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 - 10

Changwat : Udon Thani / Nong Khai

A. Phen (J.R. 2022) - J.R. 212

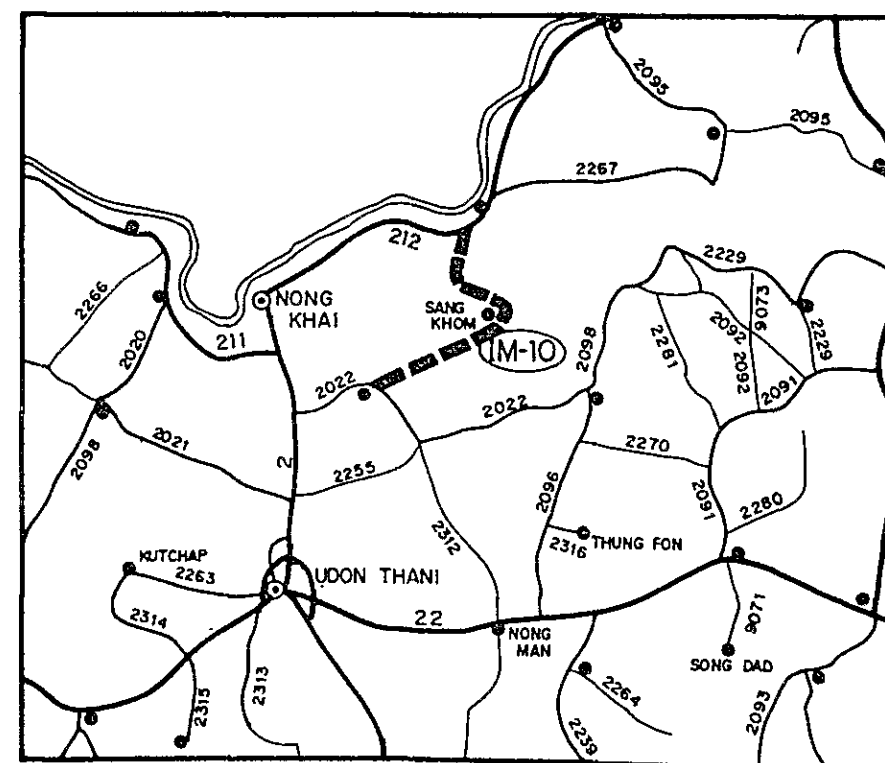
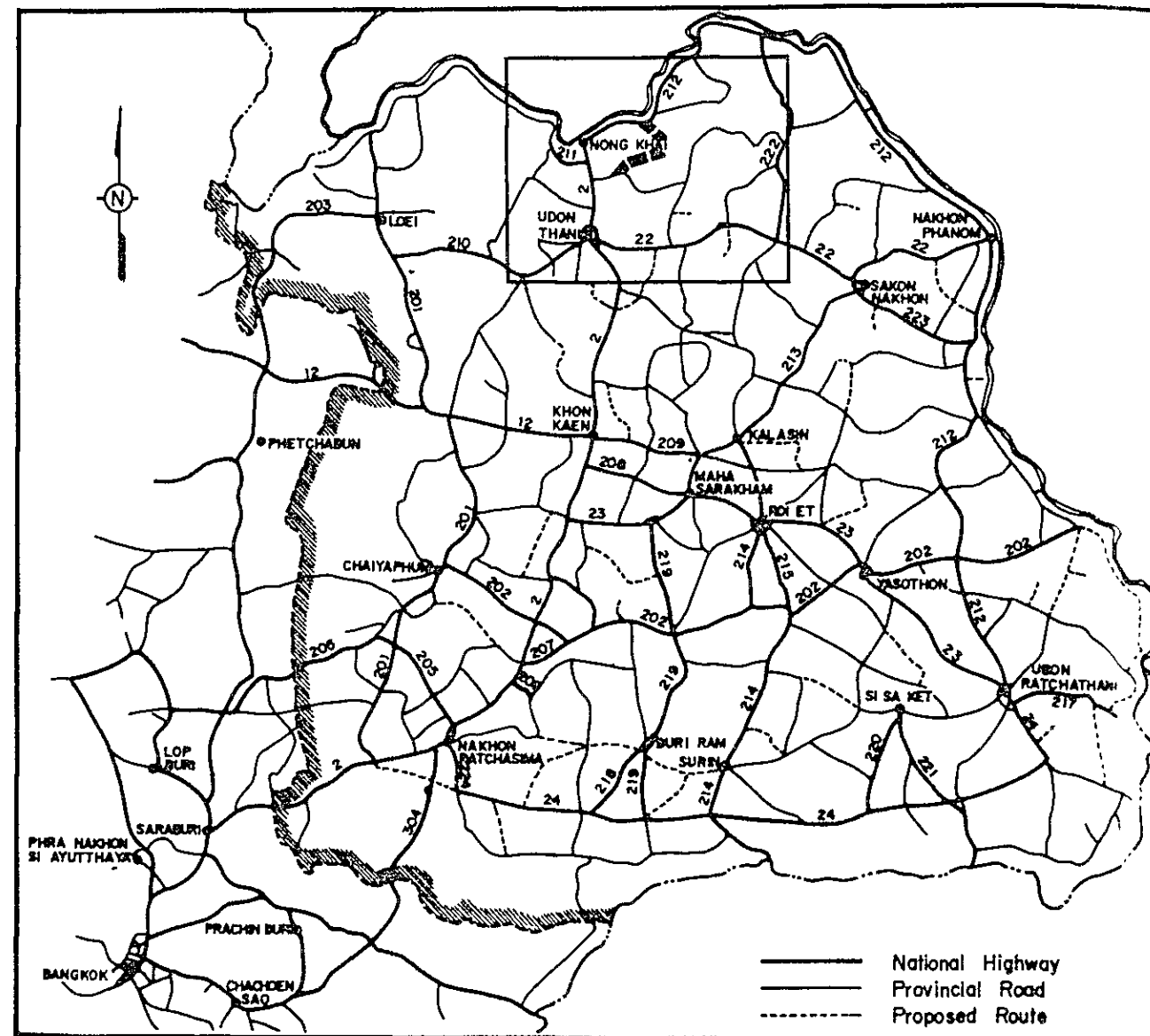
Length · 48.1 KM.

LOCATION OF PROPOSED ROUTE

SUMMARY PROPOSED ROUTE IM-10

Item	Description
Changwat	Udon Tani/Nong Khai
Origin	A. Phen (J.R.2022)
Destination	J.R.212
Length	
Total	48.1 km
Improvement Section	48.1 km
DOH Road	0 km
ARD Road	48.1 km
Others	0 km
New Alignment Section	0 km
Surface Type and Condition	Soil Aggregate, Good ~ Poor
Terrain	Flat and Rolling
Influence Area	
Area	411 km ²
Population (1982)	32,200
Principal Crops	Paddy
Traffic (ADT)	
Existing	157
1993	485
2001	615
Proposed Standard	F4 (DBST)
Total Section	
Construction Cost	
Financial	87,680 . 10 ³ ฿
Economic	79,533 . 10 ³ ฿
IRR	7.7 %
B/C	0.68
Section 1 (26 km) ^{1/}	
Construction Cost	
Financial	45,614
Economic	41,344
IRR	12.4 %
B/C	1.03
Recommendation	For immediate implementation of Section 1

^{1/} A section which has ADT of more than 300 in 7th year after opening.



1. GENERAL

1.1 Characteristics of the Route

The proposed route extends in two Changwat of Udon Thani and Nong Khai.

The route starting at Amphoe Phen on Route 2022 runs northeastward passing through Ban Nam Chum, King Amphoe Sang Khom and Ban Chaeng Dan and ends at the intersection with Route 212. Its total length is 48.1 km. (Figure 10.5.2)

The terrain is almost flat and rolling. In the influence area, there exists several village with total population of 32,200. There are three medical centers, one hospital and two secondary schools along the proposed route.

