

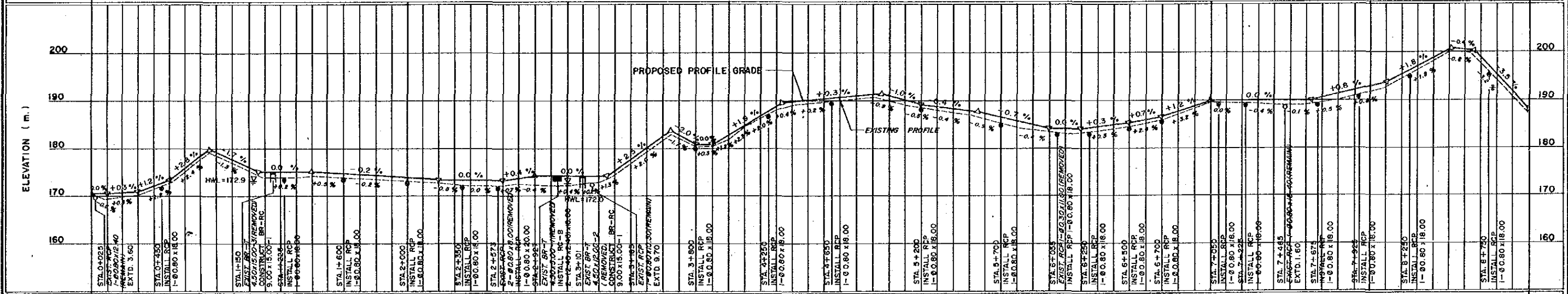


TERRAIN: ROLLING (from STA 0+000 to STA 7+000), FLAT (from STA 7+000 to STA 9+000)

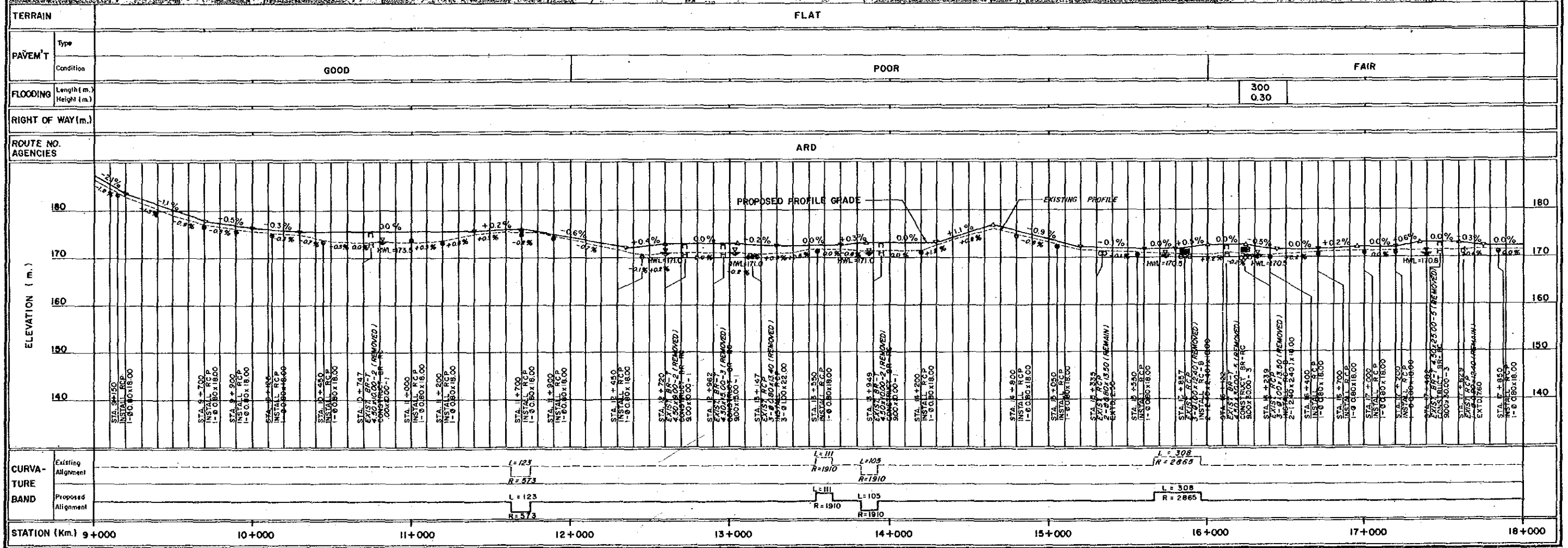
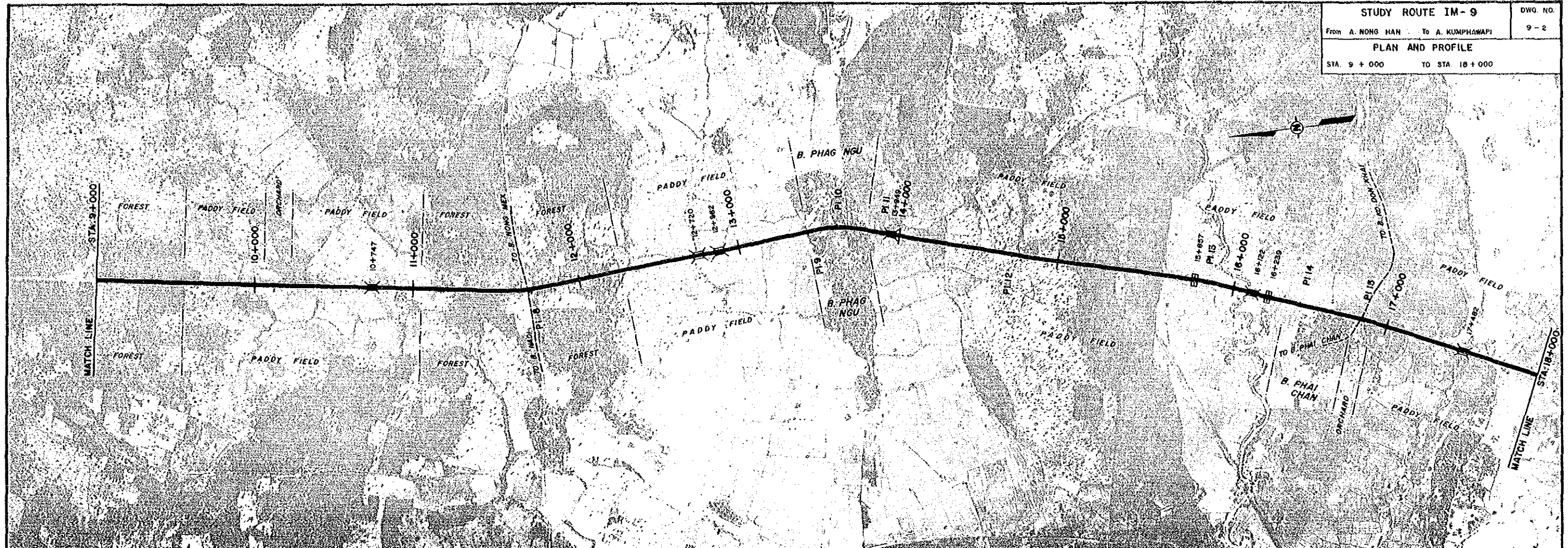
PAVEMENT	Type	LATERITE		
	Condition	FAIR	POOR	GOOD

FLOODING	Length (m.)			
	Height (m.)			
RIGHT OF WAY (m.)				

