PROPOSED ROUTE NO. IM - 7

Changwat : Udon Thani

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

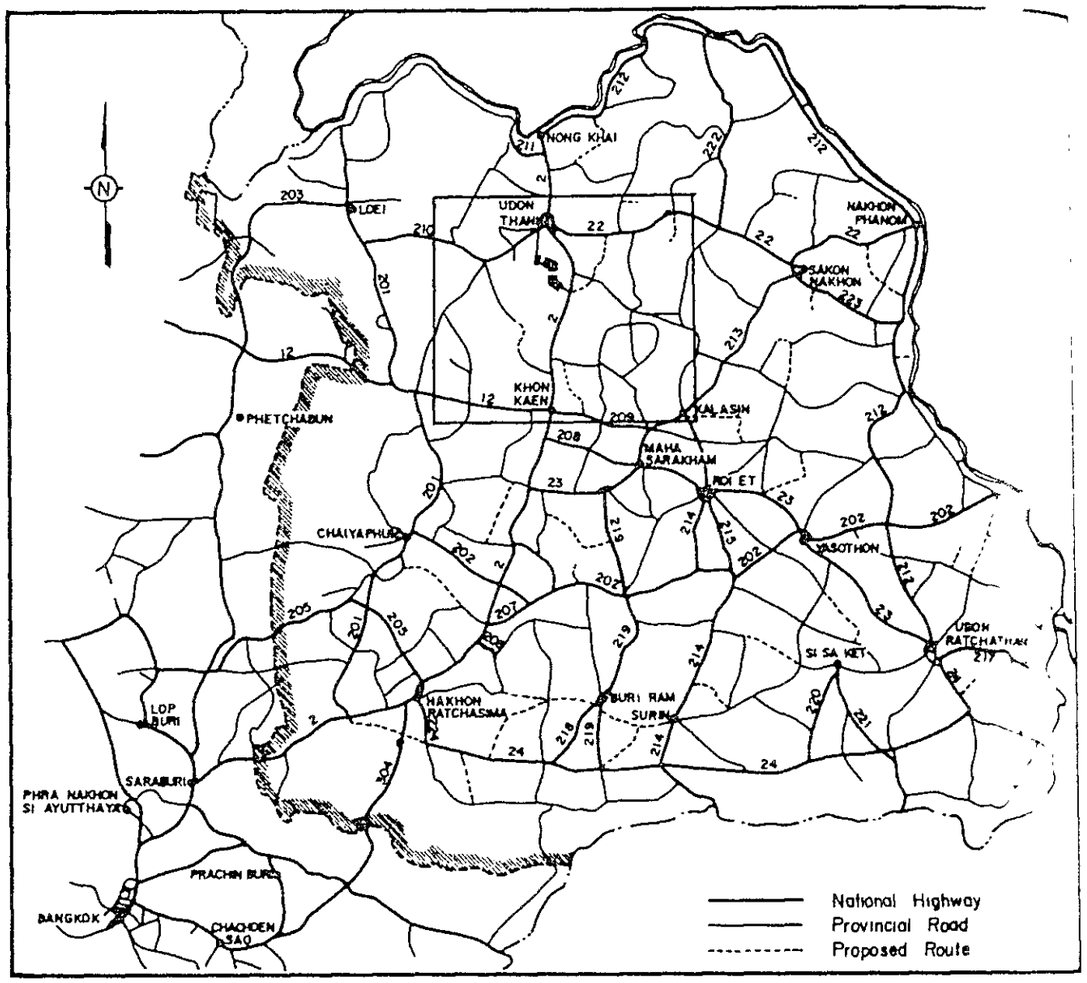
Length : 24.0 K.M.

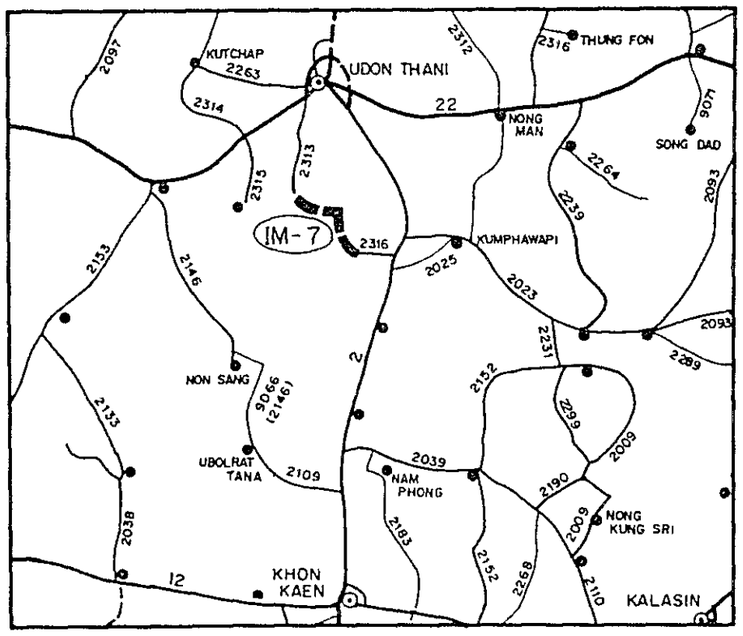
SUMMARY

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	T4 (DBST)
Construction Cost	
Financial	$45,751 \times 10^3$ ฿
Economic	$41,689 \times 10^3$ ฿
IRR	8.1 %
B/C	0.70
Social Impact	High
Recommendation	For immediate implementation

LOCATION OF PROPOSED ROUTE





1. 概　要

1.1　計画路線の概要

本路線は，Udon Thani県の南部に位置している。県道2313号線の終点にあるKhohn Lat村を起点とし，ルートは南に走り，Lup Wai 村，Sam Lian村，Khum Wa Thong 村を経て，県道2316号線で終る。その総延長は24.0kmである。　(Figure 7.5.2 参照)

沿道の地形はほぼ平坦である。影響圏内には，いくつかの村が存在し，その総人口は9,900人である。沿道には医療センターが１ケ所ある。

本路線は県道2313号線と県道2316号線の舗装された区間を経て２つの幹線道路国道 210号線と国道２号線を結ぶ重要な道路網の形成を目途として計画された。

1.2　現道の状況

計画路線に利用した現道の状況は，Table 7.1.1 に要約し，その詳細はTable 7.1.2 のインベントリー調査の結果に示した。

2．交　通

2.1　予測手法

本計画路線は道路改良後，交通所要時間の節約により転換交通や誘発交通が大量に期待できるため，交通量予測の手法として「配分方式」を適用することとした。

2.2　ゾーニング

本路線によって交通上変化が予想される地域について，２つの発生ゾーンを設定した。この地域から発生する交通の主要な着ゾーンとしてはMuang Udon Thani，Kumpawapi の２つのAmphoeを設定した。計画路線および関連する周辺道路は，計画路線について１リンク，周辺道路について６リンクの計７リンクに分割して予測を行うこととした。ゾーン界図およびゾーン・道路リンクの特性はFigure 7.2.1 およびTable 7.2.1，Table 7.2.2 に示すとおりである。

2.3　交通需要

１）旅客需要

基準年におけるＯ／Ｄペア別の旅客需要（トリップ／日）推定値はメインレポートの7.3.3.の１）で述べた算定方式に従って求めた。

推定結果は以下の通りである。

Zone	1	2	11	12	13	14
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

この交通需要を道路リンクに配分することによって得られるリンク別交通需要の推定値は次のとおりである。

PASSENGER MOVEMENT (1982)

PROPOSED ROAD LINK	TRIPS PER DAY
1	242

2）貨物需要

計画路線上の貨物交通需要（トン／日）はメインレポートの7.3.3.の1）で述べた方式によって求めた。推定のための基礎データおよび結果は次に示すとおりである。

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 交通需要の将来伸び率

1981－1987，1987－1993，1993－2007の各期間における旅客および貨物の交通需要の将来伸び率は，メインレポートの7.3.3.の1）で述べた予測式に従って求めた。予測の前提および得られた将来伸び率は以下の通りである。

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.	7.3	7.5	7.6
AGRICULTURE	0.0	0.0	0.0
FREIGHT	4.7	5.4	6.2

2.5 誘発および開発交通量

メインレポートの7.3.3.の3）で述べた方式を基に誘発および開発交通量の通常交通量に対する比率を求めた。

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 将来交通量

1) 車種構成

計画路線上の旅客・貨物に関する将来交通需要を，以下の車種構成比によって車種別交通量に交換した。

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) 将来ＡＤＴ

計画路線上のリンク加重平均将来交通量は以下に示すとおりであり，またその道路リンク別交通タイプ別の詳細はTable 7.2.3に示す。

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. 農業開発

3.1. 現況

影響圏内の農耕地の90％以上は，水田である。畑地では砂糖きびが最も多く，これに，キャツサバが次いでいる。Kumphawapi群の中心部には，大規模な精糖工場があり，この圏内で生産される砂糖きびは，2316号および2023号の各路線を経て，この工場に出荷されている。未開発可耕地については，特に畑作地帯が広範に残っている。

圏内の土地利用及び土地適応性の状況は，Table 7.3.1とFigure7.3.1に示し，また，Udon Thani県地域の作物暦はFigure7.3.2のとおりである。

3.2. 開発予測

影響圏内の将来の農業開発状況を，With ProjectとWithout Project の双方について予測した。予測した作付面積，単位当り収量及び生産量はTable 7.3.2.のとおりである。代表的作物の農家庭先価格と農業生産費とは，各県の資料及び現地調査の結果を参考にしてTable 7.3.3.のように見積った。

上記のごとく各作物ごとに予測された生産量と庭先価格により，生産価値を計算し，これから農業生産費及び別途見積られた開墾費を差引き，純生産価値（N.P.V）をTable 7.3.4.のように算出した。

このN.P.V のWith Projectの場合と，Without Project の場合の差が，この道路の開発便益である。

4. 走行費の節減

本報告書，第1巻，第7章で述べた概念と基礎データにもとづき関連する各道路リンクの走行費（以下"ＶＯＣ"という）をWith ProjectとWithout Project の両ケースについて計算した。

各リンクにおけるＶＯＣのコスト増に影響を与える道路状況は以下に示すとおりである。

Road Condition

Link No.	Terrain	Without Project: Length (km)	Without Project: /1 Road Class	Without Project: Nos. of Wooden Bridge	Without Project: Nos. of Narrow C.Bridge	With Project: Length (km)	With Project: /1 Road Class Case 1	With Project: /1 Road Class Case 2	With Project: Nos. of Wooden Narrow Bridge
1	Rolling	24.0	3	2	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節減は，With Projectの全リンクのＶＯＣとWithout Project の際のＶＯＣとの差で，当道路におけるＶＯＣの節減は次に示すとおりである。

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. エンジニアリング

5.1 予備設計

予備設計は，次に示す設計基準を基本に行った。

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 : 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 7.5.2

ルートの線形は，Figure 7.5.2 に示す。

5.2 工事数量および建設費

予備設計による工事数量と建設費は，各工種ごとに単価を付してTable 7.5.1 に示す。

道路規程別の建設費を財務費用および経済費用に分けて集計すると，下表に示すとおりとなる。

Financial and Economic Construction Cost

Road Class	Length (km)	Construction Cost (10^3 ₱) Financial Cost	Economic Cost	Remark
F4 (DBST)	24.0	45,951	41,689	
F5 (Soil Aggregate)	24.0	24,199	21,903	

6. 経済評価

年次別経済費用と便益及び評価結果はTable 7.6.1 及び7.6.2 に示す通りである。

このルートはF 4 規格ではフィージブルでないがF 5 規格ではフィージブルである。

7. 社会インパクト

社会インパクトを示すデータ及び評価結果はTable 7.7.1 に示す通りである。このルートの社会的インパクトはかなり高い。

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
VILLAGE - Name - Household (H) - Population (P)		B. KHOK LAT H = 280 P = 1500 ; B. LUP WAI H = 120 P = 600 ; B. SAMLIAM H = 50 P = 250 ; B. THONG NOI H = 40 P = 240 ; B. KHUM WA THONG H = 40 P = 200 ; B. THA YOM
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

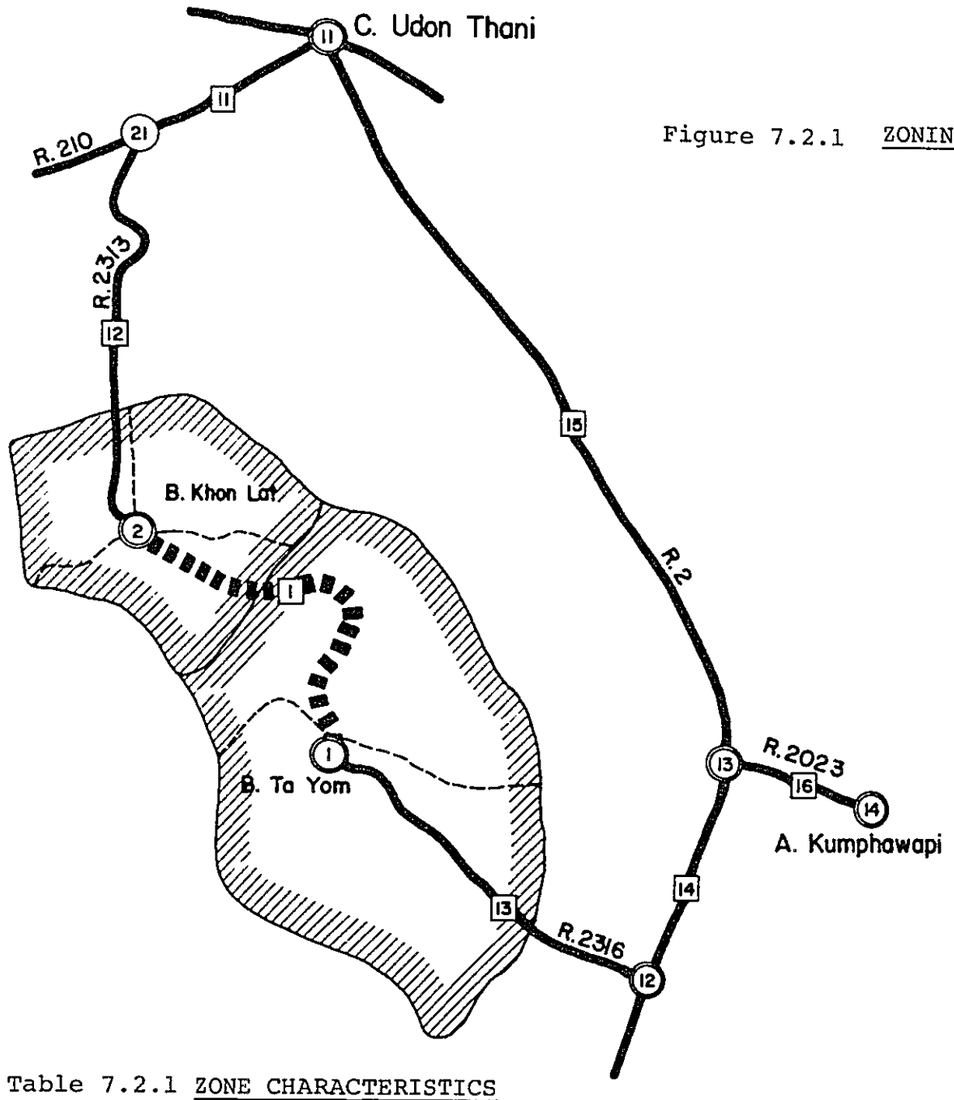


Figure 7.2.1 ZONING AND ROAD NETWORK

PROPOSED ROUTE NO. IM-7

LEGEND

- (i) Traffic Zone
- (j) Dummy Node
- [35] Road Link Code
- Proposed Road Link
- Other Road