The proposed route, upon completion, will form an important part of road network to connect two artery highways, Route 2022 and 212 in the agriculturally developed area and also play vital role to connect King Amphoe Sang Khom.

1.2 Condition of Existing Road

Condition of existing roads to be utilized for the proposed route is summarized in Table 10.1.1. The details are shown as the results of inventory survey in Table 10.1.2.

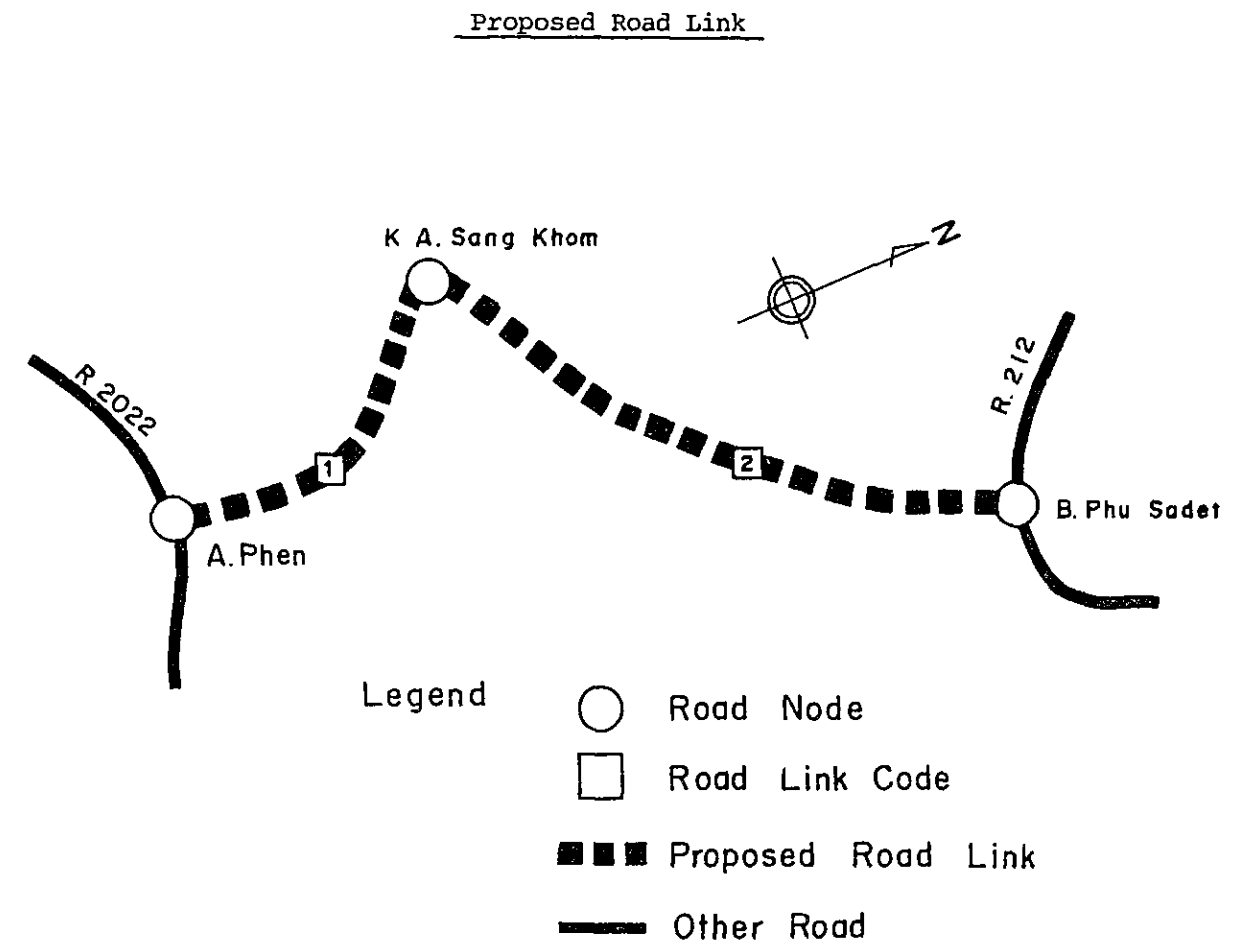
2. TRAFFIC

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:



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	2	37	5	5	5	4	32	142	-	234
	2	-	44	1	4	1	5	3	8	-	66

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	557
2	303

FREIGHT MOVEMENT (1982)

PROPOSED ROAD LINK	TONNAGE PER DAY		
	NON-AGRI.	AGRI.	TOTAL
1	100	234	334
2	7	16	23

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	1993
	1987	1993	2001
PER CAPITA INCOME	4.2	4.5	4.7
TRANS. PRICE INCREASE	4.5	4.5	4.5
POPULATION	2.1	1.7	1.5
PASSENGER MOVEMENT	6.1	6.1	6.1

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981	1987	1993
	1987	1993	2001
NON-AGRI. AGRICULTURE	7.9	7.9	7.9
	0.4	0.4	0.4
FREIGHT	2.6	2.6	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	2.8	2.9

2.6 Future Traffic

1) Traffic Composition

The movements of passenger and freight traffic 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	3.6	66.1	8.9	12.5	8.9	2.2	18.0	79.8	0.0
	1987	7.2	62.4	9.5	12.8	8.1	6.1	17.5	68.0	8.4
	1993	11.6	58.1	10.1	13.1	7.2	10.8	16.8	53.9	18.5
	2001	17.4	52.2	11.0	13.5	5.9	17.0	16.0	35.0	32.0
2	1982	0.0	88.0	2.0	8.0	2.0	31.3	18.8	50.0	0.0
	1987	5.8	82.2	2.6	7.3	2.1	27.5	18.0	46.1	8.4
	1993	12.7	75.3	3.4	6.5	2.2	23.0	17.2	41.3	18.5
	2001	22.0	66.0	4.3	5.3	2.3	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 10.2.1.

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	6	5	9	5	67	19	71	9	190	228	419
1993	15	9	13	6	94	17	54	19	228	258	485
2001	40	17	21	9	137	16	35	32	307	309	615

3. AGRICULTURAL DEVELOPMENT

3.1 Present Condition

Almost all of cultivated land in the influence area is covered by paddy fields. In the upland field, cassava ranks first followed by kenaf, ground-nuts, beans and sugar cane. Unused cultivable land for both paddy and upland field is scattered in the area.

Land use and capability conditions in the area of influence are shown in Table 10.3.1, and Figure 10.3.1.

Typical cropping calendars in the Udon Thani and Non Khai areas are shown in Figure 10.3.2.

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 10.3.2.

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 10.3.3.

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 10.3.4. 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 No.	Terrain	Without Project				With Project					
		Length (km)	1) Road Class	Nos. of Wooden Bridge	Nos. of Narrow C. Bridge	Length (km)	Load Class 1)				Nos. of Wooden Narrow Bridge
							Case 1	Case 2	Case 3	Case 4	
1	Rolling	26.0	2B	2	0	26.0	1 (F4)	1 2A	1 -	1 2A (F5)	0
2	Flat & Rolling	22.1	3	1	0	22.1					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)	5,921	8,434	12,204
1+2A (F4+F5)	5,468	7,860	11,388
1 (F4: only Link 1)	4,708	6,760	9,713
2A (F5)	3,013	5,177	8,137

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 10.5.1
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 _{>} 80%	: 15.0cm
Soil Aggregate Subbase CBR _{>} 20%	: 15.0cm
Selected Material CBR _{>} 6%	: 20.0cm

In case of F5 Standard

Soil Aggregate Surface CBR_{>20%} : 15.0cm
 Selected Material CBR_{> 6%} : 20.0cm

Pipe Culvert

Standard Size : ø 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 10.5.2

Alignment of the route is shown in Figure 10.5.2.

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 10.5.1.

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)	48.1	87,680	79,533	
F5 (Laterite)	48.1	53,516	48,457	
F4 + F5	48.1	69,147	62,674	
	F4	45,614	41,344	Adopted to link >300 in ADT
	F5	23,532	21,328	Adopted to link <300 in ADT

6. ECONOMIC EVALUATION

Yearly distribution of the economic costs and benefits, and the calculated economic indicators for evaluation are given in Table 10.6.1, 10.6.2, 10.6.3 and 10.6.4.