ROUTE NO. AGENCIES: ARD



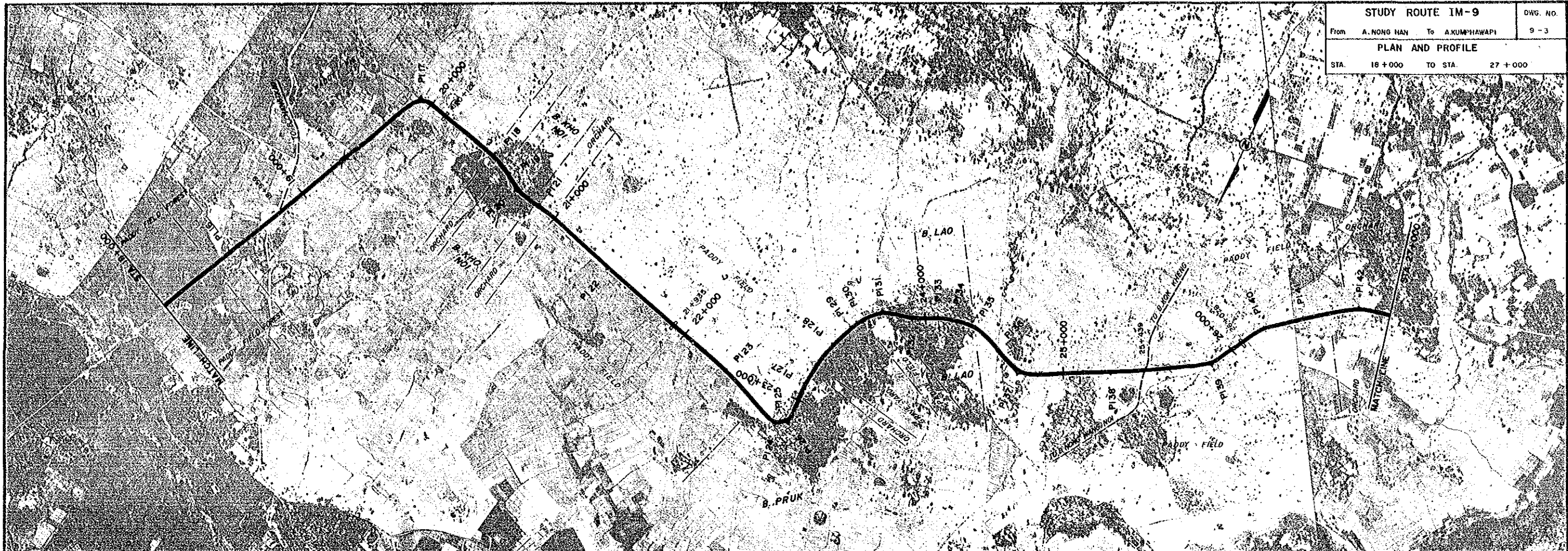
CURVA-TURE BAND	Existing Alignment	L=230 R=1432	L=173 R=2865	L=96 R=637	L=92 R=1432	L=98 R=302	L=115 R=358				
	Proposed Alignment	L=230 R=1432	L=173 R=2865	L=96 R=637	L=92 R=1432	L=98 R=302	L=115 R=358				
STATION (km)		0+000	1+000	2+000	3+000	4+000	5+000	6+000	7+000	8+000	9+000



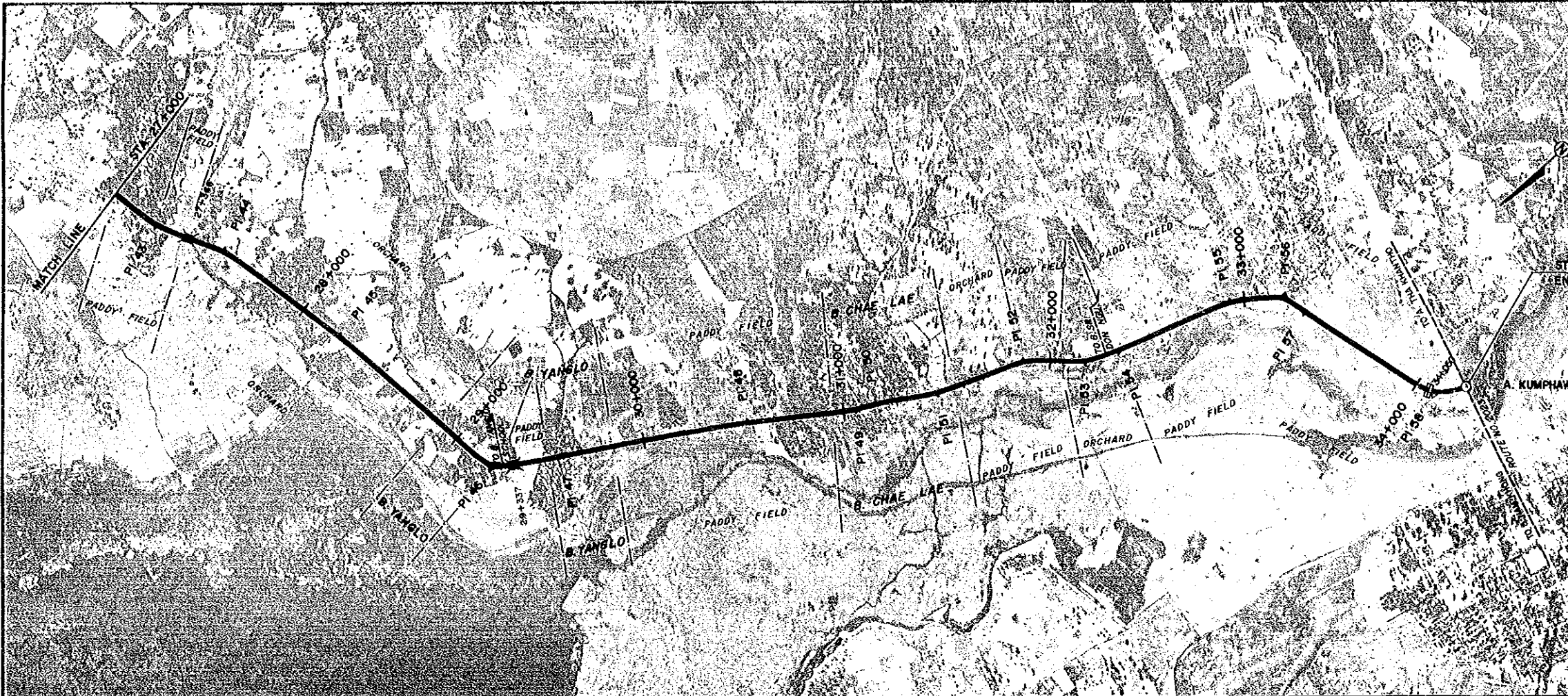


PLAN AND PROFILE

STA. 18+000 TO STA. 27+000

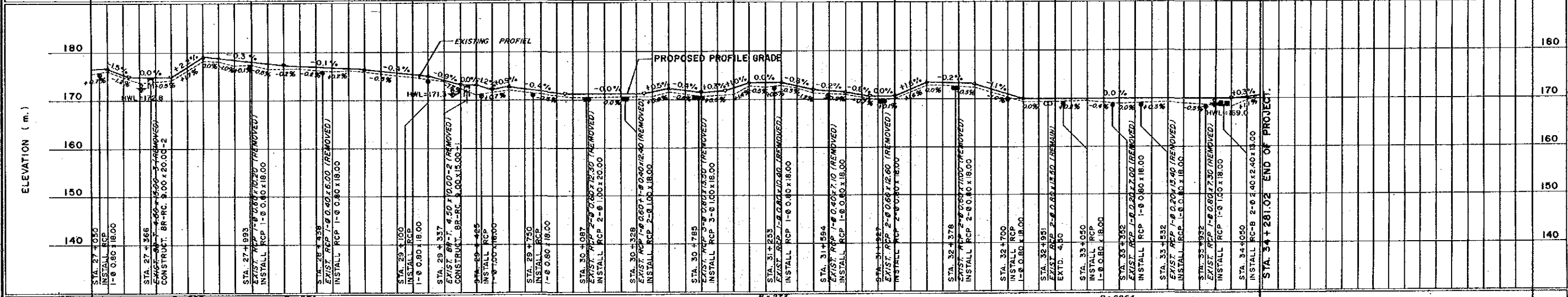


TERRAIN		FLAT	
PAVEM'T	Type	LATERITE	
	Condition	FAIR	POOR
FLOODING	Length (m.)	800	
	Height (m.)	0.20	
RIGHT OF WAY (m.)			
ROUTE NO. AGENCIES		ARD	
CURVA-TURE BAND	Existing Alignment	<p>PROPOSED PROFILE GRADE</p> <p>EXISTING PROFILE</p>	
	Proposed Alignment	<p>ELEVATION ( m )</p> <p>180</p> <p>170</p> <p>160</p> <p>150</p> <p>140</p>	
STATION (Km.)		18+000	27+000



STA. 34+281.02 = STA. 8+878.76 OF ROUTE 2023  
 END OF PROJECT

TERRAIN	FLAT	
PAVEM'T	Type	LATERITE
	Condition	POOR
FLOODING	Length (m.)	150
	Height (m.)	0.90
RIGHT OF WAY (m.)		
ROUTE NO. AGENCIES	ARD	
ELEVATION (m.)	EXISTING PROFILE	180
	PROPOSED PROFILE GRADE	170
CURVA-TURE BAND	Existing Alignment	160
	Proposed Alignment	150
STATION (Km.)	27+000	34+000



CURVA-TURE BAND	Existing Alignment	R=358 L=100	R=574 L=67	R=140 L=125	R=1910 L=99	R=273 L=62	R=409 L=198	R=147 L=107	R=638 L=208	R=337 L=107	R=2864 L=130
	Proposed Alignment	R=287 L=101	R=358 L=100	R=573 L=67	R=140 L=125	R=1910 L=99	R=273 L=62	R=409 L=198	R=147 L=107	R=638 L=208	R=337 L=107

STUDY ROUTE NO. IM-12

Changwat : Sakon Nakhon

A. Sawang Daen Din (J.R. 22) – A. Song Dao

Length : 19.1 KM.