Table 7.2.1 ZONE CHARACTERISTICS

Zone	Administrative Division: Changwat	Amphoe	Tambon Code	Population: Tambon	%	Zone	Attraction
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: Start Node	End Node	Length: $\bar{W}$	W	Grade: $\bar{W}$	W	Remark
1	1. B. Ta Yom	2. B. Khol 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 D : DIVERTED TRAFFIC
DV : DEVELOPED TRAFFIC I : INDUCED TRAFFIC

Figure 7.3.1 LAND USE AND CAPABILITY OF INFLUENCE AREA
PROPOSED ROUTE NO. IM – 7

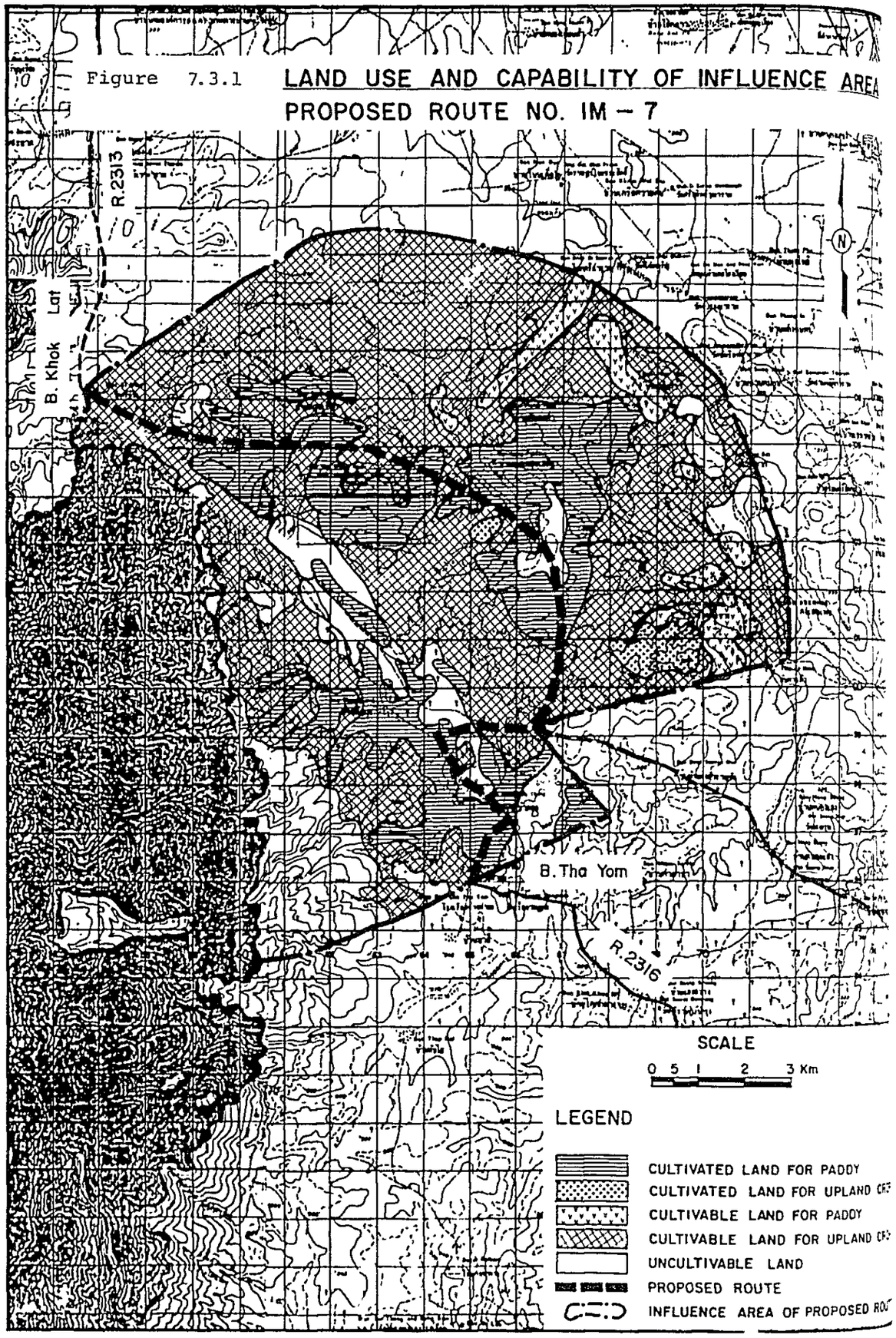
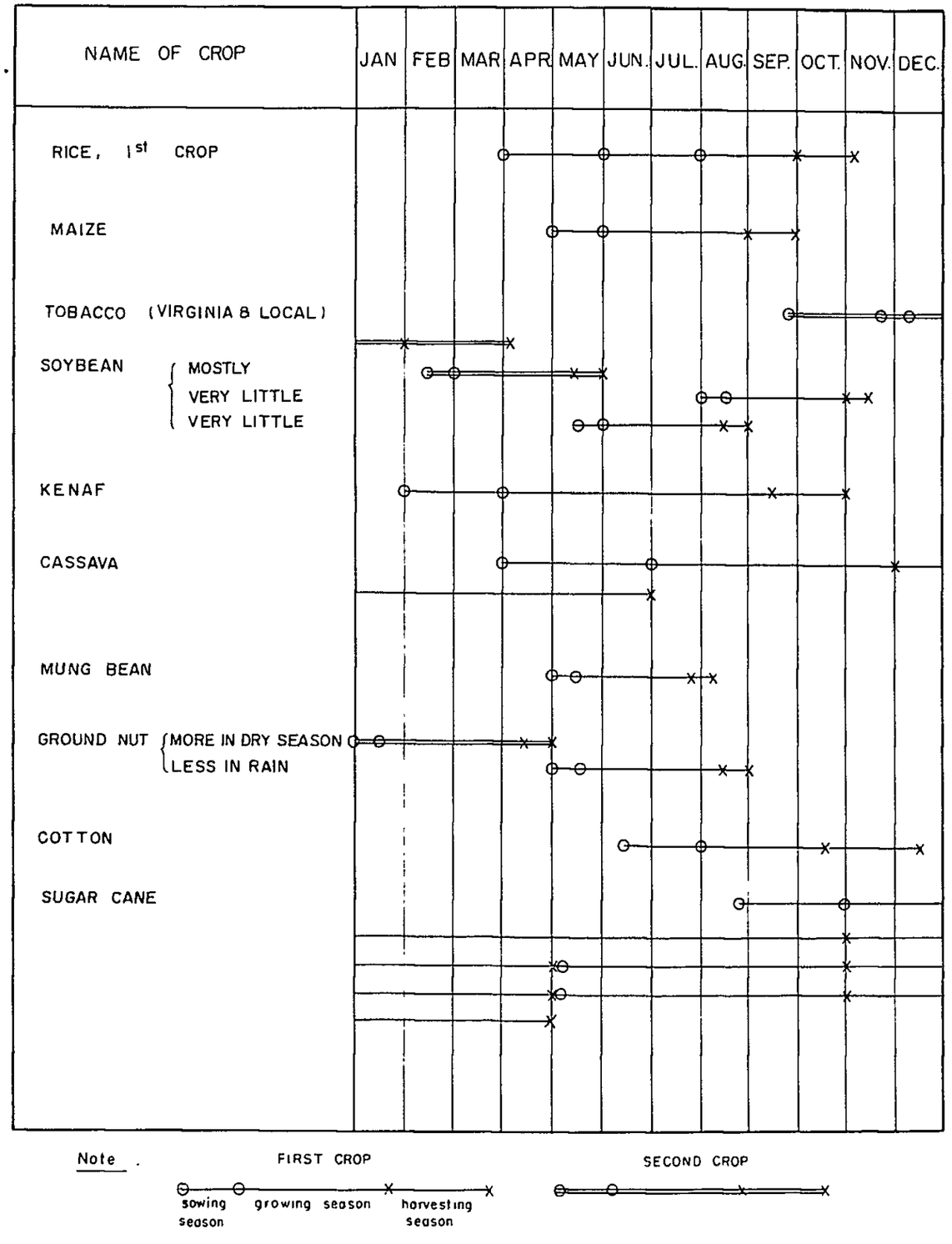


Figure 7.3.2 CROPPING CALENDAR

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

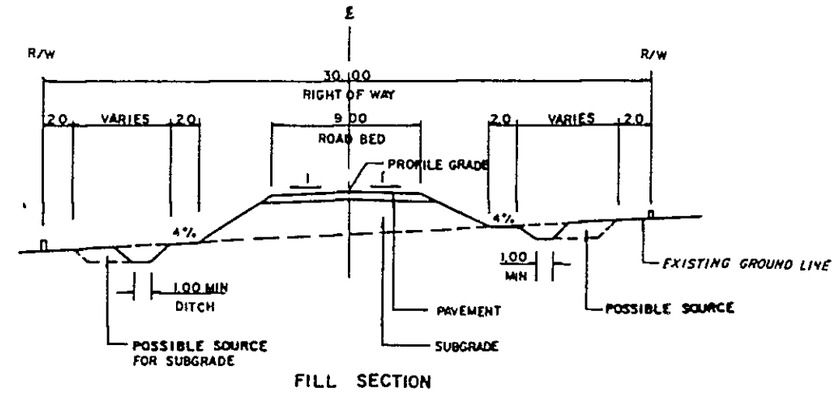
ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,887	-	-	-	597	671	-	-
WITH PROJECT (1987 - 2001)	3,984	-	-	-	612	671	-	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	612	-	-	-	759	2,506	-	-
WITH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

TABLE 7.3.4 NET PRODUCTION VALUE

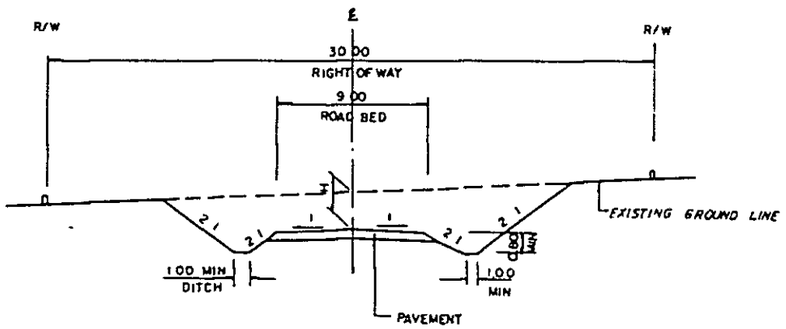
(1000 BAHT)

YEAR	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

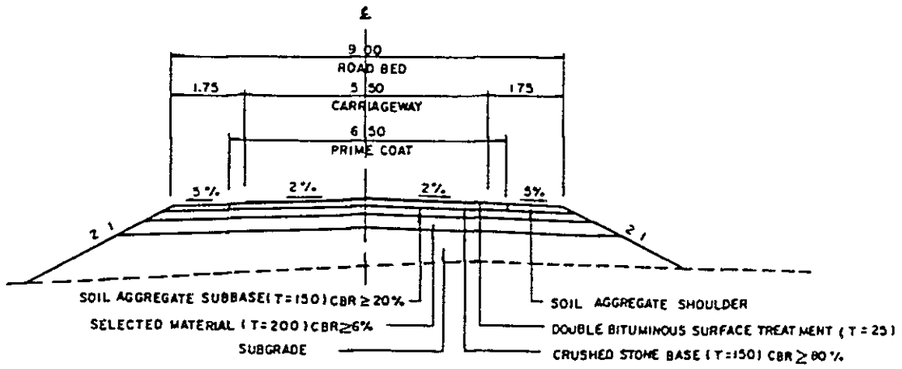
Figure 7.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE



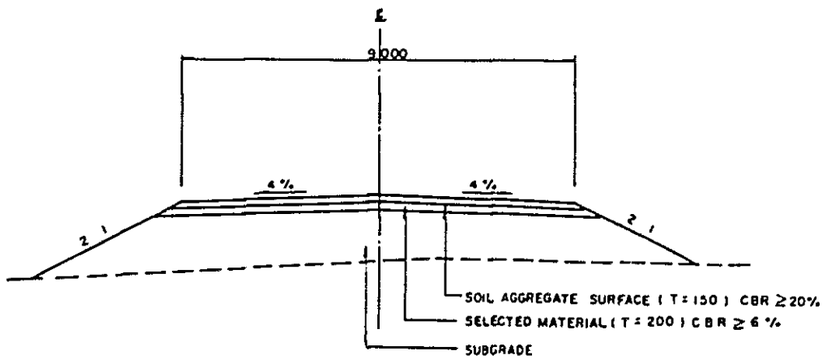
FILL SECTION



CUT SECTION

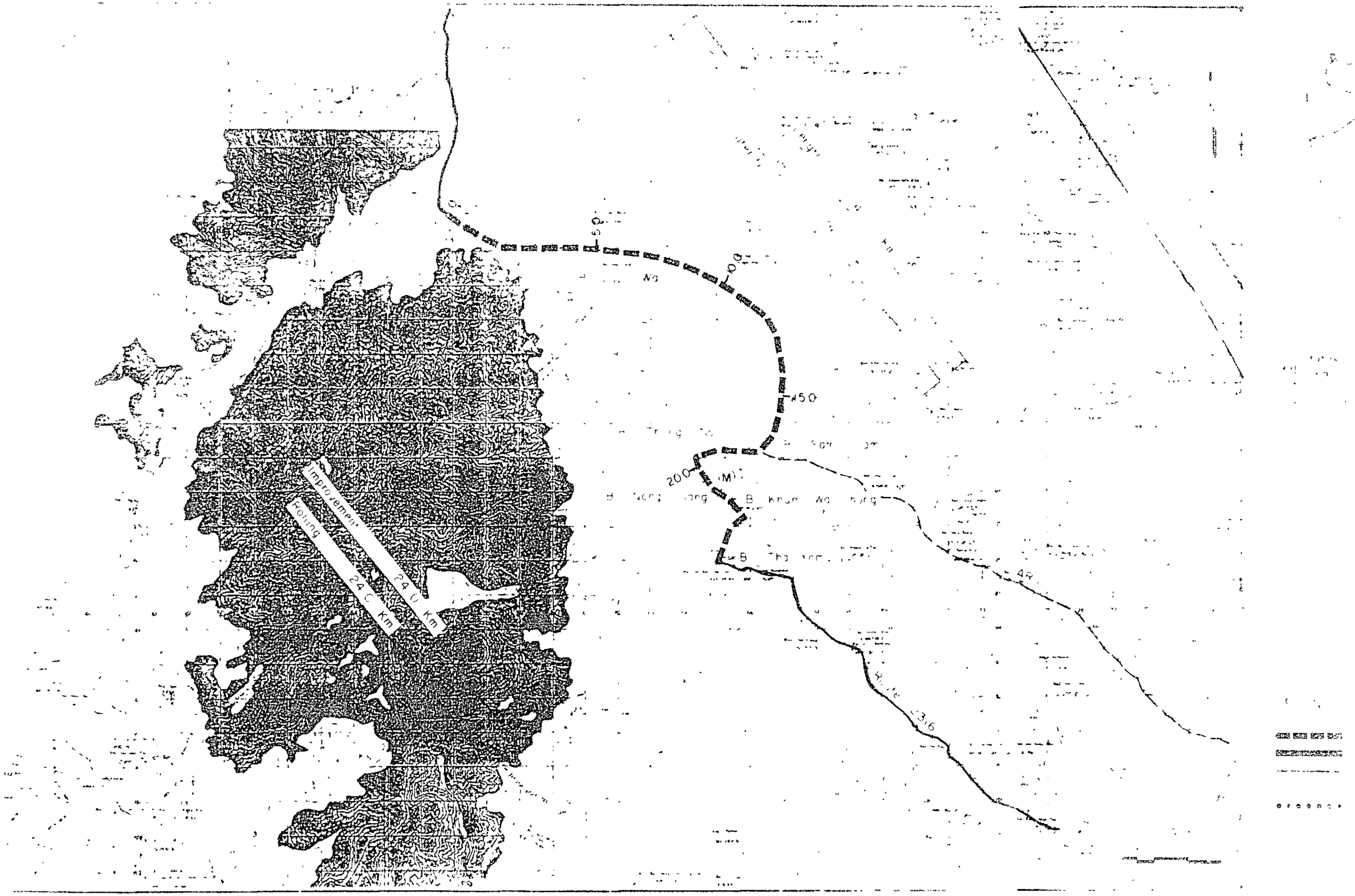


DOUBLE BITUMINOUS SURFACE TREATMENT (DBST) ROAD (Class F4)