The result indicates that the proposed project seems to be not feasible under F4 Standard but a partial section of higher ADT will be feasible under F4 Standard.

7. SOCIAL IMPACTS

Detailed data and results of quantification of indication of social impacts are tabulated in Table 10.7.1.

Table 10.1.1 SUMMARY OF ROAD INVENTORY

Item	Description	
Origin	A. Phen (J.R. 2022)	
Destination	J.R. 212	
Length		
Total		48.1 km
Improvement Section		48.1 km
DOH Road		0 km
ARD Road		48.1 km
Others		0 km
New Alignment Section		0 km
Terrain	Flat and Rolling	
Alignment (Hori./Vert.)	Fair / Fair	
Formation Width	5.0 m - 8.0 m, 6.5 m (Weighted average)	
Embankment Section		
Length		48.1 km
Height	0.2 m - 1.5 m	
Cut Section		
Length		0 km
Depth	m - m	
Surface Type and Condition		
SBST or DBST	Good	1.0 km
Soil Aggregate	Good - Poor	47.1 km
Earth		0 km
Pipe Culvert	2 each	
Box Culvert	0 each	0 m
Bridge		
Permanent Bridge	1 each	40.0 m
Narrow Concrete Bridge	0 each	0 m (4m)
Wooden Bridge	3 each	75.5 m
Overflow Section	0 place	0 km

Table 10.1.2 ROAD INVENTORY(1)

PROPOSED ROUTE NO. IM-10

ROUTE NO. ARD

A. PHEN (J.R. 2022) ~ J.R. 212

L = 48.1 Km

UDON THANI / NONG KHAI

STATION (Km)		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	
VILLAGE																		
- Name																		
- Household (H)																		
- Population (P)																		
TERRAIN		Rolling												Flat				
CROSS SECTION	Formation Width (m)	5.50	7.00		8.00	6.00		8.00					6.50		6.00	7.00		
	Embankment Height (m)	0.20	0.70	1.00	0.40	0.20	1.00	0.20	0.50	1.50	0.30	0.50	0.20	0.20	0.20	0.40		
	Cutting Depth (m)																	
PAVEMENT	Type/Length	D.T.												Laterite				
	Condition	Good												Poor				
FLOODING	Overflow Length(Km)/Height(m)																	
LAND USE	Left	Bush				Paddy				Bush				Swamp				
	Right					Paddy				Bush				Swamp				
PIPE CULVERT	Total Number	43 Pipes																
BOX CULVERT & BRIDGE	Station (Km)	1.0																
	Dimension	C-Br. 7.00 x 40.00																
										W-Br. 4.00 x 28.50	16.0		W-Br. 4.00 x 23.00	18.6			W-Br. 4.80 x 24.00	29.2
RIGHT OF WAY (m)		15.0																
ALIGNMENT	Horizontal	Poor												Fair				
	Vertical	Poor												Fair				
ROUTE NO., AGENCIES		ARD																

ROAD INVENTORY

PROPOSED ROUTE NO. IM-10

ROUTE NO. ARD

A. PHEN (J.R. 2022) ~ B. PAK BUAI (J.R. 212) (Cont'd)

L = 48.1 Km.

UDON THNAI / KHON KAEN

STATION (Km)		30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
VILLAGE				R. SOM PHON H = 20 P = 100		B. CHAENG DA H = 98 P = 980		B. SNAG NANG KHAO H = 80 P = 640									
TERRAIN		Flat			Rolling												
CROSS SECTION	Formation Width (m)	5.00	5.50	6.00	5.00		6.00	7.00	5.50								
	Embankment Height (m)	0.60	0.50	0.20	0.30	0.60	0.30	0.40	0.60	0.50							
	Cutting Depth (m)																
PAVEMENT	Type/Length	Laterite															
	Condition	Poor															
FLOODING	Overflow Length(Km)/Height(m)																
LAND USE	Left	Paddy	Bush	Paddy													
	Right	Paddy	Bush	Paddy													
PIPE CULVERT	Total Number																
BOX CULVERT & BRIDGE	Station (Km)																
	Dimension																
RIGHT OF WAY (m)								15.0									
ALIGNMENT	Horizontal	Fair			Poor												
	Vertical	Fair			Poor												
ROUTE NO., AGENCIES		ARD															

Table 10.2.1 TRAFFIC VOLUME ON ROUTE IM -10

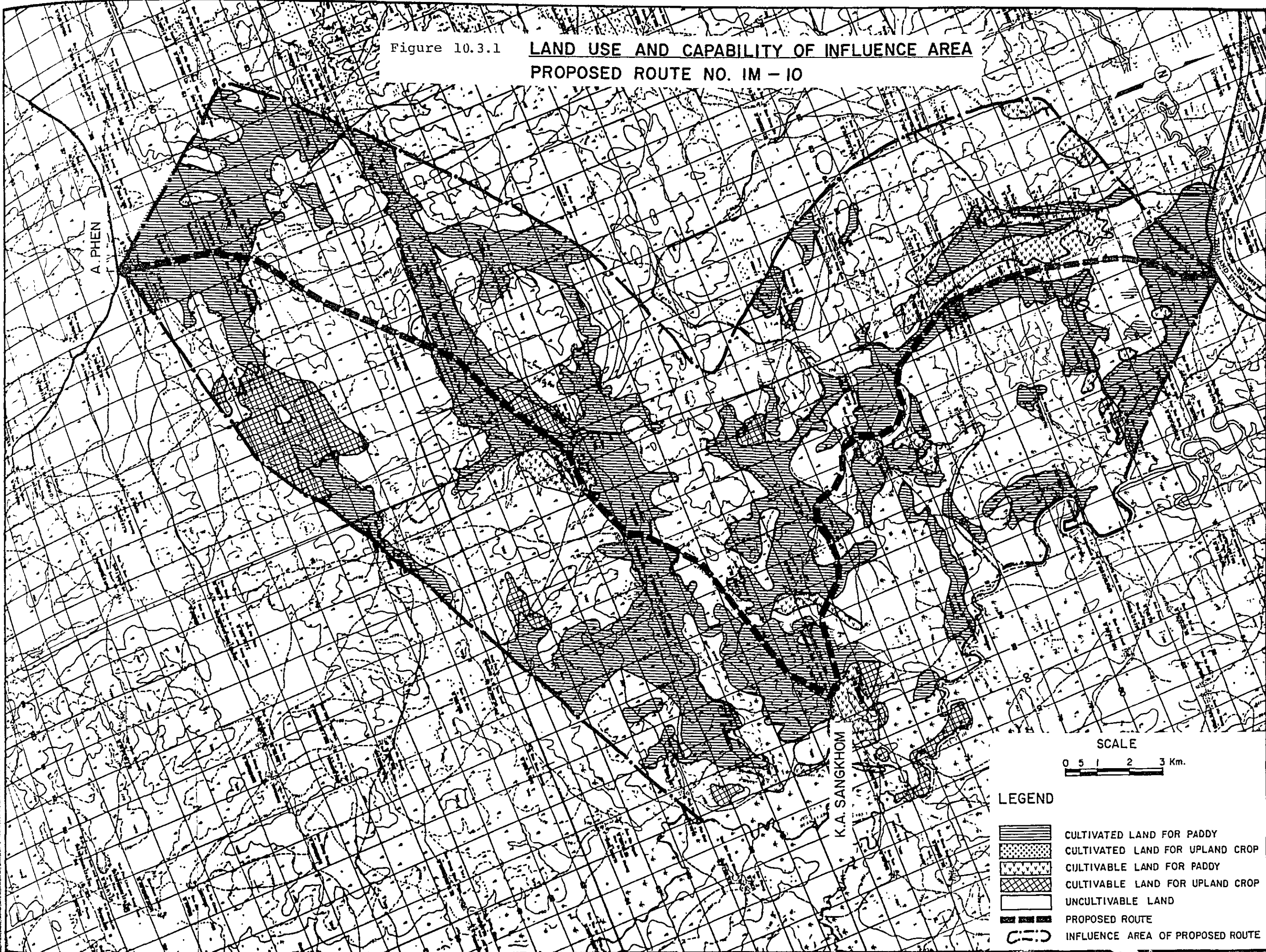
YEAR	1987			1993			2001			
LINK	1	2	AVR.	1	2	AVR.	1	2	AVR.	
P/C	N+D	6	4	5	13	13	13	33	35	34
	I	1	1	1	2	2	2	5	5	5
	DV	0	0	0	0	0	0	1	1	1
	TOTAL	6	5	6	15	15	15	39	42	40
L/B	N+D	7	2	5	11	3	8	21	7	14
	I	1	0	1	2	0	1	3	1	2
	DV	0	0	0	0	0	0	1	0	0
	TOTAL	8	2	5	13	4	9	24	8	17
M/B	N+D	10	5	8	15	6	11	25	9	18
	I	1	1	1	2	1	2	4	1	3
	DV	0	0	0	0	0	0	1	0	1
	TOTAL	11	6	9	17	8	13	30	10	21
H/B	N+D	6	1	4	8	2	5	11	4	8
	I	1	0	1	1	0	1	2	1	1
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	7	2	5	10	3	6	13	4	9
P/P&T	N+D	58	59	59	82	77	79	123	108	116
	I	9	9	9	12	11	12	18	16	17
	DV	0	0	0	3	2	3	4	4	4
	TOTAL	67	68	67	97	91	94	145	128	137
4/T	N+D	28	2	16	25	2	15	23	2	13
	I	4	0	2	4	0	2	4	0	2
	DV	0	0	0	1	0	0	1	0	0
	TOTAL	32	3	19	30	2	17	28	2	16
6/T	N+D	109	6	62	81	5	46	51	3	29
	I	16	1	9	12	1	7	8	1	4
	DV	0	0	0	3	0	1	2	0	1
	TOTAL	126	7	71	96	5	54	61	4	35
10/T	N+D	14	1	8	28	2	16	47	3	27
	I	2	0	1	4	0	2	7	0	4
	DV	0	0	0	1	0	1	2	0	1
	TOTAL	16	1	9	33	2	19	55	4	32
ADT	N+D	238	81	166	263	109	192	334	171	259
	I	36	12	25	39	16	29	50	26	39
	DV	0	0	0	9	4	6	11	6	9
	TOTAL	273	93	190	311	129	228	395	202	307
M/C	N+D	273	136	210	290	167	234	331	224	282
	I	22	14	18	23	17	20	23	20	22
	DV	0	0	0	5	3	4	5	4	4
	TOTAL	295	150	228	318	187	258	360	249	309
TOTAL	N+D	511	216	375	553	277	426	666	395	541
	I	58	26	43	62	33	49	74	46	61
	DV	0	0	0	13	7	10	16	10	13
	TOTAL	569	242	419	629	317	485	755	451	615