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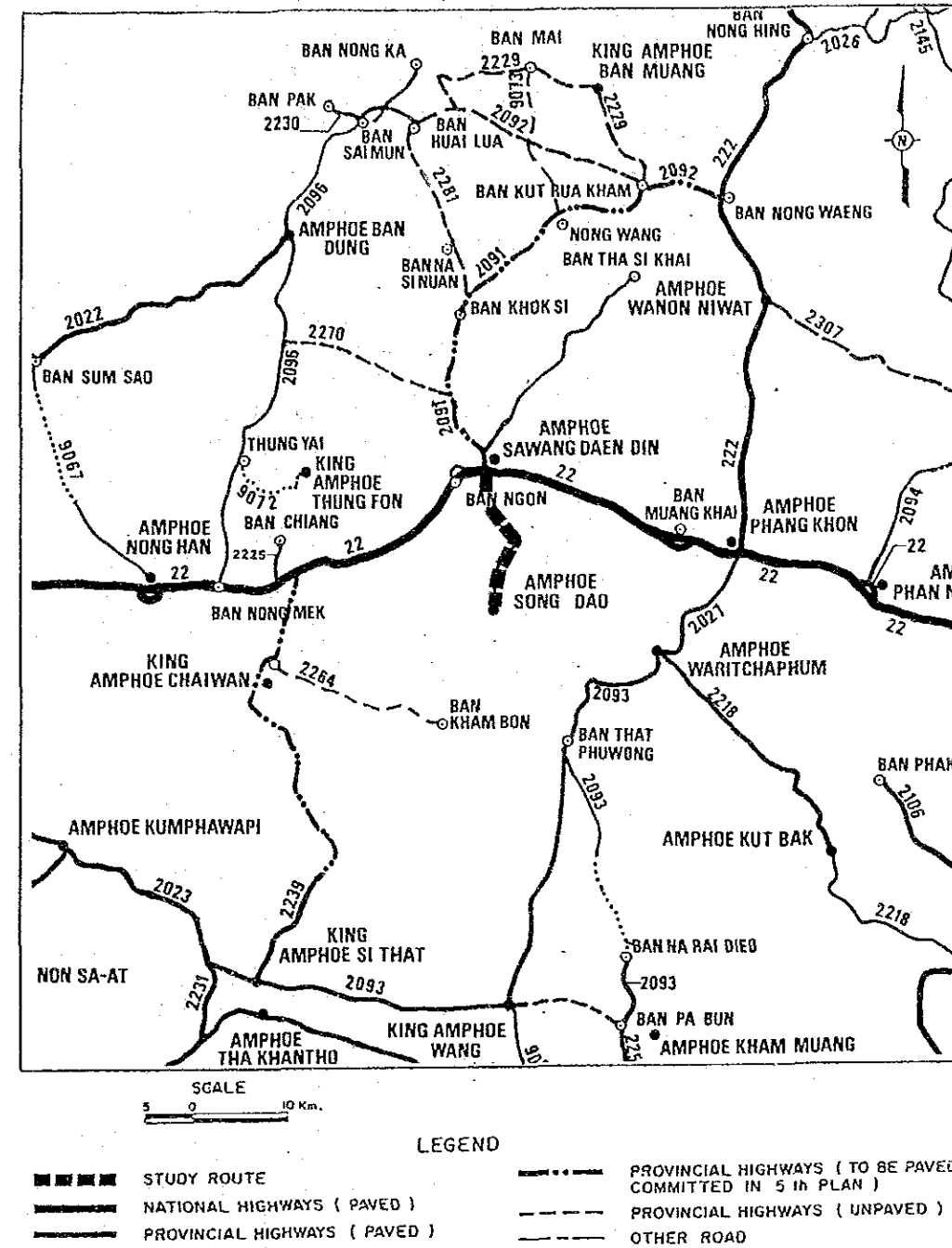
**SUMMARY**

**STUDY ROUTE IM-12**

**General**

Changwat	:	Sakon Nakhon
Origin and Destination	:	A. Sawang Daen Din—A. Song Dao
Connected Road Network	:	22
Amphoe on Route	:	4
Number of Related Villages	:	4
<b>Influence Area</b>		
Area	:	164 km <sup>2</sup>
Cultivated Area Ratio to Total Land Area in %	:	83
Population in 1983	:	15,120
Main Crops	:	Paddy & Cassava
<b>Number of Public Activities</b>		
Public Health Service Centers	:	-
Hospitals	:	-
Changwat Level	:	-
Amphoe Level	:	2
Schools	:	4
Primary	:	4
Secondary	:	1
<b>Traffic (ADT)</b>		
	:	1984—184    1988—275
	:	1994—341   2002—466
<b>Nomenclature of Study Route</b>		
Total Length	:	19.1 km
Improvement Section	:	19.1 km
DOH Road	:	-
ARD Road	:	19.1 km
Other Road	:	-
New Construction Section	:	-
Design Standard Employed	:	F4
<b>Construction Cost in Baht</b>		
Financial	:	35,211,000
Economic	:	29,633,000
<b>Economic Indicators</b>		
IRR	:	14.9%    Ranking: 6
<b>Social Impact</b>		
Social B/C Ratio	:	0.072    Ranking: 15
<b>Recommendations</b>		
Opening Year	:	1988    Overall Ranking: 10

**LOCATION OF STUDY ROUTE**

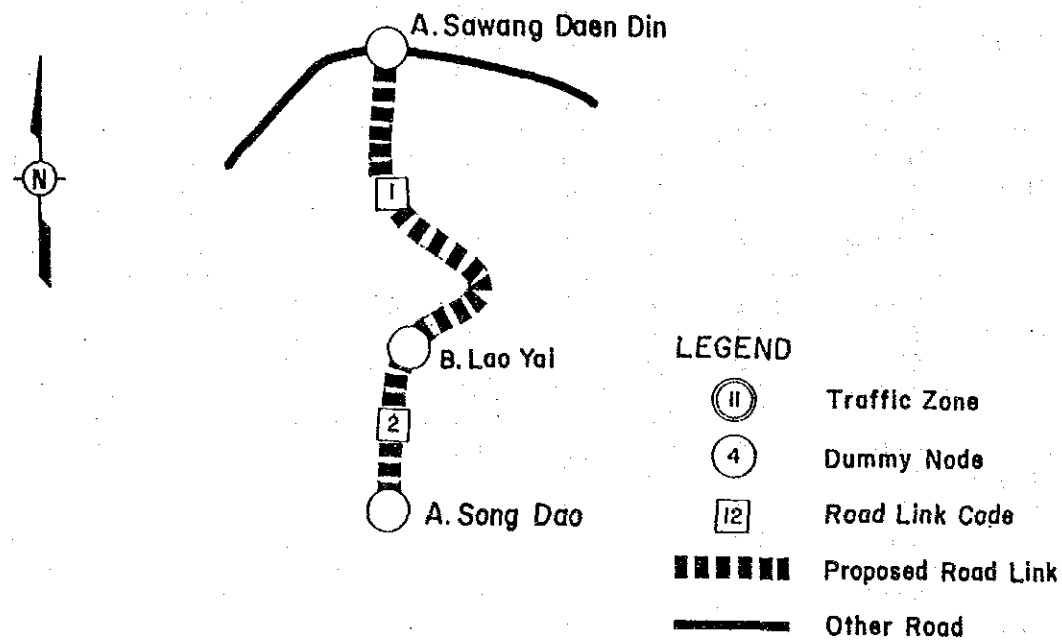


## 12.1 TRAFFIC

### 12.1.1 Method Employed in Traffic Forecasting

The growth rate method was employed in forecasting traffic because no diverted traffic after improvement was expected on this study route.

### 12.1.2 Assumed Road Link



### 12.1.3 Traffic Forecast

- 1) Items necessary for forecasting traffic were:
  - Traffic volume in base year
  - Passenger and freight movement in base year
  - Growth rates of passenger and freight movement
  - Rate of induced and developed movement
  - Traffic composition

TRAFFIC VOLUME IN BASE YEAR

LINK	TYPE OF VEHICLE								ADT	M/C	TOTAL
	P/C	L/B	M/B	H/B	P/P&T	4/T	6/T	10/T			
1	2	42	35	0	70	21	38	14	222	270	492
2	6	1	3	3	36	14	15	3	81	92	173
AVE.	3	31	26	1	61	19	32	11	184	222	407

PASSENGER AND FREIGHT MOVEMENT IN BASE YEAR

PROPOSED ROAD LINK	PASSENGER MOVEMENT (TRIPS PER DAY)	FREIGHT MOVEMENT (TONNAGE PER DAY)		
		NON-AGRI.	AGRI.	TOTAL
1	1404	101.7	107.5	209.2
2	320	34.8	36.8	71.7

GROWTH RATE OF PASSENGER MOVEMENT

(UNIT : % P.A.)

YEAR	PER CAPITA INCOME	POPULATION	PASSENGER MOVEMENT
1984 - 1988	3.1	0.5	4.9
1988 - 1994	3.1	0.3	4.8
1994 - 2002	3.1	0.3	4.7

GROWTH RATE OF FREIGHT MOVEMENT

(UNIT : % P.A.)