SOIL AGGREGATE SURFACED ROAD (Class F5)

C UDON THANI B KHOK LAT (J R 2313) : THA YOM (J R 2316)
ROUTE NO ARD : 24 0 Km

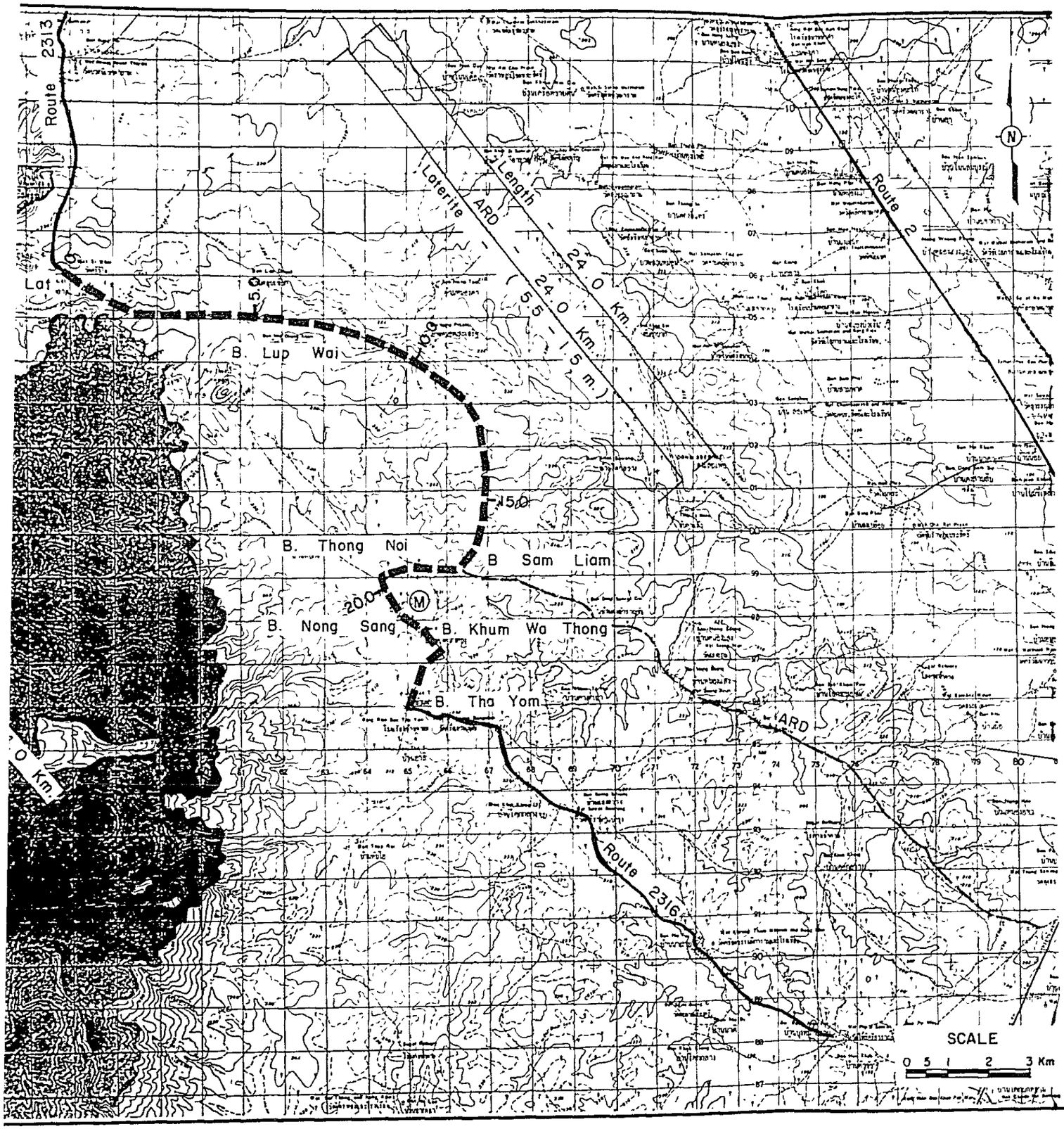


-7

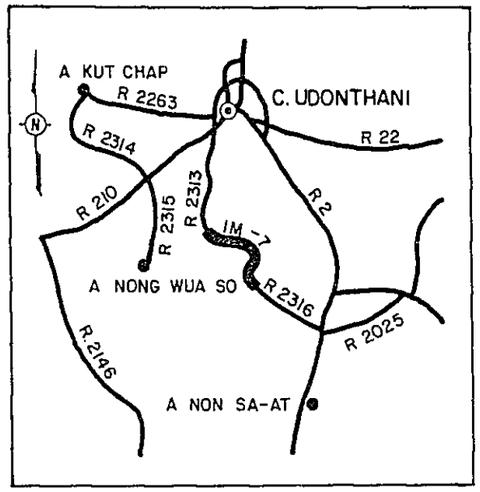
C. UDON THANI

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 x29 00	C-4 00 x29 00
2	11 6	C-7 00 x20 00	C-4 00 x20 00
3	18 2	C-7 00 x21 00	W-5 00 x18 50
4	22 9	C-7 00 x8 00	W-4 50 x6 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 7.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-7 (24.0 km)

Items	Unit of Q'ty	Financial Unit Rate ฿	(DBST) Q'ty	(DBST) Financial Cost (10^3฿)	(DBST) Economic Cost (10^3฿)	(Soil Aggregate Surface) Q'ty	(Soil Aggregate Surface) Financial Cost (10^3฿)	(Soil Aggregate Surface) 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 CONTENGENCY (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)

(1000 BAHT)

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	16,675	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)

(1000 BAHT)

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	8,761	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)		
1982	:	9.9
1993	:	11.7
Average travelling speed, without (kph)	:	40
Isolation		
Access to Amphoe		
Average distance to Amphoe (km)1/	:	12.0
Per capita time savings (10^{-4})	:	0.114
Score	:	335
Access to Artery Highway		
Average distance to highway (km)1/	:	-
Per capita time savings (10^{-4})	:	-
Score	:	100
Impassability		
Impassable week a year	:	4
Impassability per year	:	0.077
Impassability per capita (10-4)	:	0.066
Score	:	550
Health		
Access to Hospital		
Average distance to Hospital (km)1/	:	12.0
Per capita time savings (10^{-4})	:	0.114
Score	:	265
Access to Medical Facilities		
Average distance to facilities (km)1/	:	11.0
Per capita time savings (10^{-4})	:	0.104
Score	:	416
Education		
Access to Secondary School		
Number of Student in 1993 (1,000)2/	:	2.0
Average distance to school (km)	:	12.0
Per capita time savings (10^{-4})	:	0.667
Score	:	361
Teacher Intensity		
Number of teachers3/		
University graduate	:	-
Total	:	21
Number of Student	:	530
Indicators		
E1 4/	:	-
E2 5/	:	39.6
E 6/	:	39.6
Degree of Improvement7/	:	1.73
Score	:	110
Disparity		
G.P.V. in 1993 (Mn B)8/		
With project	:	17.1
Without project	:	16.4
Per capita G.P.V. in 1993 (B)		
With project (W)	:	1,462
Without project (w)	:	1,402
Degree of Disparity		
(A/W) - (A/w)9/	:	0.09
Score	:	161
Total Score	:	3,432

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 - 8

Changwat : Udon Thani

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

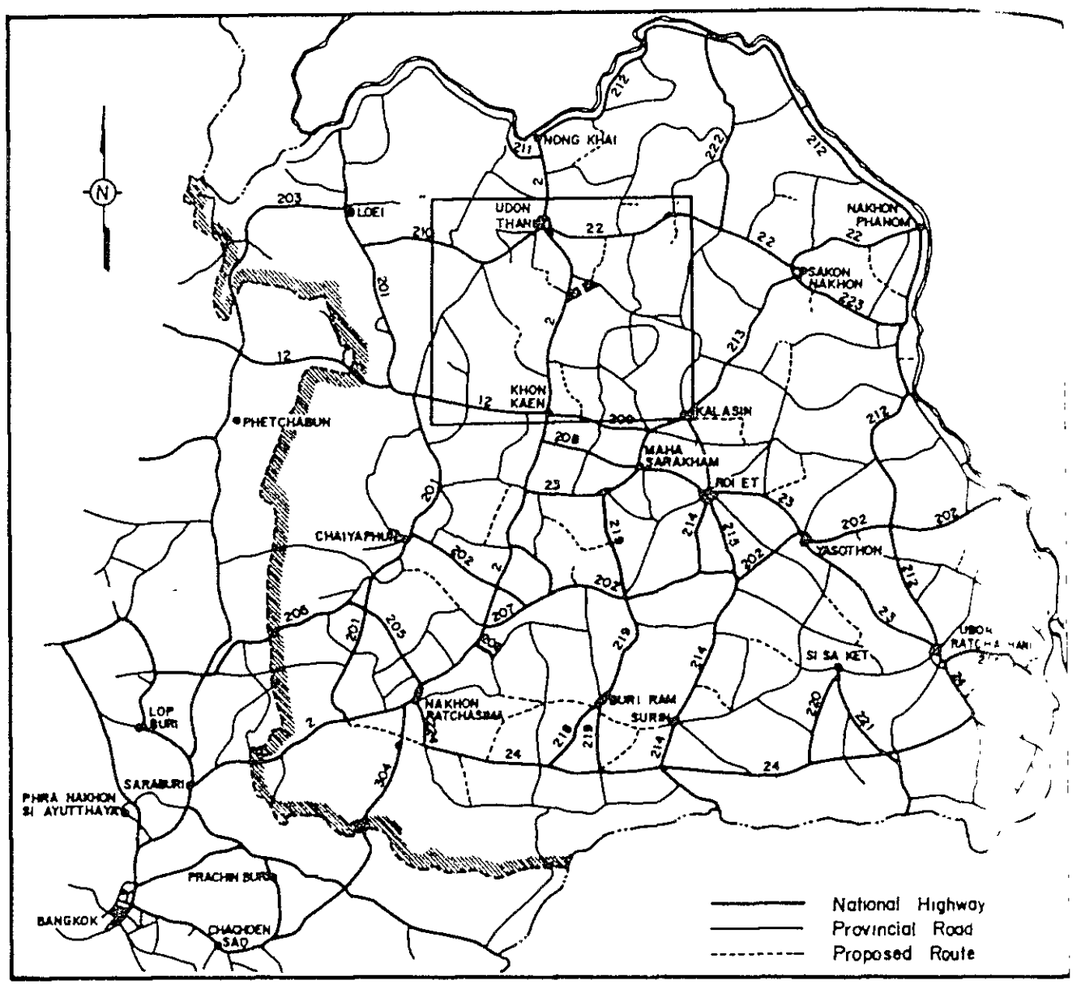
Length : 16.7 KM.

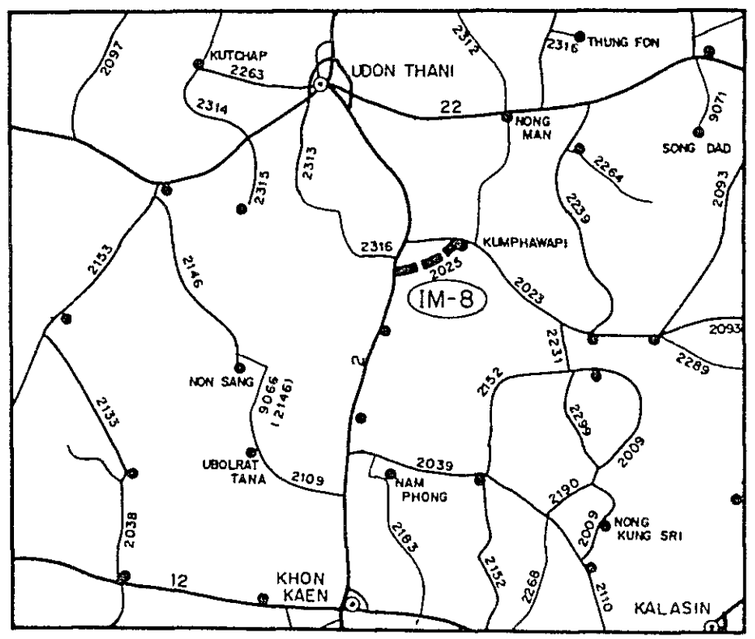
SUMMARY

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	

LOCATION OF PROPOSED ROUTE





1 概　要

1.1 計画路線の概要

本路線はUdon Thani県の南部に位置する。県道２号線のHuai Koeng村を起点とし，ルートは北東に走りPho Sawang村，Nong Noeng 村を経て県道2023号線のKumphawapi郡で終る。その全延長は16.7kmである。（Figure 8.5.2 参照）

沿道の地形は，ほとんど平坦である。影響圏内には，いくつかの村が存在しその総人口は17,900人である。沿道には，医療センターが１ケ所，病院が１ケ所ある。教育施設として中学校が１ケ所ある。