NOTE

N : NORMAL TRAFFIC
 DV : DEVELOPED TRAFFIC

D : DIVERTED TRAFFIC
 I : INDUCED TRAFFIC

Figure 10.3.1 **LAND USE AND CAPABILITY OF INFLUENCE AREA**
PROPOSED ROUTE NO. IM - 10



SCALE
 0 5 1 2 3 Km.

LEGEND








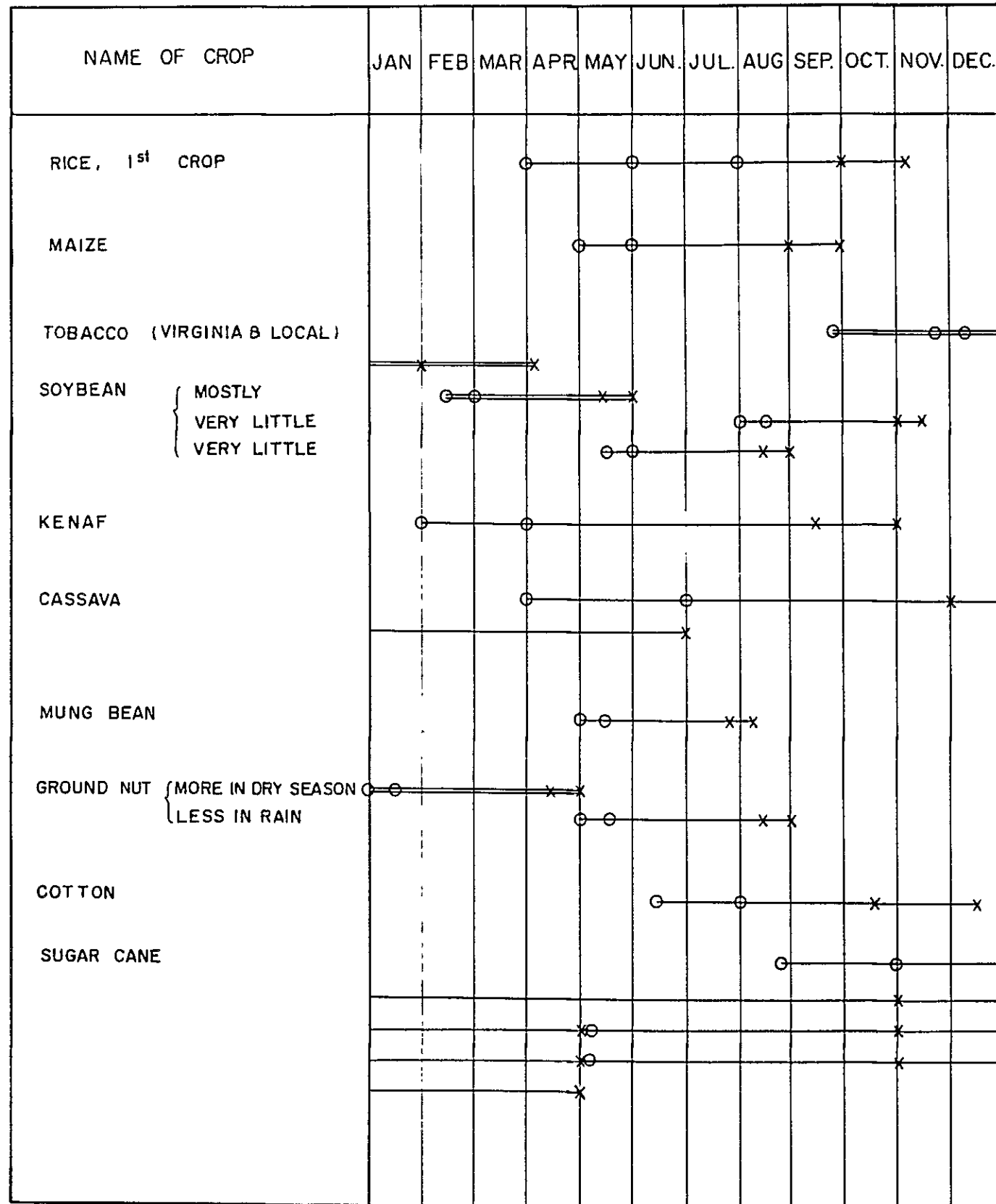
-  CULTIVATED LAND FOR PADDY
-  CULTIVATED LAND FOR UPLAND CROP
-  CULTIVABLE LAND FOR PADDY
-  CULTIVABLE LAND FOR UPLAND CROP
-  UNCULTIVABLE LAND
-  PROPOSED ROUTE
-  INFLUENCE AREA OF PROPOSED ROUTE