YEAR	NON-AGRI. FREIGHT	AGRI. FREIGHT	FREIGHT MOVEMENT
1984 - 1988	6.1	0.1	3.1
1988 - 1994	5.9	0.1	3.4
1994 - 2002	5.8	0.1	3.9



RATE OF INDUCED AND DEVELOPED MOVEMENT

(UNIT : %)

YEAR	INDUCED		DEVELOPED		
	LINK		PASSENGER	NON-AGRI.	AGRI.
	1	2	MOVEMENT	FREIGHT	FREIGHT
1988	15.0	15.0	0.0	0.0	0.1
1994	15.0	15.0	0.0	0.0	0.7
2002	15.0	15.0	0.0	0.0	1.5

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	1984	1.8	54.4	23.9	19.9	0.0	13.1	25.0	45.2	16.7
	1988	10.1	50.7	19.2	18.4	1.6	13.1	21.9	46.3	18.7
	1994	22.5	45.3	12.3	16.1	3.9	13.0	17.2	47.9	21.9
	2002	39.0	38.0	3.0	13.0	7.0	13.0	11.0	50.0	26.0
2	1984	16.0	79.8	0.6	1.8	1.8	15.8	36.8	39.5	7.9
	1988	21.1	70.5	1.1	4.3	3.0	15.2	31.1	41.8	11.9
	1994	28.8	56.6	1.9	8.0	4.7	14.2	22.5	45.3	18.0
	2002	39.0	38.0	3.0	13.0	7.0	13.0	11.0	50.0	26.0

2) The following were output:

- Forecasted ADT
- Traffic volumes

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			
1988	21	32	31	3	111	20	40	16	275	303	578
1994	56	27	37	10	125	18	47	21	341	330	671
2002	134	10	45	24	147	13	61	32	466	370	836

TRAFFIC VOLUME ON ROUTE IM- 12 LINK COUNT= 2

YEAR	LINK	1988			1994			2002		
		1	2	AVR.	1	2	AVR.	1	2	AVR.
P/C	N+D	20	15	19	58	22	49	147	34	117
	I	3	2	3	9	3	7	22	5	18
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	23	18	21	67	25	56	169	39	134
L/B	N+D	38	1	28	32	1	24	11	3	9
	I	6	0	4	5	0	4	2	0	1
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	43	1	32	37	2	27	13	3	10
M/B	N+D	36	3	27	42	6	32	49	11	39
	I	5	0	4	6	1	5	7	2	6
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	41	4	31	48	7	37	56	13	45
H/B	N+D	3	2	3	10	4	8	26	6	21
	I	0	0	0	2	1	1	4	1	3
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	4	2	3	12	4	10	30	7	24
P/P&T	N+D	111	57	97	131	48	109	160	38	127
	I	17	9	14	20	7	16	24	6	19
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	128	65	111	151	56	125	184	44	147
4/T	N+D	20	12	18	18	9	15	14	5	12
	I	3	2	3	3	1	2	2	1	2
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	23	13	20	20	10	18	16	6	13
6/T	N+D	42	16	35	49	18	41	64	22	53
	I	6	2	5	7	3	6	10	3	8
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	48	18	40	57	20	47	74	25	61
10/T	N+D	17	4	14	22	7	18	33	11	27
	I	3	1	2	3	1	3	5	2	4
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	19	5	16	26	8	21	38	13	32
ADT	N+D	286	110	239	362	115	296	505	130	405
	I	43	16	36	54	17	44	76	19	61
	DV	0	0	0	0	0	0	1	0	0
	TOTAL	329	126	275	417	132	341	581	149	466
M/C	N+D	320	181	283	354	188	310	403	206	350
	I	20	20	20	20	20	20	20	20	20
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	340	202	303	375	208	330	423	226	370
TOTAL	N+D	606	291	522	717	302	606	907	335	755
	I	63	37	56	75	37	65	96	40	81
	DV	0	0	0	0	0	0	1	0	1
	TOTAL	669	328	578	792	340	671	1004	375	836

NOTE

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

## **12.2 AGRICULTURAL DEVELOPMENT**

### **12.2.1 Present Condition**

Fifty-six percent of cultivated land in the influence area is covered by paddy fields. Many old paddy fields are affected by salinity and the average yield of rice is comparatively low. Among the major crops planted in upland fields in the 1983 crop year, cassava ranks first followed by kenaf, sugarcane, maize and beans.

Land use and capability conditions in the area are shown in Table 12.2.1 and Figure 12.2.1. A typical cropping calendar in the area is shown in Figure 12.2.2.

### **12.2.2 Development Projection**

Future agricultural development in the area of influence was projected for both cases of "with and without project". The projected planted area, unit yields by crop, and the consequent production amount are shown in Table 12.2.2.

Based on the above projected production amount, farmgate prices and production costs estimated separately, net production value (NPV) was obtained as shown in Table 12.2.3. The difference in NPV between the two cases is deemed to be the development benefit of the study route.