本路線は，農業的に開発の進んだ地域における２つの幹線道路国道２号線と県道2023号線を結ぶ距離を短縮する重要な道路網の形成を目途として計画された。

1.2 現道の状況

計画路線に利用した現道の状況は，Table 8.1.1 に要約し，その詳細はTable 8.1.2 のインベントリー調査の結果に示した。

2. 交通

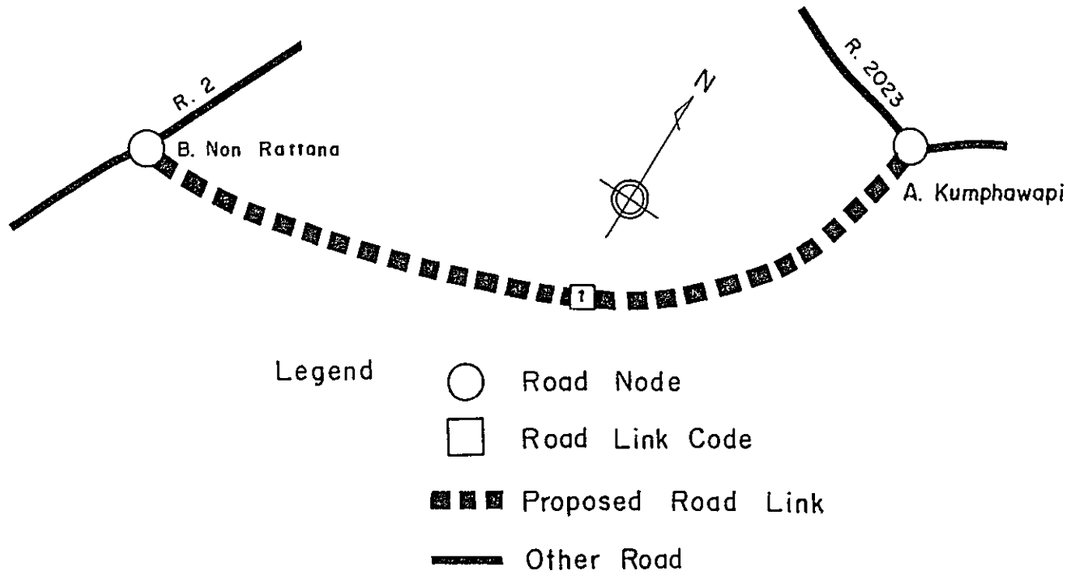
2.1 予測手法

計画対象路線に関し道路改良後の転換交通はほとんど無視し得るので，交通量予測には「伸び率方式」を適用することとした。

2.2 基準年交通量

道路リンク別車種別の基準年交通量は，ＤＯＨ交通量調査結果および本調査で実施したマニュアルカウンティングのデータを基として次のように推定した。

Proposed Road Link



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 交通需要

計画路線上の旅客交通需要（トリップ／日）および貨物交通需要（トン／日）は，先に求めた基準年の交通量に路側インタビューによって得られる平均乗車人員もしくは平均貨物積載量をかけることによって推定した。推定結果は以下のとおりである。

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 交通需要の将来伸び率

1981－1987，1987－1993，1993－2001の各期間における旅客および貨物の交通需要の将来伸び率は，メインレポートの7.3.3の1）で述べた予測式に従って求めた。予測の前提および得られた将来伸び率は以下の通りである。

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	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	1987 － 1993	1993 － 2001
NON-AGRI.	8.5	8.3	8.3
AGRICULTURE	0.0	0.0	0.0
FREIGHT	4.0	3.9	3.9

2.5 誘発および開発交通量

メインレポートの7.3.3の3）で述べた方式を基に誘発および開発交通量の通常交通量に対する比率を求めた。

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 将来交通量

1）車種構成

計画路線上の旅客・貨物に関する将来交通需要を，以下の車種構成比により車種別交通量に変換した。

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) 将来ＡＤＴ

計画路線上のリンク加重平均将来交通量は以下に示すとおりであり，またその道路リンク別交通タイプ別の詳細はTable 8.2.1に示す。

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. 農業開発

3.1 現況

影響圏内の農耕地の約85%は，水田である。畑地では，砂糖きびが一番多く，これにもキャッサバ，ケナフ，落花生が次いでいる。この圏内の近くにあるKumphawapi郡の中心地に，1日当り5300トンの砂糖きび処理能力のある大規模な精糖工場がある。

圏内の土地利用及び土地適応性の状況は，Table 8.3.1とFigure8.3.1に示し，また，Udon Thani県地域の代表的な作物暦は，Figure8.3.2.のとおりである。

3.2. 開発予測

影響圏内の将来の農業開発状況を，With ProjectとWithout Project の双方について予測した。予測した作付面積，単位当り収量及び生産量はTable 8.3.2.のとおりである。代表的作物の農家庭先価格と農業生産費とは，各県の資料及び現地調査の結果を参考にしてTable 8.3.3.のように見積った。

上記のごとく各作物ごとに予測された生産量と庭先価格により，生産価値を計算し，これから農業生産費及び別途見積られた開墾費を差引き，純生産価値（N.P.V）をTable 8.3.4.のように算出した。

このN.P.V のWith Projectの場合と，Without Project の場合の差が，この道路の開発便益である。

4. 走行費の節減

本報告書，第1巻，第7章で述べた概念と基礎データにもとづき関連する各道路リンクの走行費（以下"ＶＯＣ"という）をWith ProjectとWithout Project の両ケースについて計算した。

各リンクにおけるＶＯＣのコスト増に影響を与える道路状況は以下に示すとおりである。

Road Condition

Link No.	Terrain	Without Project Length (km)	1) Road Class	Nos. of Wooden Bridge	Nos. of Narrow C.Bridge	With Project Length (km)	1) Road Class	Nos. of Wooden Narrow Bridge
1	Flat	16.7	3	0	0	16.7	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節減は，With Projectの全リンクのＶＯＣとWithout Project の際のＶＯＣとの差で，当道路におけるＶＯＣの節減は次に示すとおりである。

Vehicle Operating Cost Saving

(Unit: 1,000 Baht)

Road Class	1987	1993	2001
1 (F4)	4,429	6,139	9,467

5. エンジニアリング

5.1 予備設計

予備設計は，次に示す設計基準を基本に行った。

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 : 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 8.5.2.

ルートの線形は，Figure 8.5.2 に示す。

5 2　工事数量および建設費

予備設計による工事数量と建設費は，各工種ごとに単価を付してTable 8.5.1に示す。

道路規程別の建設費を財務費用および経済費用に分けて集計すると，下表に示すとおりとなる。

F4 Standard (DBST)　　L = 16.7 km

Financial cost　　27,361 . 10^3 ¥

Economic Cost　　24,778 . 10^3 ¥

6　経済評価

年次別経済費用と便益及び評価結果はTable 8.6.1に示す通りである。

このルートはＦ４規格でフィージブルである。

7　社会インパクト

社会インパクトを示すデータ及び評価結果はTable 8.7.1に示す通りである。

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 - Name - Household (H) - Population (P)		B. HUAI KOENG	B. NON RATANA 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)	L=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 8.3.1 LAND USE AND CAPABILITY OF INFLUENCE AREA

PROPOSED ROUTE NO. IM - 8

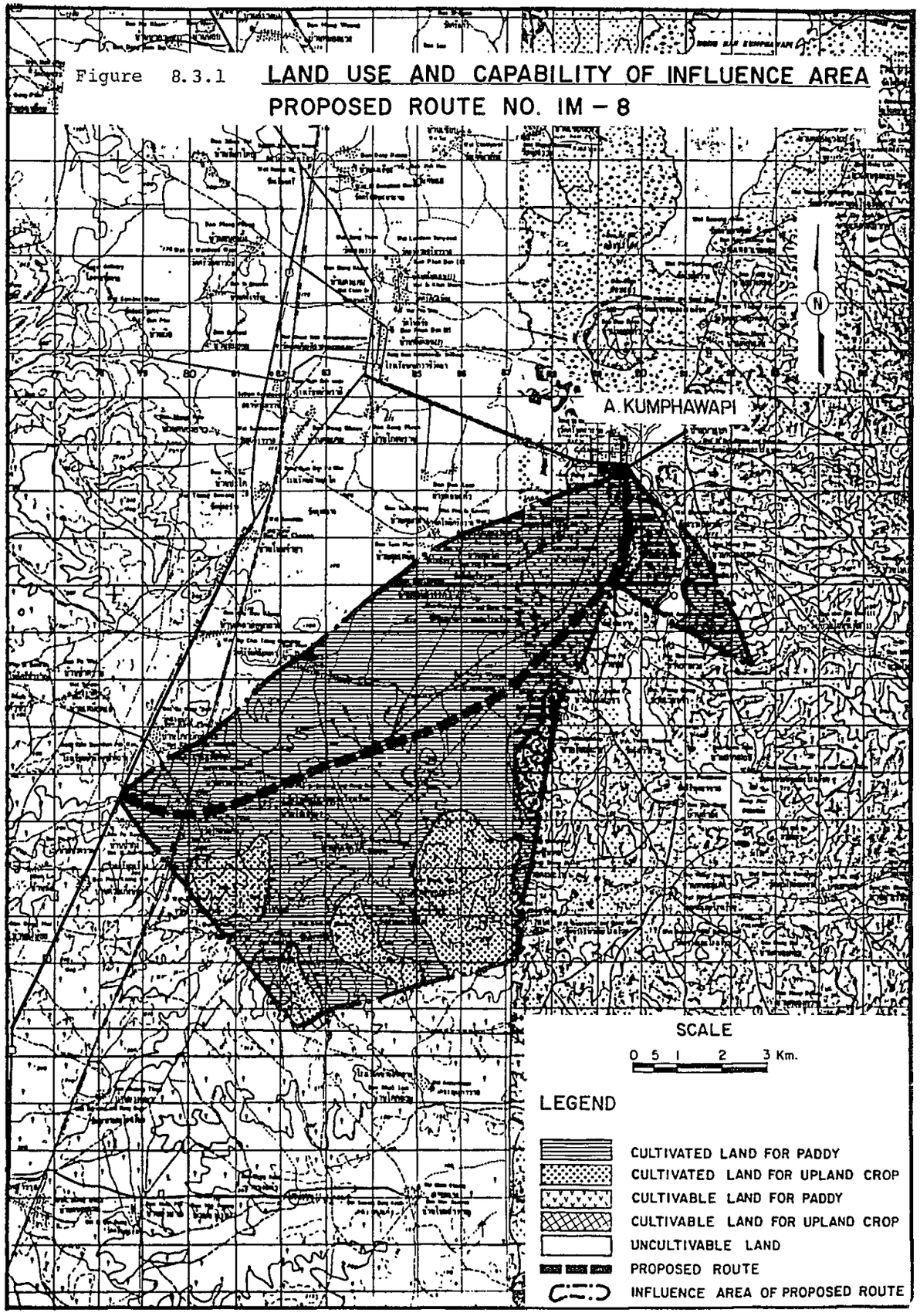


Figure 8.3.2 CROPPING CALENDAR

0200 CHANGWAT UDON THANI

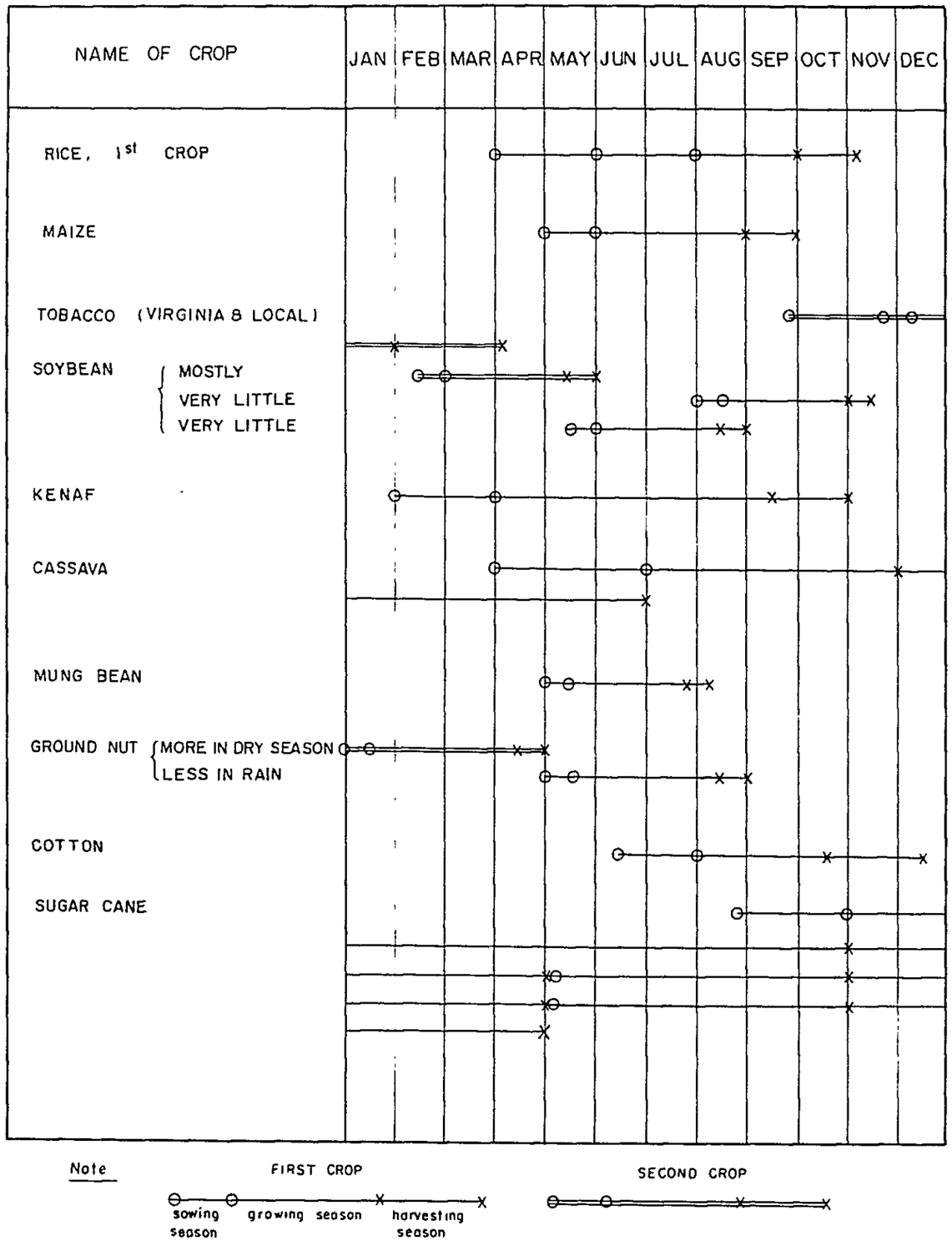


TABLE 8.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM^2)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		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

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)						B. DON SAENG H = 35 P = 210		B. NAM CHUM H = 270 P = 2150		B. KHOK H = 208 P = 1646	B. DON DUA H = 50 P = 300		B. KHOK SAWANG H = 30 P = 300		B. SANG KHOK H = 350 P = 2700		
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	0.40	
	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								16.0	18.6					29.2	
	Dimension	C-Br. 7.00 x 40.00								W-Br. 4.00 x 28.50	W-Br. 4.00 x 23.00					W-Br. 4.80 x 24.00	
RIGHT OF WAY (m)		15.0															
ALIGNMENT	Horizontal	Poor													Fair		
	Vertical	Poor													Fair		
ROUTE NO., AGENCIES		ARD															