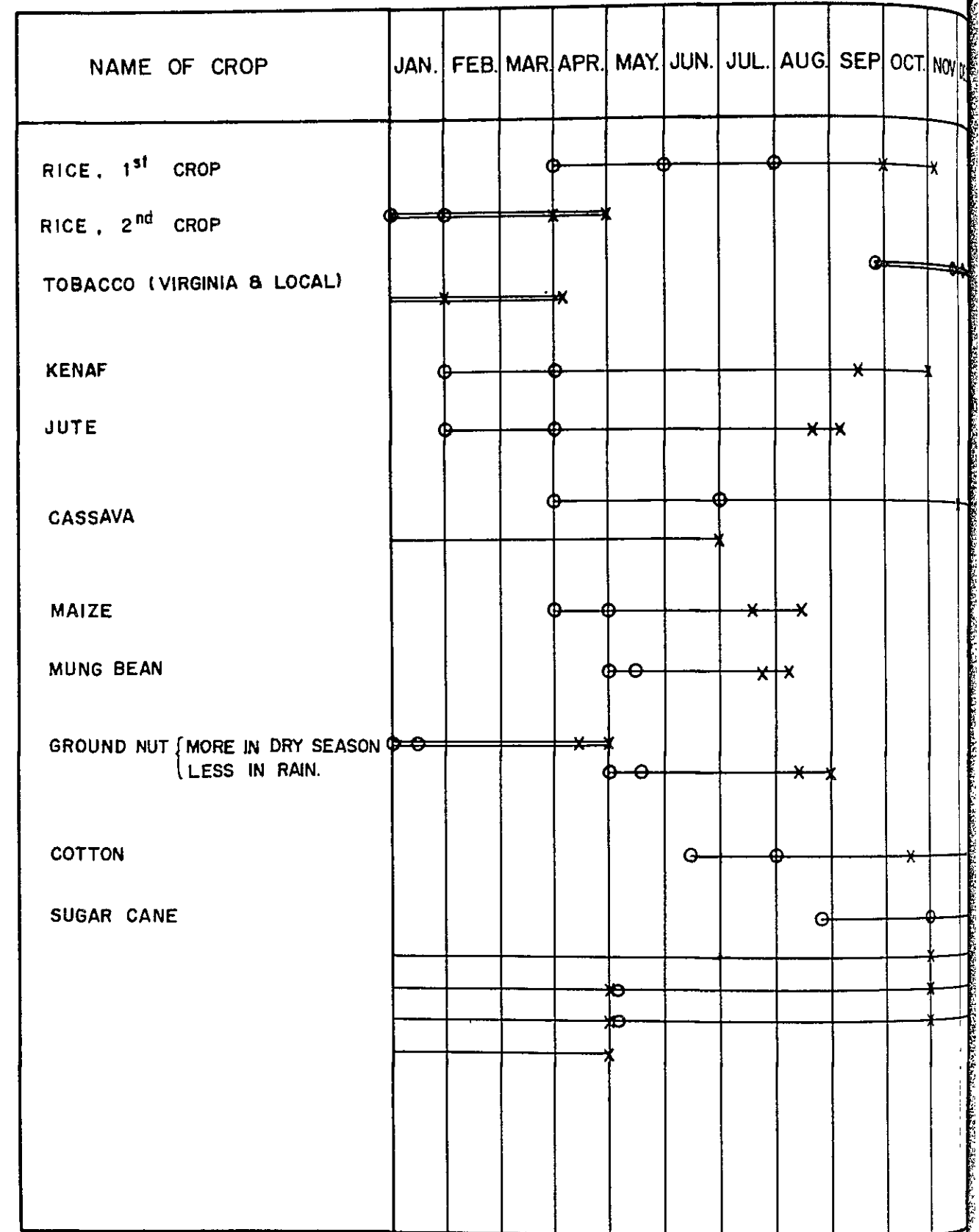
Figure 10.3.2 CROPPING CALENDAR(1)

0200 CHANGWAT UDON THANI



CROPPING CALENDAR(2)

0300 CHANGWAT NONGKHAI



Note :

TABLE 10.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM²)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		60.000 (96.0)	0.125 (0.2)	60.125 (96.2)	9.500 (15.2)	8.125 (13.0)	17.625 (28.2)
0206	PHEN	21.250 (34.0)	0.125 (0.2)	21.375 (34.2)	0.125 (0.2)	5.000 (8.0)	5.125 (8.2)
0207	SANG KHOM	25.625 (41.0)	-	25.625 (41.0)	3.750 (6.0)	3.125 (5.0)	6.875 (11.0)
0305	PHON PHISAI	13.125 (21.0)	-	13.125 (21.0)	5.625 (9.0)	-	5.625 (9.0)

TABLE 10.3.2 CROP PRODUCTION

ITEM	PADDY	MAIZE	BEANS	GRIND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON	UPLAND TOTAL	TOTAL
PLANTED AREA (1000 RAI)										
1981	65.66	-	0.22	0.89	3.28	0.11	1.65	-	6.20	71.86
1987	66.06	-	0.22	0.89	3.48	0.12	1.65	-	6.36	72.41
1993	WITHOUT PROJECT	66.45	-	0.22	0.89	0.13	1.65	-	6.58	73.03
	WITH PROJECT	68.06	-	0.22	0.89	4.16	0.13	-	7.04	75.10
2001	WITHOUT PROJECT	66.99	-	0.22	0.89	4.00	0.14	-	6.89	73.88
	WITH PROJECT	68.61	-	0.22	0.89	4.50	0.14	-	7.39	76.00
CROP YIELD (KG/RAI)										
1981	260.7	-	180.0	121.9	2232.1	6000.0	122.3	-		
1987	260.7	-	180.0	122.6	2232.1	6036.1	122.3	-		
1993	WITHOUT PROJECT	260.7	-	180.0	123.3	2232.1	6072.4	122.3	-	
	WITH PROJECT	265.5	-	182.2	124.8	2245.5	6108.9	122.3	-	
2001	WITHOUT PROJECT	260.7	-	180.0	124.3	2232.1	6121.1	122.3	-	
	WITH PROJECT	271.9	-	185.1	127.9	2263.5	6207.3	122.3	-	
CROP PRODUCTION (TON)										
1981	17,120	-	39	108	7,321	684	201	-	8,354	25,474
1987	17,223	-	39	109	7,772	730	201	-	8,851	26,075
1993	WITHOUT PROJECT	17,327	-	39	110	8,250	780	-	9,380	26,707
	WITH PROJECT	18,068	-	39	111	9,335	785	-	10,472	28,540
2001	WITHOUT PROJECT	17,466	-	39	111	8,933	851	-	10,136	27,602
	WITH PROJECT	18,655	-	40	114	10,190	863	-	11,409	30,064

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE SMALL

TABLE 10.3.3 FARMGATE PRICE AND PRODUCTION COST

ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,861	-	7,313	9,641	597	671	4,511	-
WITH PROJECT (1987 - 2001)	3,958	-	7,313	9,641	612	671	4,624	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	603	-	667	1,010	759	2,506	479	-
WITH PROJECT (1987 - 2001)	619	-	687	1,030	779	2,531	479	-

TABLE 10.3.4 NET PRODUCTION VALUE

YEAR	(1000 BAHT)					
	WITHOUT PROJECT			WITH PROJECT		
	PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
1987	26,687	2,597	29,284	27,281	2,641	29,922
1993	26,847	2,740	29,587	29,382	3,112	32,494
2001	27,063	2,945	30,008	31,367	3,422	34,789