FIGURE 12.2.1 LAND USE AND CAPABILITY OF INFLUENCE AREA

STUDY ROUTE NO. IM-12

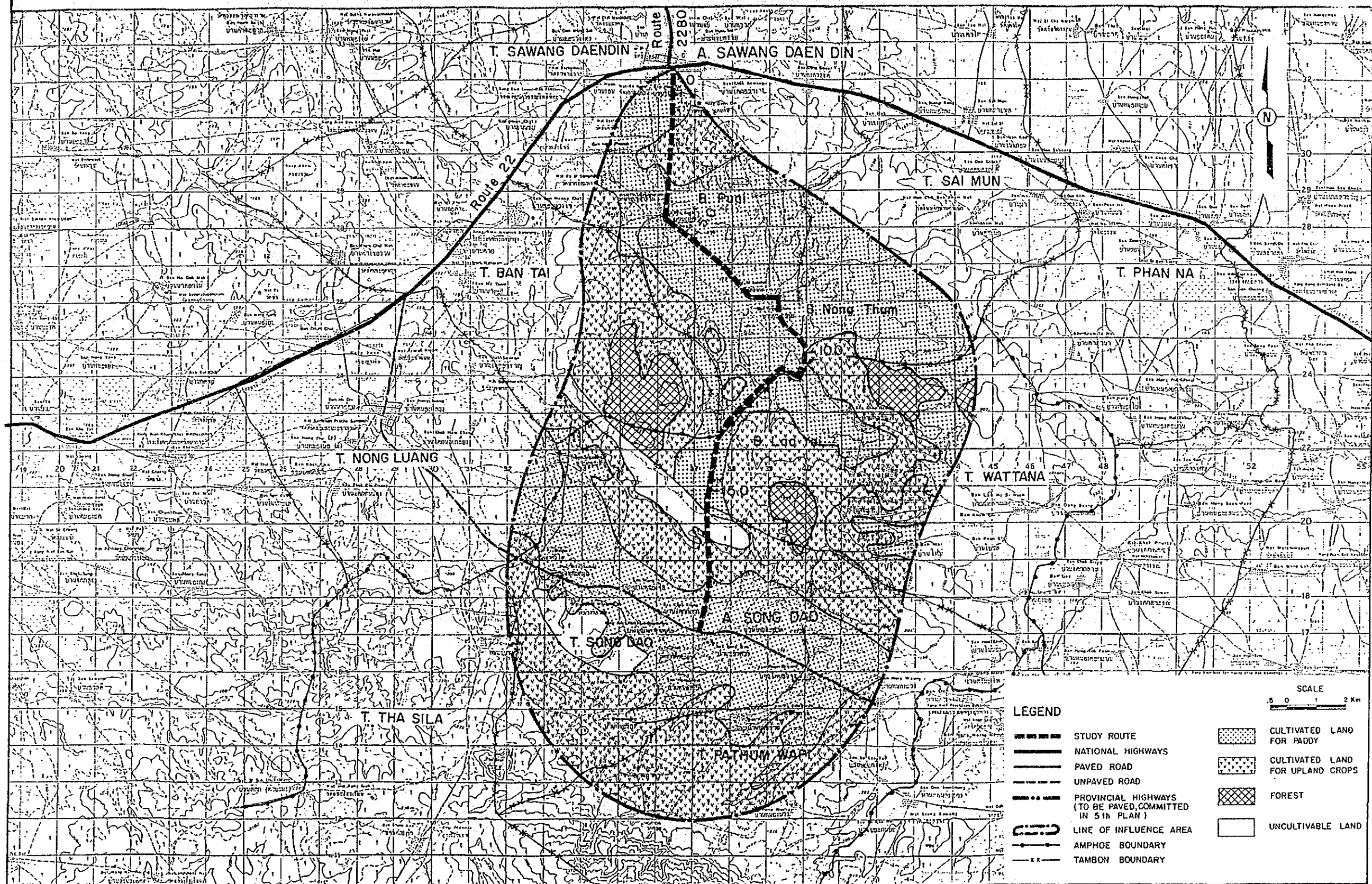


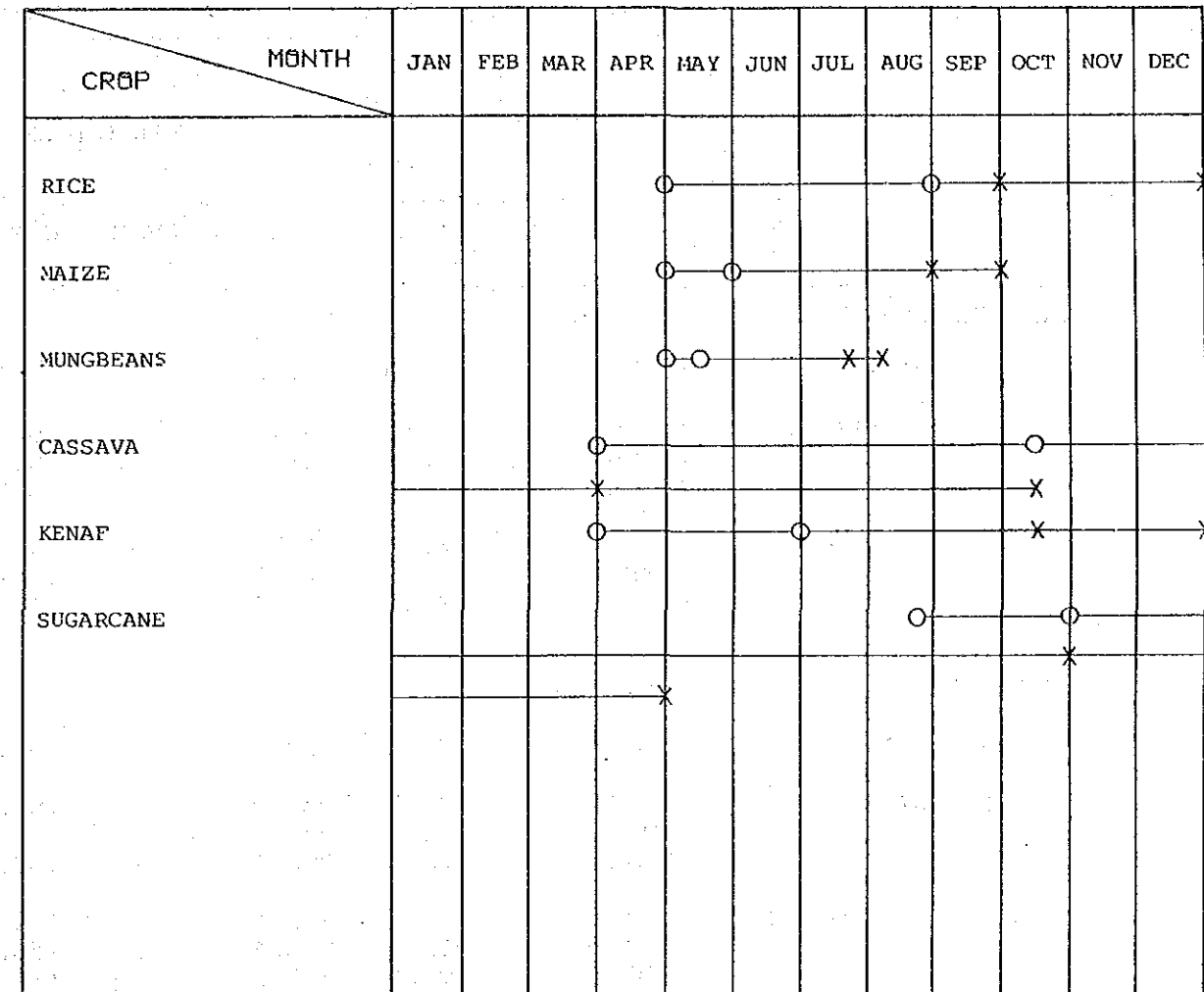




FIGURE 12.2.2 CROPPING CALENDAR

ROUTE IM-12

Related Amphoes: 0404 Sawang Daen Din  
0407 Song Dao



Note:

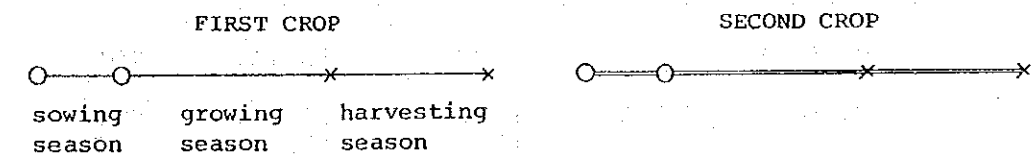


TABLE 12.2.1 CULTIVATED LAND

[ UNIT : 1000 RAI (KM2) ]

CHANGWAT	AMPHOE	CULTIVATED LAND		
		PADDY FIELD	UPLAND FIELD	TOTAL
SAKHON NAKHON	SAWANG DAEN DIN	23.25 ( 37.20)	9.43 ( 15.09)	32.68 ( 52.29)
	SONG DAO	24.81 ( 39.70)	27.81 ( 44.50)	52.62 ( 84.19)
TOTAL		48.06 ( 76.90)	37.24 ( 59.58)	85.30 (136.48)

TABLE 12.2.2 CROP PRODUCTION

ITEM		RICE	MAIZE	SORGHUM	BEANS	GROUND	CASSAVA	KENAF	SUGAR	COTTON	CASTOR	UPLAND	TOTAL
		(PADDY)				NUTS			CANE		BEANS	TOTAL	
PLANTED AREA		(1000 RAI)											
BASE YEAR	(1983)	47.10	2.73	-	0.48	-	20.50	3.07	5.99	-	-	32.77	79.87
WITHOUT PROJECT	(1988)	47.10	2.73	-	0.48	-	20.50	3.07	5.99	-	-	32.78	79.88
	(1994)	47.10	2.73	-	0.49	-	20.50	3.07	5.99	-	-	32.79	79.89
	(2002)	47.10	2.73	-	0.50	-	20.50	3.07	6.00	-	-	32.80	79.90
WITH PROJECT	(1988)	47.10	2.73	-	0.48	-	20.50	3.07	5.99	-	-	32.78	79.88
	(1994)	47.10	2.73	-	0.49	-	20.50	3.07	5.99	-	-	32.79	79.89
	(2002)	47.10	2.73	-	0.50	-	20.50	3.07	6.00	-	-	32.80	79.90
CROP YIELD		(KG/RAI)											
BASE YEAR	(1983)	278.5	350.0	-	150.0	-	2328.8	214.3	4961.4	-	-		
WITHOUT PROJECT	(1988)	278.5	351.8	-	151.5	-	2328.8	214.3	5011.2	-	-		
	(1994)	278.5	353.9	-	153.3	-	2328.8	214.3	5071.6	-	-		
	(2002)	278.5	356.7	-	155.8	-	2328.8	214.3	5153.4	-	-		
WITH PROJECT	(1988)	279.1	352.1	-	152.0	-	2328.8	214.3	5021.2	-	-		
	(1994)	282.4	356.4	-	156.6	-	2328.8	214.3	5142.9	-	-		
	(2002)	287.0	362.1	-	162.9	-	2328.8	214.3	5309.8	-	-		
CROP PRODUCTION AMOUNT		(TON)											
BASE YEAR	(1983)	13,117	956	-	72	-	47,740	658	29,719	-	-	79,145	92,262
WITHOUT PROJECT	(1988)	13,117	961	-	73	-	47,740	658	30,024	-	-	79,457	92,574
	(1994)	13,117	967	-	75	-	47,740	658	30,395	-	-	79,836	92,953
	(2002)	13,117	975	-	78	-	47,740	659	30,897	-	-	80,348	93,466
WITH PROJECT	(1988)	13,144	961	-	74	-	47,740	658	30,084	-	-	79,518	92,662
	(1994)	13,303	973	-	77	-	47,740	658	30,822	-	-	80,271	93,574
	(2002)	13,518	989	-	81	-	47,740	659	31,835	-	-	81,305	94,822

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE

TABLE 12.2.3 NET PRODUCTION VALUE

ITEM		RICE (PADDY)	MAIZE	SORGHUM	BEANS	GROUND NUTS	CASSAVA	KENAF	SUGAR CANE	COTTON	CASTOR BEANS	UPLAND TOTAL	TOTAL
FARMGATE PRICE (BAHT/TON)													
WITHOUT PROJECT	(1983 - 2002)	3,809	2,235	-	5,150	-	773	3,976	468	-	-		
WITH PROJECT	(1988 - 2002)	3,829	2,255	-	5,170	-	786	4,015	481	-	-		
CROP PRODUCTION COST (BAHT/RAI)													
BASE YEAR	(1983)	700	479	-	438	-	776	803	1,958	-	-		
WITHOUT PROJECT	(1988)	700	481	-	438	-	776	803	1,963	-	-		
	(1994)	700	483	-	438	-	776	803	1,978	-	-		
	(2002)	700	486	-	443	-	776	803	1,991	-	-		
WITH PROJECT	(1988)	701	481	-	438	-	776	803	1,969	-	-		
	(1994)	707	485	-	443	-	776	803	1,986	-	-		
	(2002)	716	490	-	448	-	776	803	2,011	-	-		
NET PRODUCTION VALUE (1000 BAHT)													
WITHOUT PROJECT	(1988)	16,994	834	-	166	-	20,971	150	2,280	-	-	24,401	41,395
	(1994)	16,994	841	-	173	-	20,971	150	2,360	-	-	24,495	41,489
	(2002)	16,994	851	-	180	-	20,971	151	2,512	-	-	24,665	41,659
WITH PROJECT	(1988)	17,310	855	-	169	-	21,616	176	2,674	-	-	25,490	42,800
	(1994)	17,636	870	-	179	-	21,616	176	2,924	-	-	25,765	43,401
	(2002)	18,035	892	-	197	-	21,616	177	3,256	-	-	26,138	44,173
NET VALUE ADDED (1000 BAHT)													
	1988	316	21	-	3	-	645	26	394	-	-	1,089	1,405
	1994	642	29	-	6	-	645	26	564	-	-	1,270	1,912
	2002	1,041	41	-	17	-	645	26	744	-	-	1,473	2,514

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE



### 12.3 VOC SAVINGS

In accordance with the concept and data given in Section 3.4 of the Text Report, VOCs on the road link concerned were calculated in the two cases of "with and without project".