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 - Name - Household (H) - Population (P)			B. 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 D : DIVERTED TRAFFIC

DV : DEVELOPED TRAFFIC I : INDUCED TRAFFIC

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

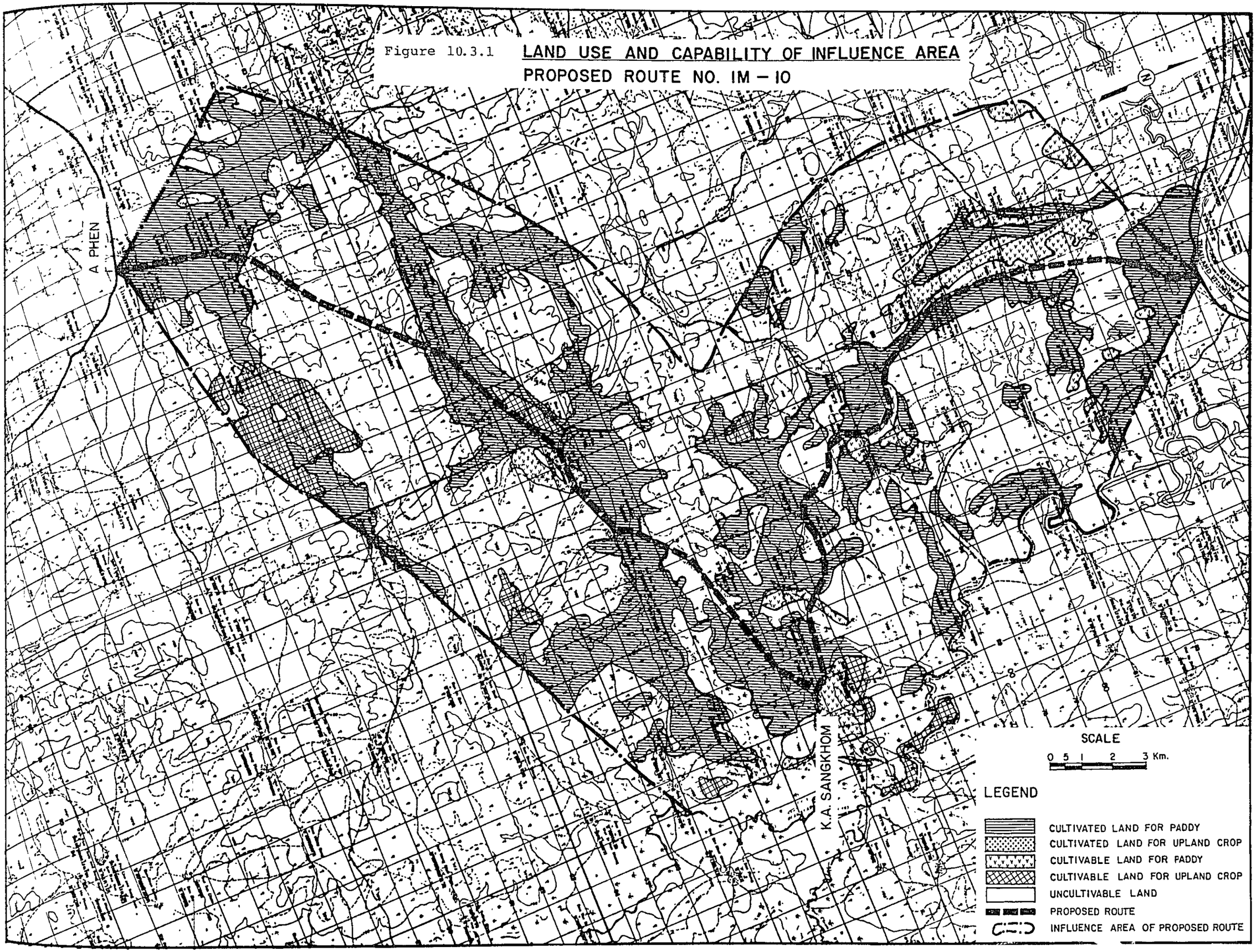
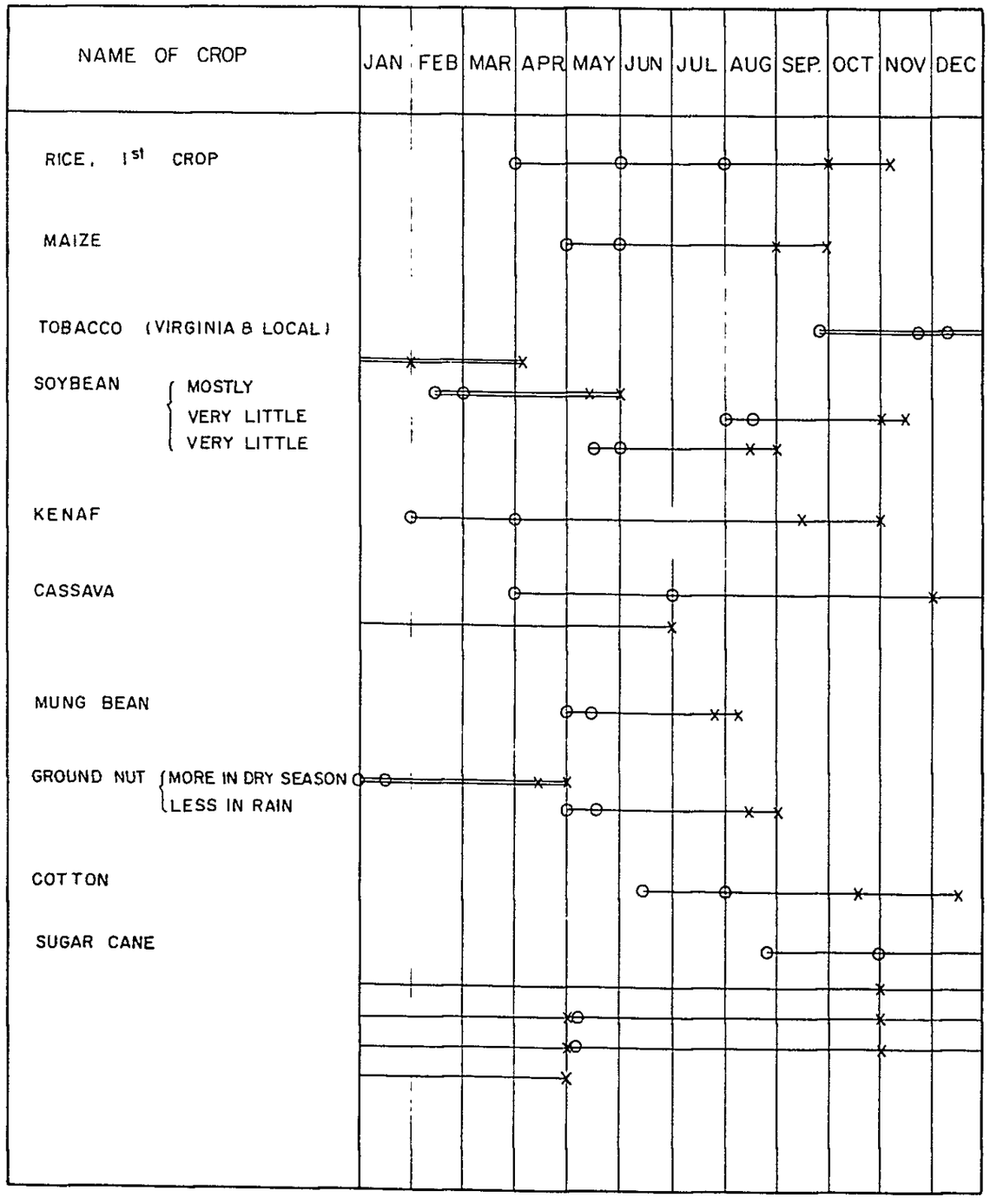


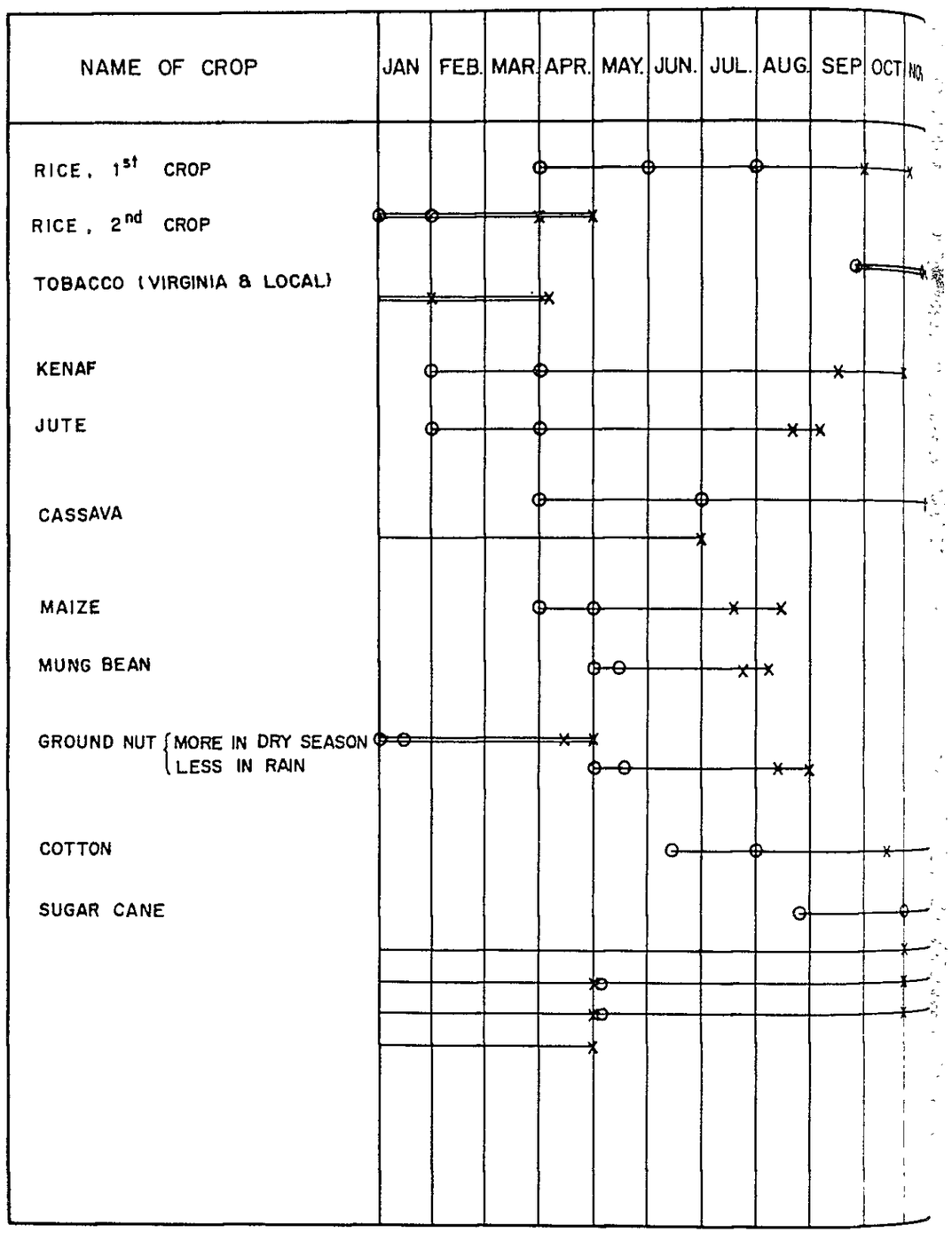
Figure 10.3.2 CROPPING CALENDAR(1)

0200 CHANGWAT UDON THANI



CROPPING CALENDAR(2)

0300 CHANGWAT NONGKHAI



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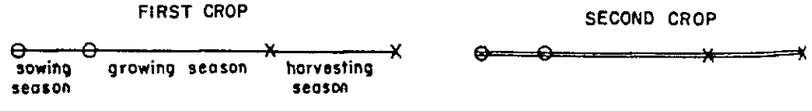
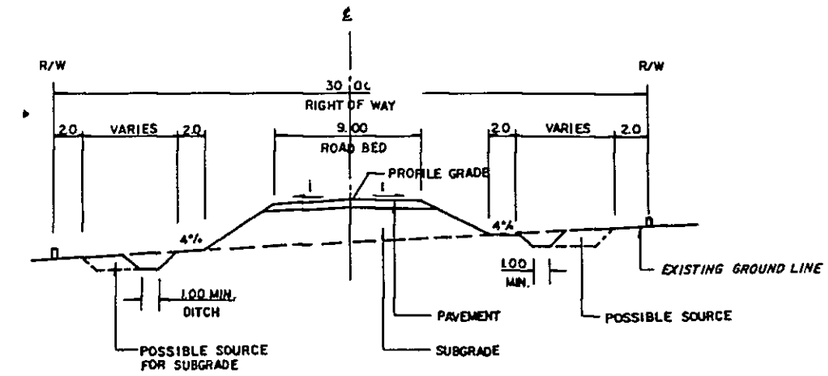
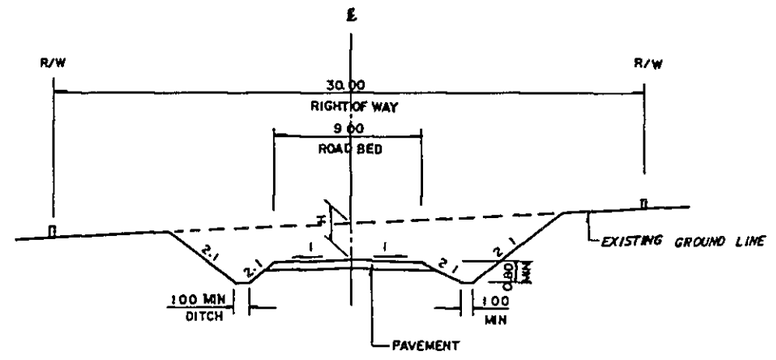


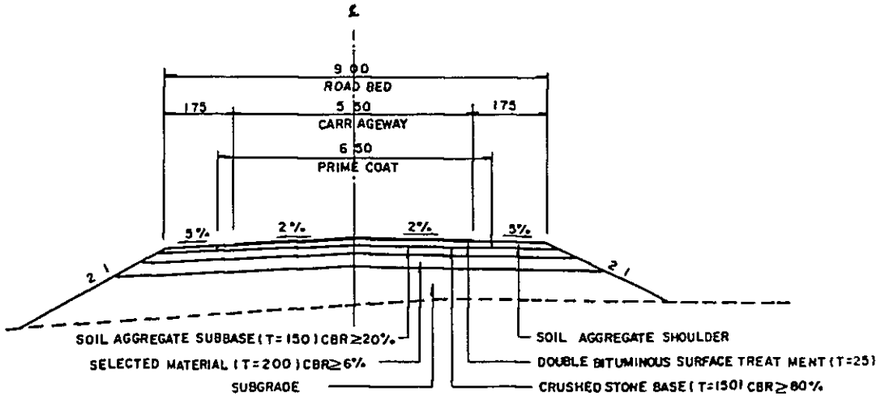
Figure 8.5.1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE



FILL SECTION



CUT SECTION

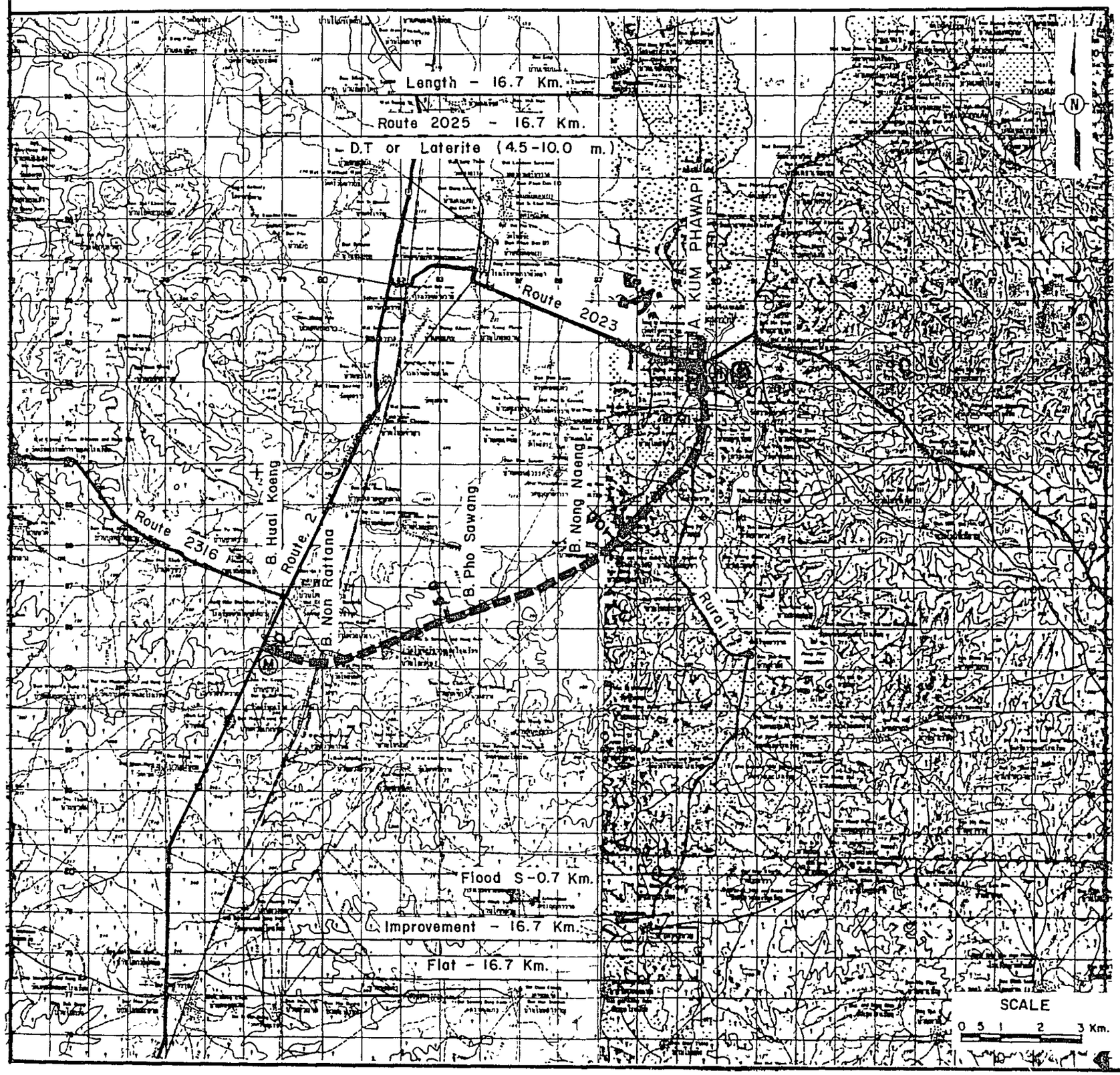


DOUBLE BITUMINOUS SURFACE TREATMENT (DBST) ROAD (Class F4)

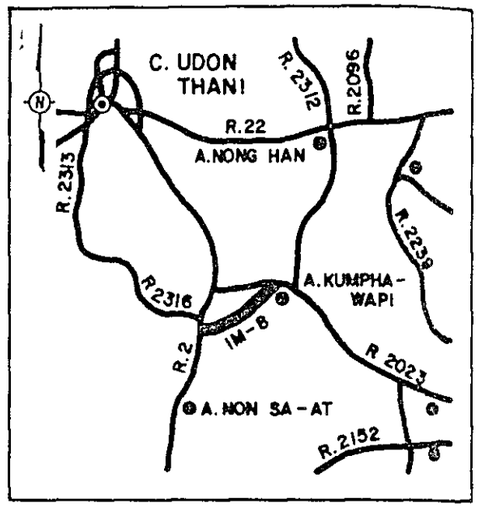
Figure 8.5.2

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
- (H) HOSPITAL
- (M) MEDICAL CENTER
- (S) SECONDARY SCHOOL

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

Items	Unit of Q'ty	Financial Unit Rate ฿	(DBST) Q'ty	(DBST) Financial Cost (10^3฿)	(DBST) Economic Cost (10^3฿)
DIRECT CONSTRUCTION COST					
Clearing and Grubbing	ha	15,000	39	585	532
Excavation - Soil	m^3	20	0	0	0
Excavation - Hard Rock	m^3	160	0	0	0
Embankment	m^3	45	66,300	2,983	2,714
Selected Material	m^3	80	31,600	2,528	2,249
Soil Aggregate Surface or Subbase	m^3	105	22,100	2,320	2,065
Crushed Stone Base	m^3	370	14,500	5,365	4,935
Soil Aggregate Shoulder	m^3	105	6,300	661	588
Prime Coat and DBST	m^2	55	82,000	4,510	4,059
Pipe Culvert	m	2,100	640	1,344	1,236
Box Culvert	m	16,000	10	160	144
Long Span Bridge	m	80,000	0	0	0
Short Span Bridge	m	40,000	0	0	0
Sub Total (a)				20,457	18,526
Miscellaneous Works (a) x 7%				1,432	1,297
Total (b)				21,889	19,823
PHYSICAL CONTENGENCY (b) x 15%				3,283	2,973
ENGINEERING AND ADMINISTRATION (b) x 10%				2,189	1,982
Sub Total				5,472	4,955
LAND ACQUISITION					
Highly Developed Land	ha	50,000	0	0	0
Less Developed Land	ha	15,000	0	0	0
Sub Total				0	0
GRAND TOTAL				27,361	24,778

Table 8.6.1 COST AND BENEFITS

(F4 STANDARD)

(1000 BAHT)

YEAR	COST CONST. COST	BENEFITS AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	DISCOUNTED(12%) COST	BENEFIT
1984	0	0	0	0	0	0	0
1985	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
VOC 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)	
1982	: 17.9
1993	: 23.0
Average travelling speed, without (kph)	: 48
Isolation	
Access to Amphoe	
Average distance to Amphoe (km) 1/	: 8.5
Per capita time savings (10^{-4})	: 0.026
Score	: 76
Access to Artery Highway	
Average distance to highway (km) 1/	: 0
Per capita time savings (10^{-4})	: 0
Score	: 0
Impassability	
Impassable week a year	: -
Impassability per year	: 0
Impassability per capita (10^{-4})	: 0
Score	: 0
Health	
Access to Hospital	
Average distance to Hospital (km) 1/	: 8.5
Per capita time savings (10^{-4})	: 0.026
Score	: 60
Access to Medical Facilities	
Average distance to facilities (km) 1/	: 5.0
Per capita time savings (10^{-4})	: 0.015
Score	: 60
Education	
Access to Secondary School	
Number of Student in 1993 (1,000) 2/	: 3.9
Average distance to school (km)	: 8.5
Per capita time savings (10^{-4})	: 0.151
Score	: 82
Teacher Intensity	
Number of teachers 3/	
University graduate	: 1
Total	: 8
Number of Student	: 206
Indicators	
E1 4/	: 4.9
E2 5/	: 38.8
E 6/	: 43.7
Degree of Improvement 7/	: 1.57
Score	: 100
Disparity	
G.P.V. in 1993 (Mn B) 8/	
With project	: 61.8
Without project	: 60.1
Per capita G.P.V. in 1993 (B)	
With project (W)	: 2,687
Without project (w)	: 2,613
Degree of Disparity	
(A/W) - (A/w) 9/	: 0.03
Score	: 54
Total Score	: 432

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 - 9

Changwat : Udon Thani

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

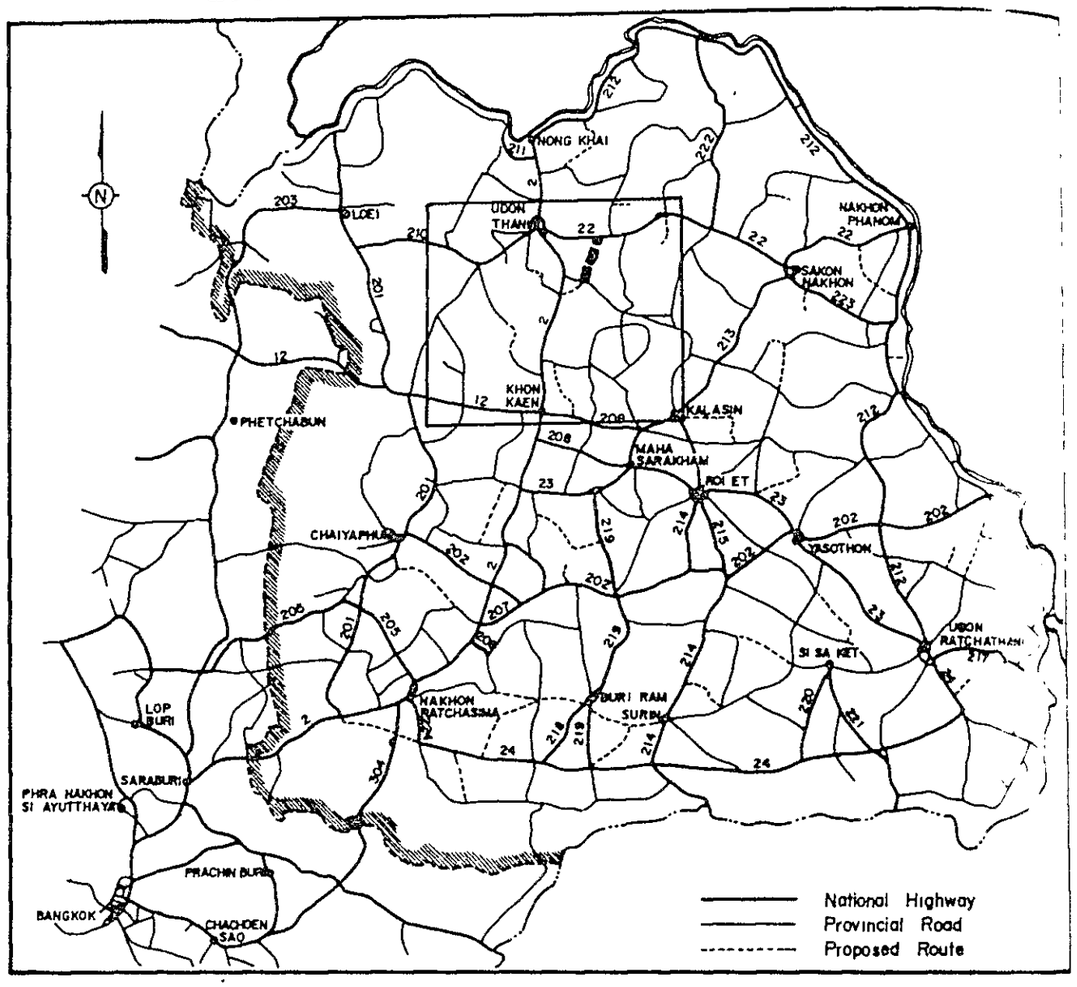
Length : 33.4 KM.

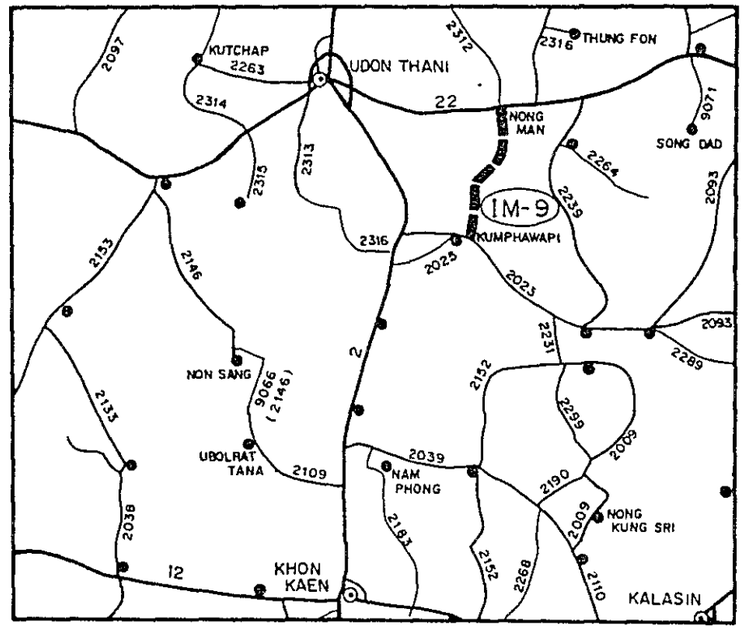
SUMMARY

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

LOCATION OF PROPOSED ROUTE





1. 概　　要

1.1　計画路線の概要

本路線は,Udon Thani 県の東部に位置する。Nong Han郡に起点をもつルートは，南に走り,Phung Ngu村，Muang Phrub 村，Don Yang村を経て，県道2023号線のKumphawapi郡で終る。その総延長は33.4kmである（Figure9.5.2参照）

沿道の地形はほぼ平坦である。影響圏内にはいくつかの村があり，その総人口は，27,900人である。沿道には，医療センターが3ケ所，病院が1ケ所あり，教育施設として中学校が2ケ所ある。