Figure 10.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE

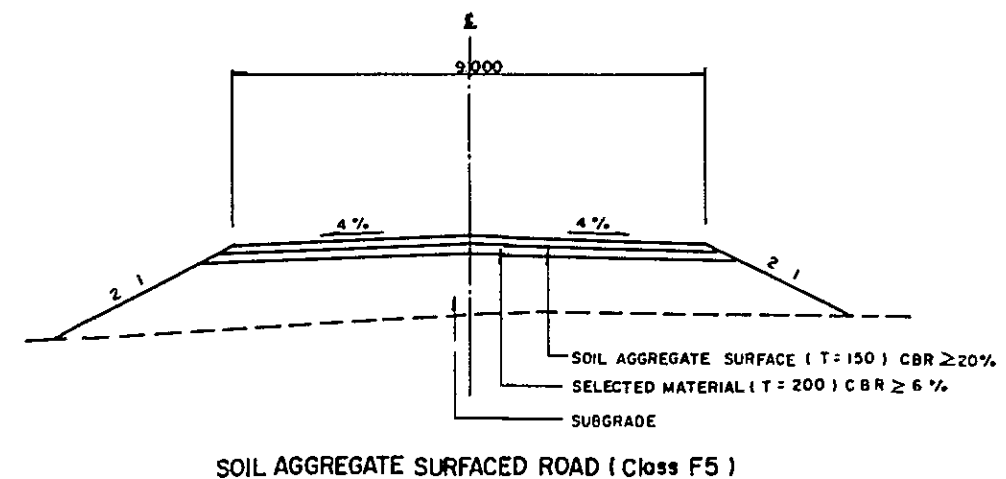
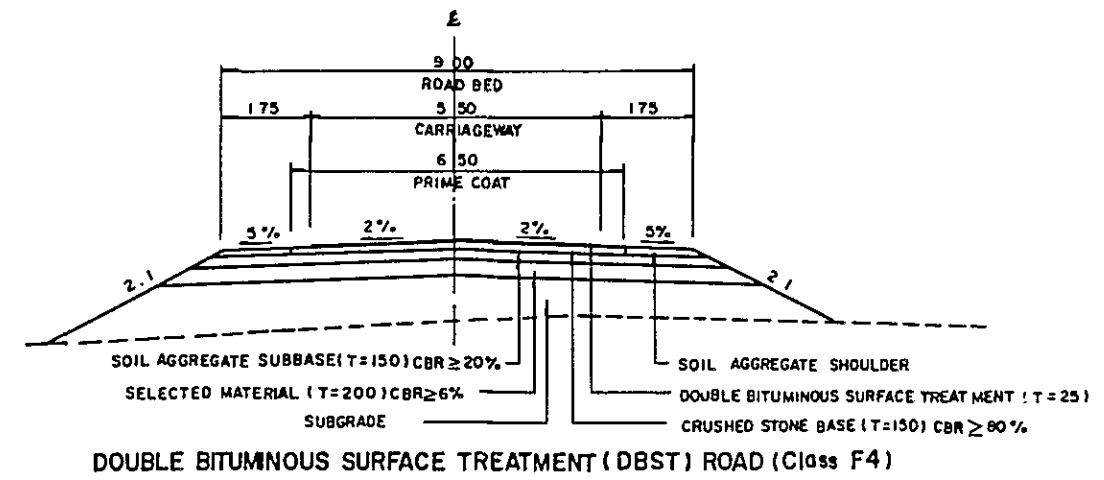
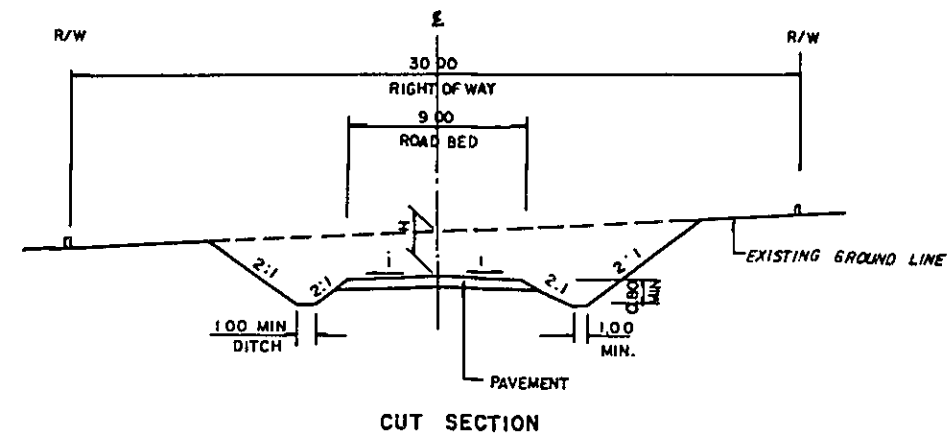
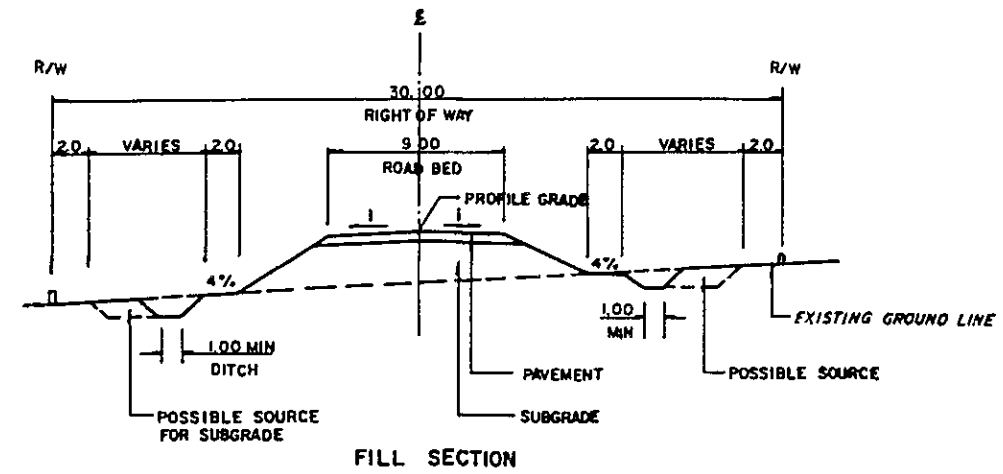
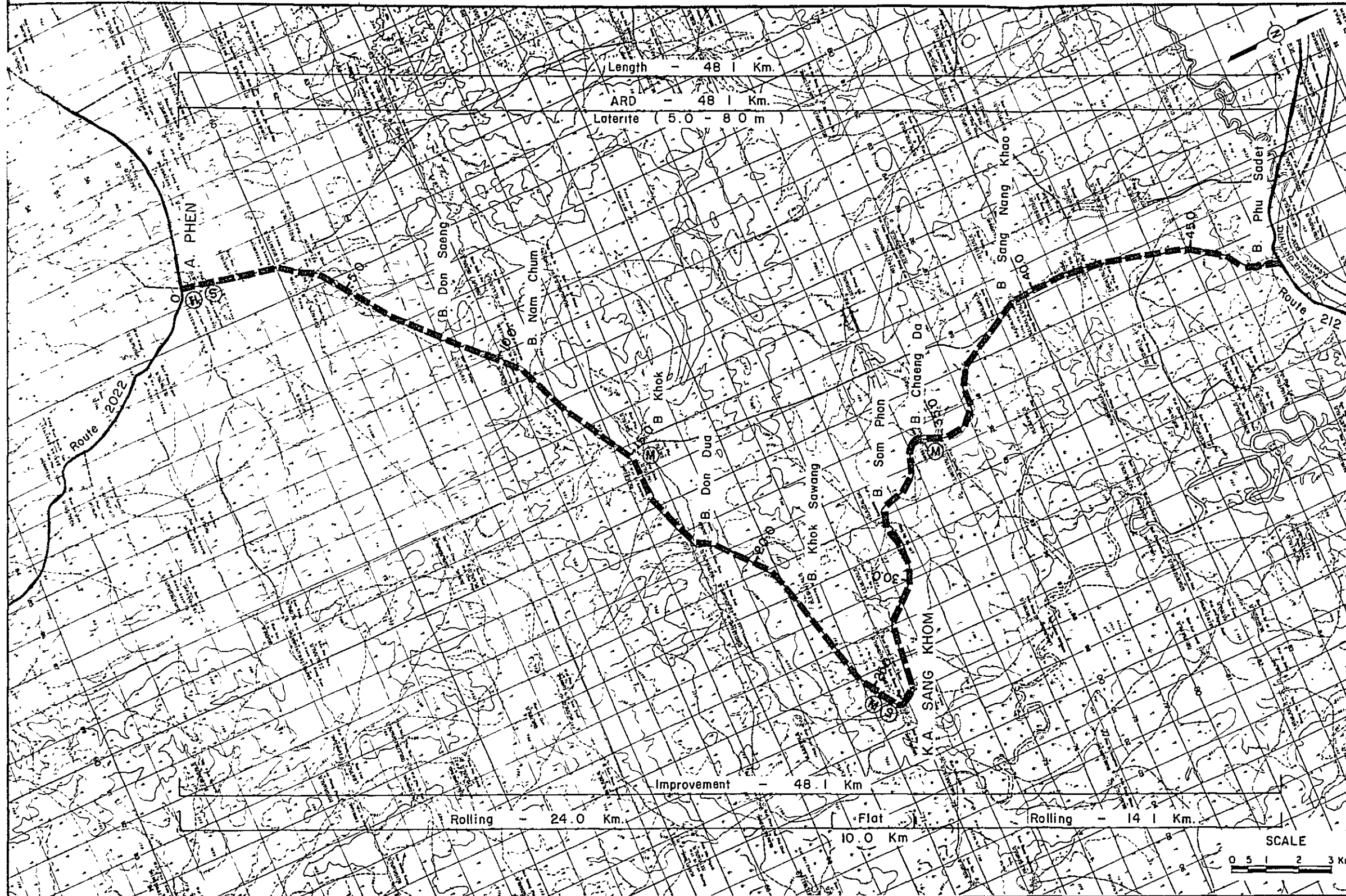