Road length by road class is shown in Table 12.3.1. Data for additional VOCs are shown in Table 12.3.2.

VOC savings, obtained as the balance of total link VOCs between the two cases, were calculated as shown in Table 12.3.3.

**TABLE 12.3.3 VEHICLE OPERATING COST SAVING**

(UNIT : 1000 BAHT)

LINK NO.	1988			1994			2002		
	WITHOUT	WITH	SAVING	WITHOUT	WITH	SAVING	WITHOUT	WITH	SAVING
1	9,291	6,078	3,212	11,781	7,673	4,108	16,505	10,699	5,806
2	929	713	216	1,132	776	356	1,491	920	571
TOTAL	10,219	6,791	3,428	12,913	8,449	4,464	17,996	11,619	6,377

**NOTE**

- (1) WITHOUT : WITHOUT PROJECT CASE
- (2) WITH : WITH PROJECT CASE
- (3) SAVING : VEHICLE OPERATING COST SAVING
- (4) LINK NO. = 1 - 9 : PROPOSED LINK
- (5) LINK NO. = 11 - 19 : SURROUNDING LINK

**TABLE 12.3.1 ROAD LENGTH BY ROAD CLASS**

(UNIT : KM)

LINK NO.	WITHOUT PROJECT CASE						WITH PROJECT CASE
	PAVED	LATERITE			EARTH	TOTAL	
		GOOD	FAIR	POOR			
1	-	7.7	6.3	-	-	14.0	14.0
2	-	2.3	2.8	-	-	5.1	5.1

**TABLE 12.3.2 DATA FOR ADDITIONAL VOC COST**

(UNIT OF LENGTH : M)

LINK NO.	CASE	CURVE									GRADE					VILLAGE NO. LENGTH	NO. OF INTER-SECTION	NO. OF TIMBER BRIDGE	NO. OF NARROW BRIDGE	NO. OF CORNER	
		100	150	200	250	300	375	500	750	1500	1	2	3	4	5						
1	WITHOUT	121	109	274	-	-	57	248	224	554	2800	2300	250	-	200	3	2200	4	4	-	2
	WITH	121	109	274	-	-	57	248	224	554	3300	2300	250	-	200	3	2200	-	-	-	2
2	WITHOUT	-	-	-	-	-	-	-	-	-	1900	1600	100	200	1	1346	1	-	1	-	
	WITH	-	-	-	-	-	-	-	-	-	1950	1250	450	200	-	1346	-	-	-	-	

## 12.4 ENGINEERING

### 12.4.1 Soil and Materials

Existing subgrade soil and material sources in the vicinity of the study route investigated by DOH and their physical characteristics are shown in Figure 12.4.1 and Table 12.4.1, respectively.

Rock aggregate sources were assumed as shown below:

No.	Source	Description of Sample	Est. Quantity m <sup>3</sup>
12/CS-1	KM. 149+100 Rt 6KM. Udon Thani-Sakon Nakhon	Sandstone	Plentiful

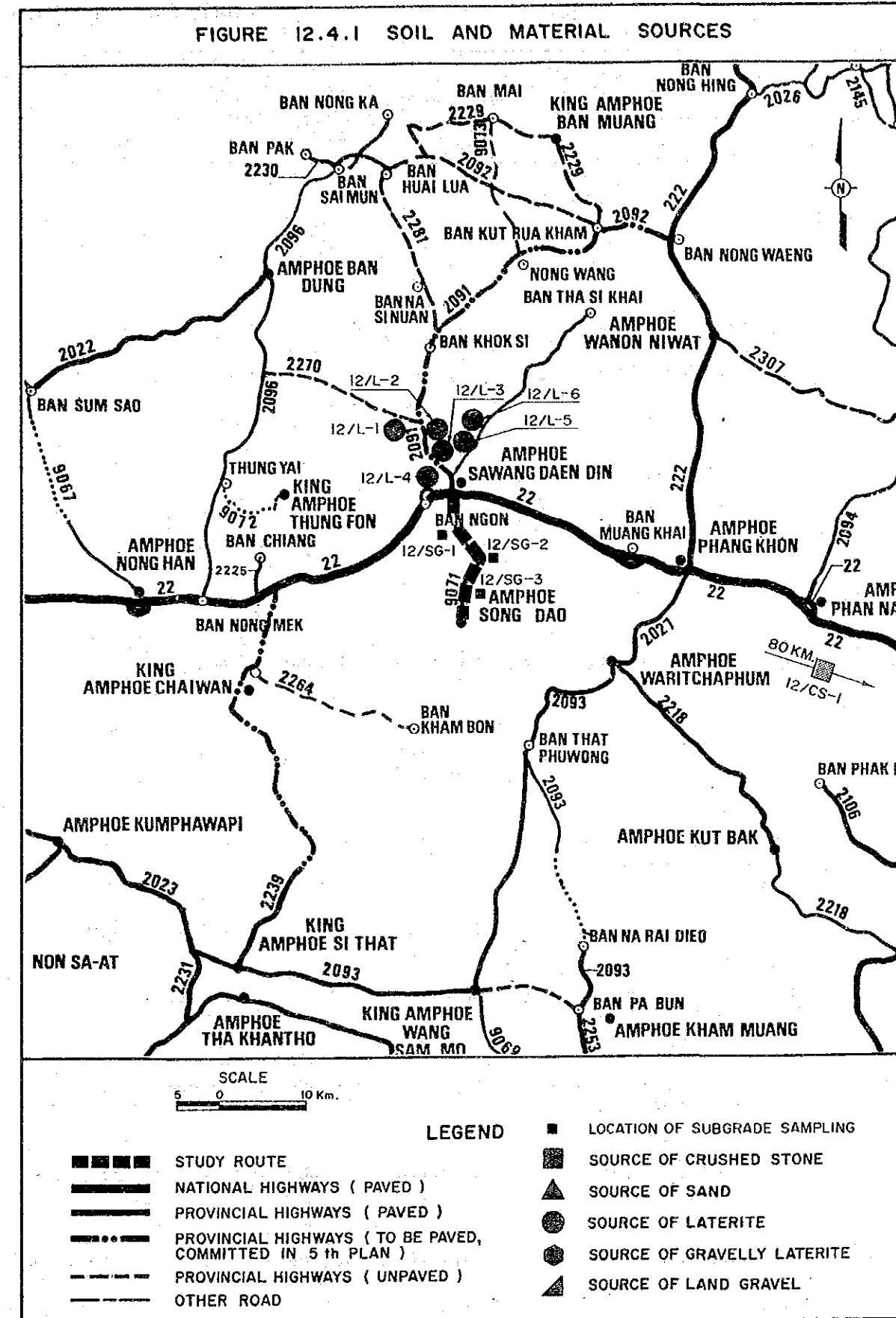


TABLE 12.4.1 PHYSICAL CHARACTERISTICS OF MATERIALS

No.	Source	Description of Sample	Est. Quantity m <sup>3</sup>	AASHTO Classification	Sieve Analysis % Passing								Plasticity		Comp. DH-T Stand. Opt.		Lab. C.B.R. Swell		Durability	
					50.0	25.0	19.0	9.5	#4	#10	#40	#200	LL	PT	95%	gm/cc	95%	%	Abr.	Dur.
<u>SUBGRADE</u>																				
12/SG-1.	KM. 5+500 Rt 12 M.			A-4			100	93.4	80.6	77.4	45.5	25.1	6.0	13.2	1.893	21.2	-			
12/SG-2.	KM. 10+700 Lt 15 M.			A-2-4			100	99.8	98.9	25.1		N-P		10.8	1.844	18.2	-			
12/SG-3.	KM. 15+700 Lt 12 M.			A-2-4				100	99.7	32.8		N-P		11.4	1.903	200	-			
<u>LATERITE</u>																				
12/L-1	KM. 5+000 Lt close to Sawang Daen Din - Nong Waeng	Laterite	37,500	A-2-7			100	70	32	21	18	16	44.8	17.8				40.2	71.4	
	L1:S1 = 3:2 by weight	Laterite and sand		A-2-4			100	87	60	44	20	10	23.5	9.6	9.60	1.972	58.4	-		
12/L-2	KM. 7+500 Rt close to Sawang Daen Din - Nong Waeng	Laterite	48,000	A-2-4	100	99	94	72	49	37	31	26		N.P.				40.6	70.4	
	L2:S1 = 7:3 by weight	Laterite and sand		A-2-4	100	99	86	80	50	49	30	19		N.P.	8.30	2.145	36.0	-		
12/L-3	KM. 14+100 Rt close to Sawang Daen Din - Nong Waeng	Laterite	32,000	A-2-4		100	99	76	37	21	17	16	29.0	8.0	9.50	2.008	27.0	-	30.6 70.0	
12/L-4	KM. 15+500 Lt close to Sawang Daen Din - Nong Waeng	Laterite	126,000	A-1-a	100	99	96	69	43	21	16	15		N.P.	9.90	2.043	30.0	-	32.8 67.9	
12/L-5	KM. 1+500 Lt 100 M. Sanam Chai - Tha Si Kai	Laterite	20,000		100	98		73		21	15	10	31.2	8.5						
12/L-6	KM. 14+000 Rt 30 M. Sawang Daen Din - Ban Khok Si	Laterite	10,000		100	98		76		36	30	14	34.4	10.2						