本路線は農業的に開発の進んだ地域における2つの幹線道路国道21号線と県道2023号線を結ぶ重要な形成を目途に計画されたものである。

1.2　現道の状況

計画路線に利用した現道の状況は，Table 9.1.1に要約し，その詳細はTable 9.1.2のインベントリー調査の結果に示した。

2. 交通

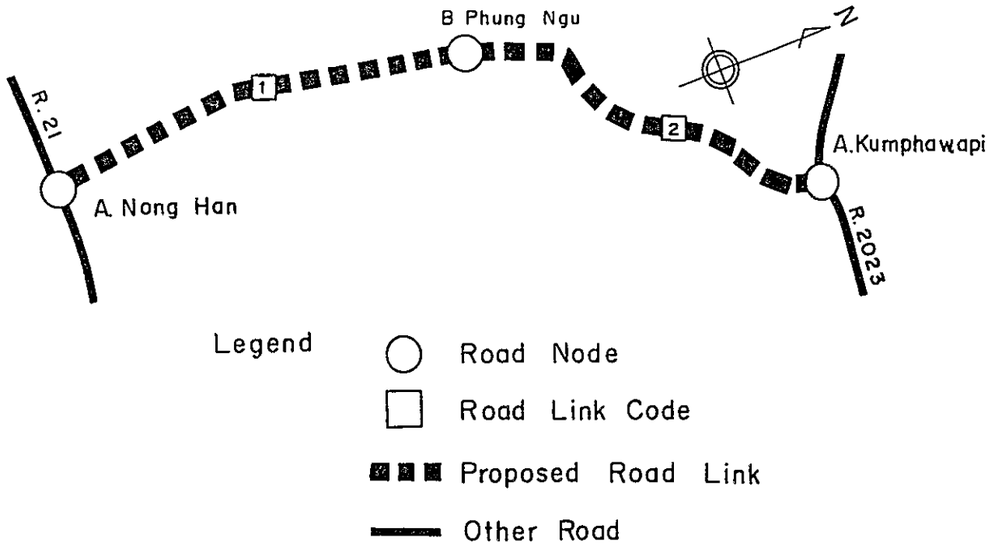
2.1　予測手法

計画対象路線に関し道路改良後の転換交通はほとんど無視し得るので，交通量予測には「伸び率方式」を適用することとした。

2.2　基準年交通量

道路リンク別車種別の基準年交通量は，本調査で実施したマニュアルカウンティングのデータを基として次のように推定した。

Proposed Road Link



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　交通需要

計画路線上の旅客交通需要（トリップ／日）および貨物交通需要（トン／日）は，先に求めた基準年の交通量に路側インタビューによって得られる平均乗車人員もしくは平均貨物積載量をかけることによって推定した。推定結果は以下のとおりである。

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 交通需要の将来伸び率

1981－1987, 1987－1993, 1993－2001の各期間における旅客および貨物の交通需要の将来伸び率は，メインレポートの7.3.3の1）で述べた予測式に従って求めた。予測の前提および得られた将来伸び率は以下の通りである。

GROWTH RATE OF PASSENGER MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 － 1987	1987 － 1993	1993 － 2001
PER CAPITA INCOME	4.2	4.5	4.7
TRANS. PRICE INCREASE	4.5	4.5	4.5
POPULATION	1.5	1.3	1.1
PASSENGER MOVEMENT	5.6	5.7	5.8

GROWTH RATE OF FREIGHT MOVEMENT

ITEM	GROWTH RATE (% P.A.)		
	1981 － 1987	1987 － 1993	1993 － 2001
NON-AGRI.	7.2	7.3	7.5
AGRICULTURE	0.1	0.1	0.1
FREIGHT	3.2	3.3	3.3

2.5 誘発および開発交通量

メインレポートの7.3.3の3）で述べた方式を基に誘発および開発交通量の通常交通量に対する比率を求めた。

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 将来交通量

1）車種構成

計画路線上の旅客・貨物に関する将来交通需要を，以下の車種構成比によって車種別交通量に変換した。

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	3.3	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）将来ＡＤＴ

計画路線上のリンク加重平均将来交通量は以下に示すとおりであり，またその道路リンク別交通タイプ別の詳細はTable 9.2.1に示す。

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	354	357	713
2001	47	78	96	42	155	14	30	27	487	411	898

3. 農業開発

3.1. 現況

影響圏は，Kumphawapi郡側とNong Khai 郡側との二つの地域に分かれている。水田地帯は，農耕地に対し，Kumphawapi側で約80％で，Nong Khai 側で約93％を占めている。畑地の約半分は，砂糖きびで占められており，その他はキャツサバ，ケナフ・メイズ及び豆類である。この地域には，１日当りの処理能力が，それぞれ 5,300トンおよび 1,900トンの二つの大規模な精糖工場が，Kumphawapi郡の中心地とNong Khai の近くに位置し，この二つの工場で，砂糖きびの集荷期である11月から６月までに，毎年総計 1.4百万トンの砂糖きびを集荷している。Nong Khai 側に，畑地の未開発可耕地が残っているが，水田適地は残っていない。

圏内の土地利用及び土地適応性の状況は，Table 9.3.1とFigure9.3.1に示し，また，Udon Thani県の代表的な作物暦は，Figure9.3.2のとおりである。

3.2. 開発予測

影響圏内の将来の農業開発状況を，With ProjectとWithout Project の双方について予測した。予測した作付面積，単位当り収量及び生産量はTable 9.3.2.のとおりである。代表的作物の農家庭先価格と農業生産費とは，各県の資料及び現地調査の結果を参考にしてTable 9.3.3.のように見積った。

上記のごとく各作物ごとに予測された生産量と庭先価格により，生産価値を計算し，これから農業生産費及び別途見積られた開墾費を差引き，純生産価値（N.P.V）をTable 9.3.4.のように算出した。

このN.P.V のWith Projectの場合と，Without Project の場合の差が，この道路の開発便益である。

4. 走行費の節減

本報告書，第１巻，第７章で述べた概念と基礎データにもとづき関連する各道路リンクの走行費（以下“ＶＯＣ”という）をWith ProjectとWithout Project の両ケースについて計算した。

各リンクにおけるＶＯＣのコスト増に影響を与える道路状況は以下に示すとおりである。

Road Condition

No	Link Terrain	Without Project Length (km)	Without Project 1) Road class	Without Project Nos. of Wooden Bridge	Without Project Nos. of Narrow C.Bridge	With Project Length (km)	With Project 1) Road Class Case 1	With Project 1) Road Class Case 2	With Project Nos. of Wooden Narrow Bridge
1	Flat	13.4	2B	5	0	13.4	1(F4)	2A(F5)	0
2	Flat	20.0	2B	9	0	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節減は，With Projectの全リンクのＶＯＣとWithout Project の際のＶＯＣとの差で，当道路におけるＶＯＣの節減は次に示すとおりである。

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. エンジニアリング

5.1 予備設計

予備設計は，次に示す設計基準を基本に行った。

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 Fig 9.5.2

ルートの線形は，Figure 9.5.2 に示す。

5 2　工事数量および建設費

予備設計による工事数量と建設費は，各工種ごとに単価を付してTable 9.5.1に示す。

道路規程Ｆ４の建設費を財務費用および経済費用に分けて集計すると，下表に示すとおりとなる。

Financial and Economic Construction Cost

Road Class	Length (km)	Construction Cost (10^3¥) Financial cost	Economic Cost	Remark
F4 (DBST)	33.4	72,564	65,760	
F5 (Soil Aggregate)	33.4	45,218	40,887	

6. 経済評価

年次別経済費用と便益及び評価結果はTable 9.6.1に示す通りである。

このルートはＦ４規格でフィージブルである。

7. 社会インパクト

社会インパクトを示すデータ及び評価結果はTable 9.7.1に示す通りである。

Table 9.1.1 SUMMARY OF ROAD INVENTORY

Item	Description		
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
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 - Name - Household (H) - Population (P)		A. NONG HAN							B. PHUNG NGU H = 300 P = 2400				B. KHO NOI H = 120 P = 840	B. MUANG PHRUK H = 150 P = 1200	B. LAO YAI H = 185 P = 1500		B. CHIANG SOM H = 30 P = 250	B. DON YANG H = 320 P = 2400
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-Br. 4.50 x 15.00	W-Br. 4.50 x 5.00				W-Br. 4.50 x 10.00	W-Br. 4.50 x 9.50 W-Br. 4.50 x 15.50	W-Br. 4.50 x 10.00	W-Br. 4.50 x 30.00	W-Br. 4.50 x 25.50	W-Br. 4.50 x 10.00 W-Br. 4.50 x 9.00 W-Br. 4.50 x 5.50					W-Br. 4.50 x 16.00	W-Br. 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														

Table 9.2.1 TRAFFIC VOLUME ON ROUTE IM - 9

YEAR		1987			1993			2001		
LINK		1	2	AVR.	1	2	AVR.	1	2	AVR.
P/C	N+D	11	5	7	23	14	18	49	35	41
	I	2	1	1	3	2	3	7	5	6
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	13	6	9	26	16	20	57	40	47
L/B	N+D	46	89	72	52	88	74	60	73	68
	I	7	13	11	8	13	11	9	11	10
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	53	103	83	60	102	85	69	84	78
M/B	N+D	34	25	29	47	45	46	74	90	83
	I	5	4	4	7	7	7	11	13	12
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	39	29	33	54	52	53	85	103	96
H/B	N+D	6	5	6	14	16	15	32	39	36
	I	1	1	1	2	2	2	5	6	5
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	7	6	7	16	18	17	37	45	42
P/P&T	N+D	100	63	78	121	82	98	158	119	135
	I	15	9	12	18	12	15	24	18	20
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	115	72	89	139	95	112	182	137	155
4/T	N+D	24	27	26	18	21	20	10	13	12
	I	4	4	4	3	3	3	1	2	2
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	28	32	30	20	25	23	11	15	14
6/T	N+D	19	24	22	20	26	23	21	29	26
	I	3	4	3	3	4	3	3	4	4
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	22	28	26	23	30	27	25	33	30
10/T	N+D	9	14	12	13	18	16	20	26	23
	I	1	2	2	2	3	2	3	4	4
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	11	16	14	15	21	19	23	30	27
ADT	N+D	250	253	252	308	311	310	423	423	423
	I	38	38	38	46	47	46	63	64	63
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	288	291	290	354	358	356	487	487	487
M/C	N+D	291	299	296	327	335	332	384	388	386
	I	24	25	25	25	26	25	24	25	25
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	315	324	320	352	360	357	408	413	411
TOTAL	N+D	541	552	548	635	646	641	807	812	810
	I	62	63	62	71	72	72	88	88	88
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	603	615	610	706	718	713	895	900	898

NOTE

N : NORMAL TRAFFIC D : DIVERTED TRAFFIC

DV : DEVELOPED TRAFFIC I : INDUCED TRAFFIC

LAND USE AND CAPABILITY OF INFLUENCE AREA
PROPOSED ROUTE NO IM – 9

Figure 9.3.2 CROPPING CALENDAR

0200 CHANGWAT UDON THANI

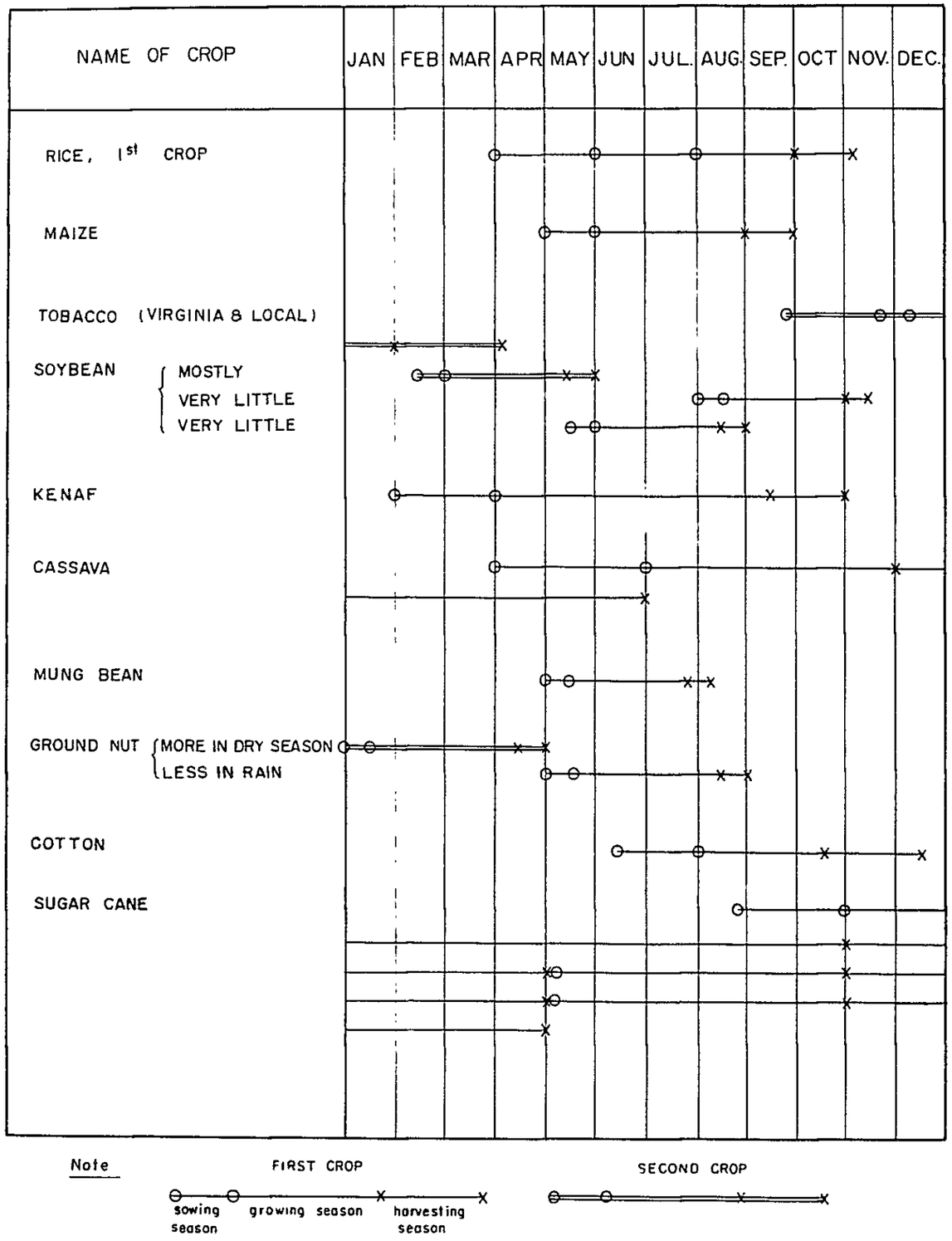


TABLE 9.3.1 CULTIVATED & CULTIVABLE LAND

(1979)

[UNIT : 1000 RAI (KM^2)]

AMPHOE CODE	AMPHOE NAME	CULTIVATED LAND			UNUSED CULTIVABLE LAND		
		PADDY	UPLAND	TOTAL	PADDY	UPLAND	TOTAL
		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

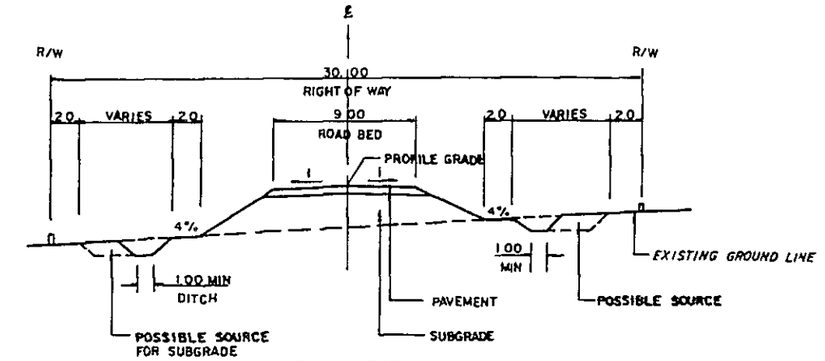
ITEM	PADDY	MAIZE	BEANS	GRUND NUTS	CASSAVA	SUGAR CANE	KENAF	COTTON
FARMGATE PRICE (BAHT/TON)								
WITHOUT PROJECT (1981 - 2001)	3,887	2,750	-	9,641	597	671	4,511	-
WITH PROJECT (1987 - 2001)	3,984	2,819	-	9,641	612	671	4,624	-
CROP PRODUCTION COST (BAHT/RAI)								
WITHOUT PROJECT (1981 - 2001)	612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