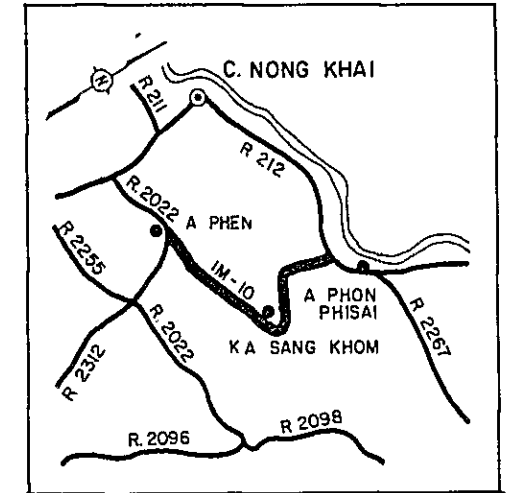
Figure 10.5.2 PROPOSED ROUTE NO. 1M-10

C. UDON THANI
NONG KHAI

A. PHEN (J.R. 2022) - J.R. 212
ROUTE NO. ARD L = 48.1 Km.



LOCATION MAP



BRIDGE LIST

No.	Station Km.	Proposed Bridge	Existing Bridge
1	1 0	—	C - 7 00 x 40 00
2	16 0	C-7 00 x 32 00	W - 4 00 x 28 50
3	18 6	C-7 00 x 26 00	W - 4 00 x 23 00
4	29 2	C-7 00 x 26 00	W - 4 80 x 24 00

LEGEND

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

Table 10.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-10 (48.1 km) (1)

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	113	1,695	1,542	113	1,695	1,542
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	151,300	6,808	6,195	151,300	6,808	6,195
Selected Material	m ³	80	99,900	7,992	7,112	99,900	7,992	7,112
Soil Aggregate Surface or Subbase	m ³	105	69,900	7,339	6,532	69,900	7,339	6,532
Crushed Stone Base	m ³	370	45,900	16,983	15,624	10,700	3,959	3,642
Soil Aggregate Shoulder	m ³	105	19,800	2,079	1,850	4,600	483	429
Prime Coat and DBST	m ²	55	259,100	14,251	12,826	60,500	3,328	2,995
Pipe Culvert	m	2,100	1,540	3,234	2,975	1,540	3,234	2,975
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	84	3,360	2,990	84	3,360	2,990
Sub Total (a)				63,742	57,650		38,199	34,416
Miscellaneous Works (a) x 7%				4,462	4,036		2,674	2,409
Total (b)				68,204	61,686		40,873	36,825
PHYSICAL CONTEGENCY (b) x 15%				10,231	9,253		6,131	5,524
ENGINEERING AND ADMINISTRATION (b) x 10%				6,820	6,169		4,087	3,683
Sub Total				17,051	15,422		10,218	9,207
LAND ACQUISITION								
Highly Developed Land	ha	50,000	38	1,900	1,900	38	1,900	1,900
Less Developed Land	ha	15,000	35	525	525	35	525	525
Sub Total				2,425	2,425		2,425	2,425
GRAND TOTAL				87,680	79,533		53,516	48,457

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

Items	Unit of Q'ty	Financial Unit Rate ₪	Proposed Route Number								
			IM-10 (1-2) (26.0 km) 1/			IM-10 (2-3) (22.1 km) 2/			IM-10 (T) (48.1 km) 3/		
			Q'ty	Financial Cost (10 ³ ₪)	Economic Cost (10 ³ ₪)	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	60	900	819	53	795	723	113	1,695	1,542
Excavation - Soil	m ³	20	0	0	0	0	0	0	0	0	0
Excavation - Hard Rock	m ³	160	0	0	0	0	0	0	0	0	0
Embankment	m ³	45	59,800	2,691	2,448	91,500	4,117	3,746	151,300	6,808	6,195
Selected Material	m ³	80	53,000	4,240	3,773	46,900	3,752	3,339	99,900	7,992	7,112
Soil Aggregate Surface or Subbase	m ³	105	37,100	3,895	3,466	32,800	3,444	3,065	69,900	7,339	6,532
Crushed Stone Base	m ³	370	24,400	9,028	8,305	2,400	888	816	26,800	9,916	9,122
Soil Aggregate Shoulder	m ³	105	10,500	1,102	981	1,100	115	102	11,600	1,218	1,084
Prime Coat and DBST	m ²	55	137,500	7,563	6,806	13,800	759	683	151,300	8,322	7,490
Pipe Culvert	m	2,100	700	1,470	1,352	840	1,764	1,622	1,540	3,234	2,975
Box Culvert	m	16,000	0	0	0	0	0	0	0	0	0
Long Span Bridge	m	80,000	0	0	0	0	0	0	0	0	0
Short Span Bridge	m	40,000	58	2,320	2,064	26	1,040	925	84	3,360	2,990
Sub Total (a)				33,210	30,018		16,675	15,026		49,885	45,046
Miscellaneous Works (a) x 7%				2,325	2,101		1,167	1,052		3,492	3,153
Total (b)				35,535	32,119		17,842	16,078		53,377	48,199
PHYSICAL CONTINGENCY (b) x 15%				5,330	4,818		2,676	2,412		8,007	7,230
ENGINEERING AND ADMINISTRATION (b) x 10%											
ADMINISTRATION (b) x 10%				3,554	3,212		1,784	1,608		5,338	4,820
Sub Total				8,884	8,030		4,460	4,020		13,345	12,050
LAND ACQUISITION											
Highly Developed Land	ha	50,000	17	850	850	21	1,050	1,050	38	1,900	1,900
Less Developed Land	ha	15,000	23	345	345	12	180	180	35	525	525
Sub Total				1,195	1,195		1,230	1,230		2,425	2,425
GRAND TOTAL				45,614	41,344		23,532	21,328		69,147	62,674

Note: 1/ = DBST Link
 2/ = Soil Aggregate Surface Link
 3/ = Total Link

Table 10.6.1 COST AND BENEFITS
(F4 STANDARD)

YEAR	COST		BENEFITS			DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
1984	15,907	0	0	0	0	22,348	0
1985	39,767	0	0	0	0	49,884	0
1986	23,860	0	0	0	0	26,723	0
1987	0	638	5,921	-148	6,410	0	5,723
1988	0	962	6,340	-135	7,166	0	5,713
1989	0	1,285	6,759	-121	7,922	0	5,639
1990	0	1,609	7,178	-108	8,678	0	5,515
1991	0	1,932	7,596	-94	9,435	0	5,353
1992	0	2,256	8,015	-80	10,191	0	5,163
1993	0	2,579	8,434	-67	10,947	0	4,952
1994	23,280	2,854	8,906	-49	11,711	10,531	4,730
1995	0	3,128	9,377	-30	12,475	0	4,498
1996	0	3,403	9,848	-12	13,238	0	4,262
1997	0	3,677	10,319	6	14,002	0	4,025
1998	0	3,952	10,791	24	14,766	0	3,790
1999	0	4,226	11,262	42	15,530	0	3,559
2000	0	4,500	11,733	60	16,294	0	3,334
2001	-37,894	4,775	12,204	79	17,058	-6,923	3,116
TOTAL	64,920	41,774	134,682	-633	175,823	102,563	69,374