## 12.4.2 Preliminary Design

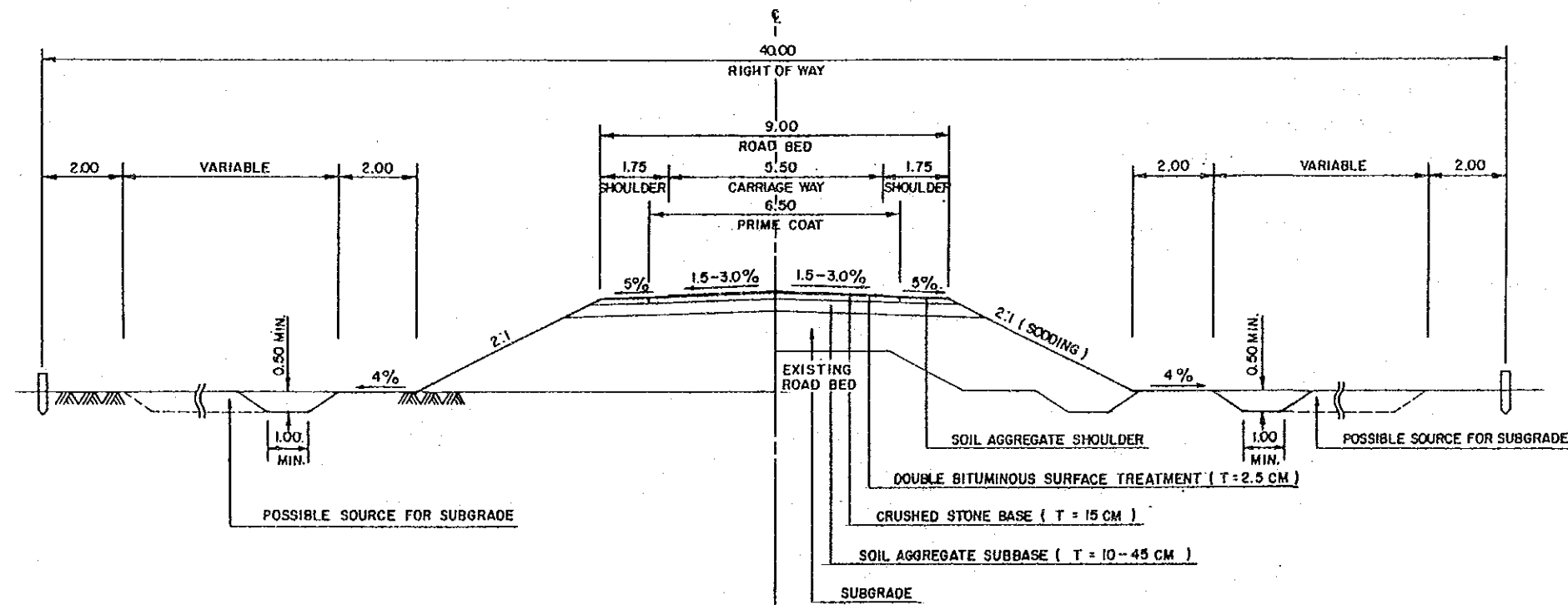
### 12.4.2.1 Design Criteria

Design Standard	:	F4
Geometric Design Criteria	:	DOH (Provincial Highway)
Typical Cross Section	:	as shown in Figure 12.4.2
Minimum Height of Embankment in Flooding Section	:	0.7 m above flood level
Pavement Structure		
DBST	:	2.5 cm
Crushed Aggregate Base	CBR $\geq$ 80%	: 15.0 cm
Soil Aggregate Subbase	CBR $\geq$ 25%	: 10.0 cm (minimum requirement)
Selected Materials	CBR $\geq$ 6%	: as required
Pipe Culvert		
Standardized type	:	80, 100, 120 & 150 cm in diameter
Location	:	as required
Standard intervals		
Paddy area	:	200 m
Others	:	500 m

Box Culvert		
Standard size	:	1.5 $\times$ 1.5, 2.4 $\times$ 2.4 & 3.0 $\times$ 3.0 m
Location	:	as required
Bridge		
Reinforced concrete standard type	:	Width 9.0 m
Substructure	:	Pile-bent type

The existing and designed plan and profile are shown in Drawings 12-1/12-3.

FIGURE 12.4.2 TYPICAL CROSS SECTION



PROVINCIAL HIGHWAY ( CLASS F 4 )



**12.4.2.3 Pavement Design**

1) Cumulative number of ESA in one direction

- ESA conversion factors

Heavy bus	:	0.50
Medium truck	:	0.76
Heavy truck	:	1.24

- Forecasted ADT by vehicle type

Year	1988				1994			
	1	2	3	4	1	2	3	4
Traffic/road link								
Heavy bus	4	2	—	—	2	4	—	—
Medium truck	8	18	—	—	57	20	—	—
Heavy truck	19	5	—	—	26	8	—	—

- Cumulative number of ESA in one direction by road link

Road link	1	2	3	4
7 years (10 <sup>6</sup> )	0.092	0.031	-	-

2) Design CBR values

Road link	1	2	3	4
Design CBR (%)	21.2	18.3	-	-

3) Required thickness of pavement

Surfacing	:	DBST (2.5 cm)		
Aggregate base	:	15 cm (CBR not less than 25%)		
Subbase	:	Minimum requirement 10 cm		
Road link	1	2	3	4
	10 cm	10 cm	-	-

4) Overlay required in 7 years

DBST resurfacing

**12.4.2.4 Drainage and Structures**

The locations of existing and designed RC box culverts and RC bridges and their dimensions are shown below:

STATION	EXISTING STRUCTURES		PROPOSED STRUCTURES	
	TYPE	SIZE	TYPE	SIZE
0 + 284	Timber Bridge	4.0 x 6.5	RC Bridge	9.0 x 10.0
1 + 589	" "	4.0 x 7.0	" "	9.0 x 10.0
1 + 764	" "	4.0 x 6.0	" "	9.0 x 10.0
7 + 494	" "	4.0 x 8.0	" "	9.0 x 10.0
17 + 776	RC Bridge	4.5 x 28.0	" "	4.5 x 28.0

**12.4.3 Quantities and Construction and Road Maintenance Costs**

The required construction costs were estimated based on the preliminary design as shown in Table 12.4.2. Financial costs with breakdown into local and foreign currency portions, economic costs and residual values were estimated as follows and in 12.4.4:

IM-12 L=19.1 km	(baht)
Financial cost	: 35,211,000
Economic cost	: 29,633,000
Residual value	: 13,049,000

The required road maintenance cost savings are shown in Table 12.4.3.