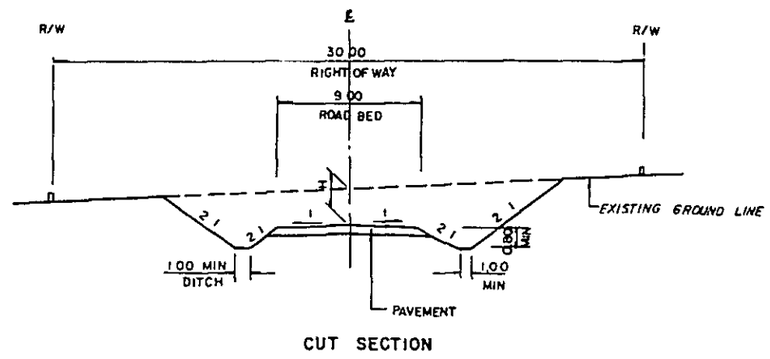
(1000 BAHT)

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

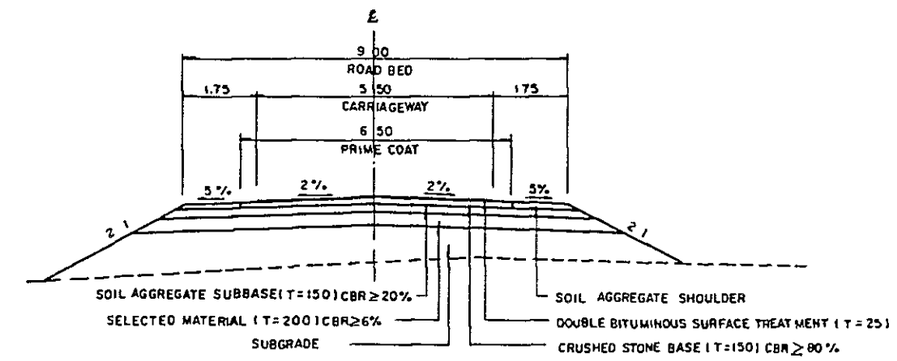
Figure 9. 5. 1 TYPICAL CROSS SECTION AND TYPICAL PAVEMENT STRUCTURE



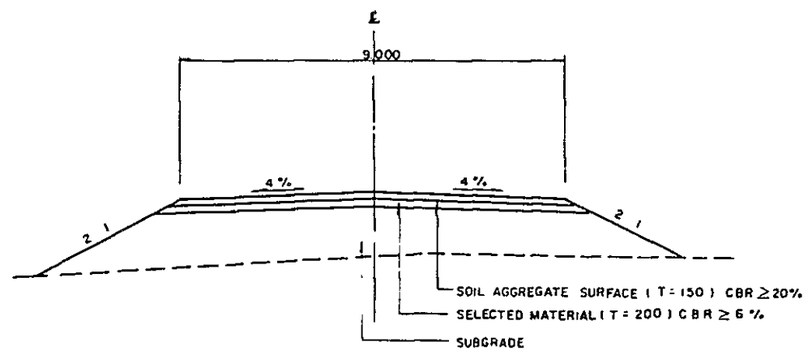
FILL SECTION



CUT SECTION



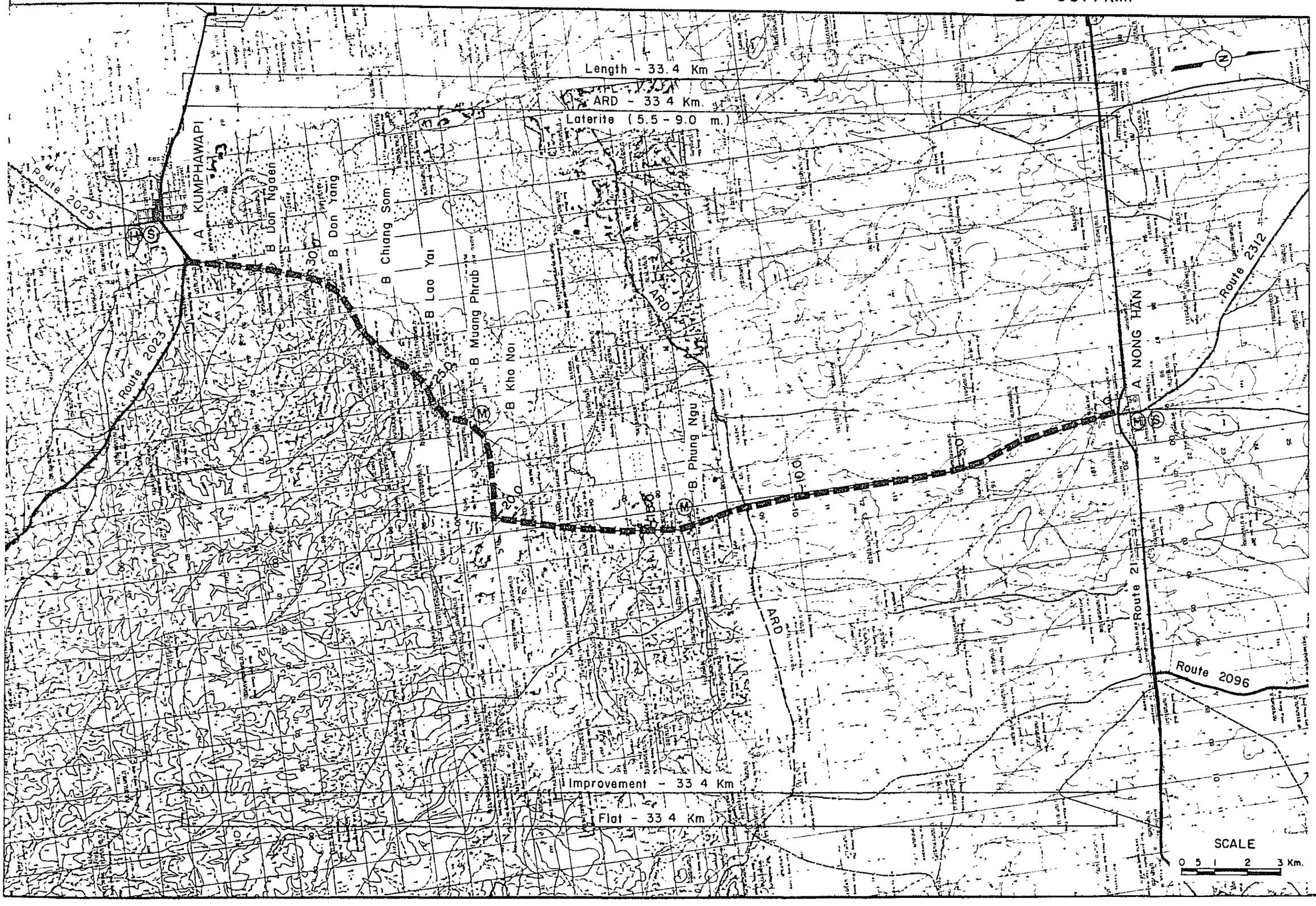
DOUBLE BITUMINOUS SURFACE TREATMENT (DBST) ROAD (Class F4)



SOIL AGGREGATE SURFACED ROAD (Class F5)

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.

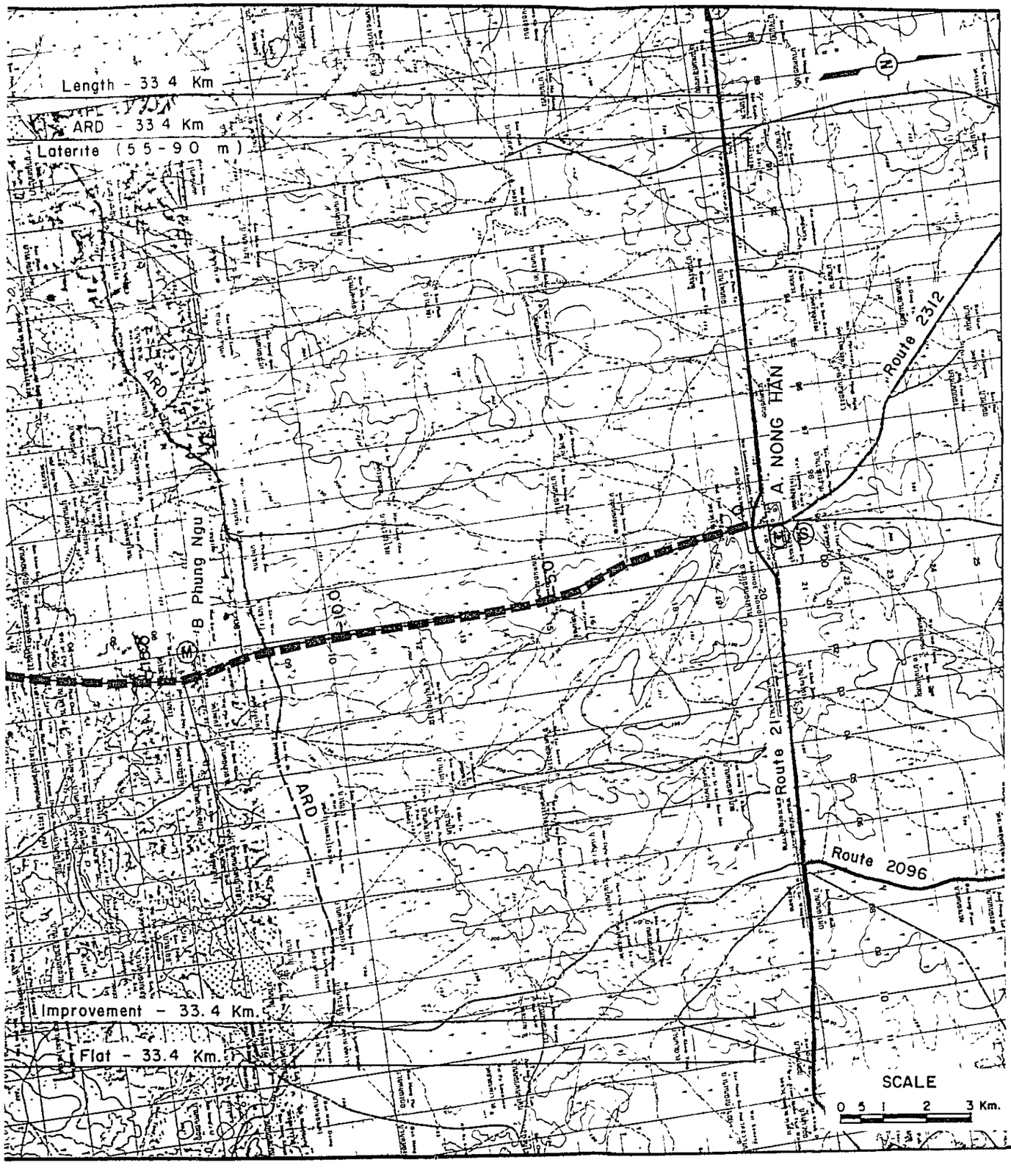


No.	Static Km
1	11
2	30
3	107
4	127
5	129
6	139
7	160
8	174
9	192
10	194
11	199
12	271
13	290
14	333

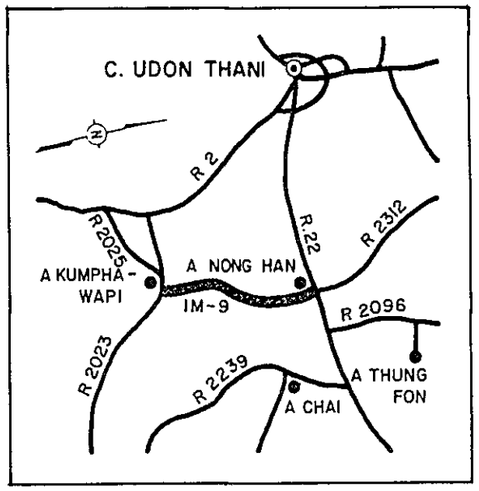
LEGEND

ANI · 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 50x15 00
2	3 0	C-7.00 x 7 00	W-4 50x 5 00
3	10 7	C-7 00 x 12.00	W-4 50x10 00
4	12 7	C-7 00 x 12.00	W-4 50x 9 50
5	12.9	C-7 00 x 18 00	W-4 50x15 50
6	13 9	C-7 00 x 12.00	W-4 50x10 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 50x10 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-4.50x16 00
13	29.0	C-7.00 x 12.00	W-4.00x 9 00
14	33.3	C-7 00 x 18.00	W-4 50x16 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 9.5.1 CONSTRUCTION QUANTITIES AND COSTS IM-9 (33.4 km)

Items	Unit of Q'ty	Financial Unit Rate ¥	(DBST) Q'ty	(DBST) Financial Cost (10^3¥)	(DBST) Economic Cost (10^3¥)	(Soil Aggregate Surface) Q'ty	(Soil Aggregate Surface) Financial Cost (10^3¥)	(Soil Aggregate Surface) 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 CONTENGENCY (b) x 15%				8,408	7,591		5,126	4,606
ENGINEERING AND ADMINISTRATION (b) x 10%				5,605	5,061		3,417	3,070
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)

	COST	BENEFITS				DISCOUNTED(12%)	
YEAR	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	COST	BENEFIT
1984	13,152	0	0	0	0	18,478	0
1985	32,880	0	0	0	0	41,245	0
1986	19,728	0	0	0	0	22,095	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)		
1982	:	27.9
1993	:	32.5
Average travelling speed, without (kph)	:	48
Isolation		
Access to Amphoe		
Average distance to Amphoe (km) 1/	:	9.5
Per capita time savings (10^{-4})	:	0.020
Score	:	59
Access to Artery Highway		
Average distance to highway (km) 1/	:	0
Per capita time savings (10^{-4})	:	0
Score	:	0
Impassability		
Impassable week a year	:	1
Impassability per year	:	0.019
Impassability per capita (10^{-4})	:	0.006
Score	:	50
Health		
Access to Hospital		
Average distance to Hospital (km) 1/	:	8.3
Per capita time savings (10^{-4})	:	0.018
Score	:	42
Access to Medical Facilities		
Average distance to facilities (km) 1/	:	3.2
Per capita time savings (10^{-4})	:	0.007
Score	:	28
Education		
Access to Secondary School		
Number of Student in 1993 (1,000) 2/	:	7.8
Average distance to school (km)	:	8.3
Per capita time savings (10^{-4})	:	0.074
Score	:	40
Teacher Intensity		
Number of teachers 3/		
University graduate	:	-
Total	:	9
Number of Student	:	264
Indicators		
E1 4/	:	-
E2 5/	:	34.1
E 6/	:	34.1
Degree of Improvement 7/	:	2.01
Score	:	128
Disparity		
G.P.V. in 1993 (Mn B) 8/		
With project	:	135.9
Without project	:	131.1
Per capita G.P.V. in 1993 (B)		
With project (W)	:	4,182
Without project (w)	:	4,034
Degree of Disparity		
(A/W) - (A/w) 9/	:	0
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.