DISCOUNTED ECONOMIC COSTS :	102,563
DISCOUNTED ECONOMIC BENEFITS :	69,374
AGRICULTURAL DEVELOPMENT BENEFIT	14,888
VOC SAVING	54,995
RMC SAVING	-509
NET PRESENT VALUE :	-33,188
BENEFIT COST RATIO :	0.68
INTERNAL RATE OF RETURN :	7.7 %

Table 10.6.2 COST AND BENEFITS
(F4&F5 COMBINED)

YEAR	COST		BENEFITS			DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
1984	12,535	0	0	0	0	17,611	0
1985	31,337	0	0	0	0	39,309	0
1986	18,802	0	0	0	0	21,058	0
1987	0	638	5,468	-52	6,054	0	5,405
1988	0	962	5,867	-41	6,788	0	5,411
1989	0	1,285	6,265	-29	7,521	0	5,354
1990	0	1,609	6,664	-18	8,255	0	5,246
1991	0	1,932	7,063	-6	8,989	0	5,100
1992	0	2,256	7,461	6	9,722	0	4,926
1993	0	2,579	7,860	17	10,456	0	4,730
1994	13,552	2,854	8,301	32	11,186	6,130	4,518
1995	0	3,128	8,742	46	11,916	0	4,297
1996	0	3,403	9,183	61	12,646	0	4,072
1997	0	3,677	9,624	76	13,377	0	3,845
1998	0	3,952	10,065	90	14,107	0	3,621
1999	0	4,226	10,506	105	14,837	0	3,400
2000	0	4,500	10,947	119	15,567	0	3,185
2001	-30,139	4,775	11,388	134	16,297	-5,506	2,977
TOTAL	46,087	41,774	125,404	540	167,718	78,602	66,088

DISCOUNTED ECONOMIC COSTS :	78,602
DISCOUNTED ECONOMIC BENEFITS :	66,088
AGRICULTURAL DEVELOPMENT BENEFIT	14,888
VOC SAVING	51,137
RMC SAVING	63
NET PRESENT VALUE :	-12,514
BENEFIT COST RATIO :	0.84
INTERNAL RATE OF RETURN :	10.1 %

Table 10.6.3 COST AND BENEFITS
(F4,SECTION 1)

YEAR	COST		BENEFITS			DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	16,537	0	0	0	0	20,744	0
1986	24,807	0	0	0	0	27,784	0
1987	0	335	4,708	4	5,047	0	4,506
1988	0	512	5,050	12	5,574	0	4,443
1989	0	688	5,392	20	6,100	0	4,342
1990	0	865	5,734	28	6,627	0	4,211
1991	0	1,041	6,076	36	7,153	0	4,059
1992	0	1,218	6,418	44	7,680	0	3,891
1993	0	1,394	6,760	52	8,206	0	3,712
1994	12,584	1,542	7,129	62	8,733	5,692	3,527
1995	0	1,691	7,498	72	9,261	0	3,340
1996	0	1,839	7,867	82	9,788	0	3,152
1997	0	1,988	8,237	92	10,316	0	2,965
1998	0	2,136	8,606	101	10,843	0	2,783
1999	0	2,284	8,975	111	11,370	0	2,606
2000	0	2,433	9,344	121	11,898	0	2,434
2001	-19,663	2,581	9,713	131	12,425	-3,592	2,270
TOTAL	34,265	22,545	107,507	968	131,019	50,628	52,241

DISCOUNTED ECONOMIC COSTS :	50,628
DISCOUNTED ECONOMIC BENEFITS :	52,241
AGRICULTURAL DEVELOPMENT BENEFIT	8,021
VOC SAVING	43,905
RMC SAVING	315
NET PRESENT VALUE :	1,613
BENEFIT COST RATIO :	1.03
INTERNAL RATE OF RETURN :	12.4 %

Table 10.6.4 COST AND BENEFITS
(F5,SECTION 2)

YEAR	COST		BENEFITS			DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	8,531	0	0	0	0	10,701	0
1986	12,797	0	0	0	0	14,333	0
1987	0	303	760	-56	1,007	0	899
1988	0	450	817	-53	1,214	0	968
1989	0	597	873	-49	1,421	0	1,012
1990	0	744	930	-46	1,629	0	1,035
1991	0	891	987	-42	1,836	0	1,042
1992	0	1,038	1,043	-39	2,043	0	1,035
1993	0	1,185	1,100	-35	2,250	0	1,018
1994	1,214	1,311	1,172	-30	2,453	549	991
1995	0	1,437	1,244	-26	2,656	0	958
1996	0	1,563	1,316	-21	2,858	0	920
1997	0	1,690	1,388	-16	3,061	0	880
1998	0	1,816	1,459	-11	3,264	0	838
1999	0	1,942	1,531	-7	3,467	0	794
2000	0	2,068	1,603	-2	3,669	0	751
2001	-7,608	2,194	1,675	3	3,872	-1,390	707
TOTAL	14,934	19,229	17,898	-428	36,699	24,193	13,847

DISCOUNTED ECONOMIC COSTS :	24,193
DISCOUNTED ECONOMIC BENEFITS :	13,847
AGRICULTURAL DEVELOPMENT BENEFIT	6,866
VOC SAVING	7,232
RMC SAVING	-252
NET PRESENT VALUE :	-10,346
BENEFIT COST RATIO :	0.57
INTERNAL RATE OF RETURN :	6.4 %

Table 10.7.1 SOCIAL INDICATORS
(Proposed Route IM-10)

Population (1,000)		Education	
1982	: 32.2	Access to Secondary School	
1993	: 39.5	Number of Student in 1993 (1,000) ^{2/}	: 8.7
Average travelling speed, without (kph)		Average distance to school (km)	: 6.2
	: 44	Per capita time savings (10 ⁻⁴)	: 0.088
Isolation		Score	: 48
Access to Amphoe		Teacher Intensity	
Average distance to Amphoe (km) ^{1/}	: 6.1	Number of teachers ^{3/}	
Per capita time savings (10 ⁻⁴)	: 0.014	University graduate	: 1
Score	: 41	Total	: 19
Access to Artery Highway		Number of Student	: 470
Average distance to highway (km) ^{1/}	: 22	Indicators	
Per capita time savings (10 ⁻⁴)	: 0.049	E1 ^{4/}	: 2.1
Score	: 107	E2 ^{5/}	: 40.4
Impassability		E ^{6/}	: 42.5
Impassable week a year	: -	Degree of Improvement ^{7/}	: 1.61
Impassability per year	: 0	Score	: 103
Impassability per capita (10 ⁻⁴)	: 0	Disparity	
Score	: 0	G.P.V. in 1993 (Mn B) ^{8/}	
Health		With project	: 80.0
Access to Hospital		Without project	: 74.6
Average distance to Hospital (km) ^{1/}	: 14.0	Per capita G.P.V. in 1993 (B)	
Per capita time savings (10 ⁻⁴)	: 0.031	With project (W)	: 2,025
Score	: 72	Without project (w)	: 1,889
Access to Medical Facilities		Degree of Disparity	
Average distance to facilities (km) ^{1/}	: 3.4	(A/W) - (A/w) ^{9/}	: 0.11
Per capita time savings (10 ⁻⁴)	: 0.008	Score	: 196
Score	: 32	Total Score	: 599

Note:

- ^{1/} () shows the length or distance in without project case. Unless otherwise, lengths 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.