**12.4.4 Construction and Disbursement Schedules**

IM-12

Length = 19.1 km

Construction Schedule

Assumption: Completion date December 31, 1987

Year & Month	1986												1987											
	Dry season						Wet						Dry season						Wet		Dry			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
WORK ITEMS																								
CONTRACT																								
PREPARATORY WORKS																								
MAJOR WORKS (PRECEDING)																								
PAVEMENT WORKS																								
MAJOR WORKS (FOLLOWING)																								
STRUCTURE WORKS																								
MISC. WORKS																								
CLEARING-UP																								
PAYMENT IN %	15 %												85 %											

Yearly Disbursement Schedule

Assumption: Annual rise in prices

Year	Base year	(1985)	1986	1987
Currency	1984			
Local	100	110.0	121.0	133.1
Foreign	100	106.5	113.4	120.8

**LOCAL AND FOREIGN COMPONENTS OF CONSTRUCTION COST**

(Route IM - 12)

(Unit : Million Baht)

	1986			1987			Total		
	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total
Construction Cost	2.7	2.5	5.2	15.4	14.6	30.0	18.1	17.1	35.2
Price Contingency	0.6	0.3	0.9	5.1	3.0	8.1	5.7	3.3	9.0
Total	3.3	2.8	6.1	20.5	17.6	38.1	23.8	20.4	44.2
	(0.12)	(0.10)	(0.23)	(0.76)	(0.65)	(1.41)	(0.88)	(0.76)	(1.64)

Remarks : L/C : Local Currency Portion  
 F/C : Foreign Currency Portion  
 ( ) : US\$ Equivalent ( US\$1 = 27 Baht)

TABLE 12.4.2 CONSTRUCTION QUANTITIES AND COSTS  
(ROUTE IM-12 Length=19.1 km)

DBST										
Item	Unit	Financial		Financial Cost 1000 B			Economic Cost		Residual Value	
		Unit Rate	Quantity	Total	Local	Foreign	%	1000 B	%	1000 B
		B								
<b>EARTHWORK</b>										
Clearing & Grubbing	ha	10,000	44	440			83		90	
Roadway Excavation, Unclassified	m3	19	1,700	32						
Embankment, Common Soil	m3	38	151,100	5,742						
Embankment, Selected Material	m3	70	0	0						
Replacement of Soft Spot	m3	88	2,100	185						
Sub Total				6,399	3,263	3,135		5,311		4,780
<b>SUBBASE &amp; BASE COURSES</b>										
Subbase, Soil Aggregate	m3	112	18,000	2,016			83		50	
Aggregate Base*	m3	372	18,700	6,956						
Cement Stabilized Base	m3	390	0	0						
Shoulder, Soil Aggregate	m3	120	7,200	864						
Sub Total				9,836	5,312	4,525		8,164		4,082
<b>SURFACE COURSES</b>										
Asphaltic Prime/Tack Coat	m2	12	124,200	1,490			85		50**	
Double Bituminous Surface Treatment*	m2	39	105,100	4,099						
Asphaltic Concrete Surfacing**	t	750	0	0						
Sub Total				5,589	2,459	3,130		4,751		0
<b>STRUCTURES</b>										
RC Pipe Culvert (D 1.0m Equivalent)	m	2,000	785	1,570			83		50	
RC Box Culvert (2.4mx2.4m Equivalent)	m	18,800	0	0						
RC Bridge (W=9.0m L=10m Equivalent)	m	46,500	60	2,790						
Sub Total				4,360	2,180	2,180		3,619		1,809
Total (a)				26,185	13,214	12,970		21,845		10,671
<b>INCIDENTALS</b>										
Miscellaneous Work ((a)x7%)	ls			1,833	916	916	83	1,521	0	0
CONTRACT AMOUNT (b)				28,018	14,131	13,887		23,366		10,671
PHYSICAL CONTINGENCIES ((b)x10%) (c)				2,802	1,413	1,389		2,337		1,067
ENGINEERING AND SUPERVISION (((b)+(c))x10%) (d)				3,082	1,233	1,849	85	2,620	0	0
<b>LAND ACQUISITION</b>										
Highly Developed Land	ha	50,000	25	1,250			100		100	
Less Developed Land	ha	15,000	4	60						
Sub Total (e)	ls			1,310	1,310	0		1,310		1,310
PROJECT COST ((b)+(c)+(d)+(e))				35,211	18,087	17,124		29,633		13,049
AVERAGE COST PER KM				1,844						

Note : \* The unit prices are modified by aggregate haulage distance.  
\*\* Rate is applied only for Asphaltic Concrete Surfacing

TABLE 12.4.3 ROAD MAINTENANCE COST SAVING

LINK NO.	YEAR	WITHOUT PROJECT CASE						WITH PROJECT CASE						ROAD MAINTENANCE COST SAVING (1000 BAHT)
		AVERAGE DAILY TRAFFIC <ADT> (VEHICLE)	LENGTH OF LINK <L> (KM)	FACTOR FOR ADT <A1>	ROAD CHARA. FACTOR <KA>	UNIT MAINTENANCE COST <U> (BAHT/KM)	TOTAL MAINTENANCE COST <T> (1000 BAHT)	AVERAGE DAILY TRAFFIC <ADT> (VEHICLE)	LENGTH OF LINK <L> (KM)	FACTOR FOR ADT <X3>	ROAD CHARA. FACTOR <KB>	UNIT MAINTENANCE COST <U> (BAHT/KM)	TOTAL MAINTENANCE COST <T> (1000 BAHT)	
1	1988	285.5	14.0	0.50	1.64	17,277	242	307.3	14.0	0.00	1.17	13,129	184	58
	1994	375.0	14.0	0.71	1.78	18,807	263	389.5	14.0	0.00	1.17	13,129	184	79
	2002	546.9	14.0	0.95	1.96	20,601	288	542.7	14.0	0.00	1.17	13,129	184	105
2	1988	99.3	5.1	0.07	1.34	14,091	72	118.2	5.1	0.00	1.17	13,129	67	5
	1994	121.8	5.1	0.12	1.37	14,475	74	123.3	5.1	0.00	1.17	13,129	67	7
	2002	163.0	5.1	0.22	1.44	15,181	77	139.5	5.1	0.00	1.17	13,129	67	10
TOTAL	1988	235.8	19.1			16,426	314	256.8	19.1			13,129	251	63
	1994	307.3	19.1			17,651	337	318.4	19.1			13,129	251	86
	2002	444.4	19.1			19,153	366	435.1	19.1			13,129	251	115

NOTE (1) TOTAL MAINTENANCE COST  $T = U * L$

(2) UNIT MAINTENANCE COST  $U = M * (KA \text{ or } KB) * FA * (1 + FR) * FE$

M ; SPECIFIED MAINTENANCE COST

WITHOUT PROJECT CASE  $M = 7,700$  BAHT/KM

WITH PROJECT CASE  $M = 8,200$  BAHT/KM

FA = 1.40

ADMINISTRATION FACTOR FOR DIRECT LABOUR OPERATION BY DOH

FR = 0.15

EMERGENCY REHABILITATION COST FACTOR

FE = 0.85

ECONOMIC MAINTENANCE COST FACTOR TO FINANCIAL MAINTENANCE COST

(3) ROAD CHARACTERISTIC FACTOR

WITHOUT PROJECT CASE  $KA = 1.29 + 0.70 * A1$

WITH PROJECT CASE  $KB = 1.17 + 0.05 * X3$

(4) FACTOR FOR ADT

WITHOUT PROJECT CASE  $A1 = -0.1630 + 0.002320 * ADT$

WITH PROJECT CASE  $X3 = -0.2034 + 0.000409 * (ADT / \text{LANE})$  ; LANE = 2



## 12.5 EVALUATION

### 12.5.1 Economic Evaluation

The yearly distribution of the economic costs and benefits and the calculated economic indicators for evaluation are given in the following table.

The results indicate that the improvement of this study route is feasible by employing the F4 standard with DBST surfacing.

COSTS AND BENEFITS STATEMENT OF ROUTE IM - 12  
(1000 BAHT)

YEAR	COST		BENEFITS			DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	TOTAL COST	TOTAL BENEFIT
1986	4,445	0	0	0	0	5,576	0
1987	25,488	0	0	0	0	28,547	0
1988	0	1,405	3,428	63	4,896	0	4,371
1989	0	1,490	3,601	67	5,157	0	4,111
1990	0	1,574	3,773	71	5,418	0	3,854
1991	0	1,659	3,946	75	5,679	0	3,609
1992	0	1,743	4,119	79	5,940	0	3,371
1993	0	1,828	4,291	82	6,201	0	3,142
1994	0	1,912	4,464	86	6,462	0	2,923
1995	6,876	1,987	4,703	90	6,780	3,110	2,738
1996	0	2,063	4,942	94	7,098	0	2,560
1997	0	2,138	5,181	97	7,416	0	2,388
1998	0	2,213	5,420	101	7,734	0	2,223
1999	0	2,288	5,660	104	8,052	0	2,067
2000	0	2,364	5,899	108	8,370	0	1,918
2001	0	2,439	6,138	111	8,688	0	1,778
2002	-13,049	2,514	6,377	115	9,006	-2,384	1,645
<b>TOTAL</b>	<b>23,760</b>	<b>29,615</b>	<b>71,942</b>	<b>1,343</b>	<b>102,899</b>	<b>34,849</b>	<b>42,701</b>
<b>DISCOUNTED</b>	<b>34,849</b>	<b>12,354</b>	<b>29,789</b>	<b>558</b>	<b>42,701</b>		

NET PRESENT VALUE	:	7,852
BENEFIT/COST RATIO	:	1.23
INTERNAL RATE OF RETURN	:	14.9 %
FIRST YEAR RATE OF RETURN	:	12.8 %
OPTIMUM OPENING YEAR	:	1988

### SENSITIVITY TESTS

ITEM	CASE		
	BASE	1	2
NET PRESENT VALUE	7,852	2,625	1,447
BENEFIT/COST RATIO	1.23	1.07	1.04
INTERNAL RATE OF RETURN	14.9 %	12.9 %	12.6 %
FIRST YEAR RATE OF RETURN	12.8 %	11.1 %	10.9 %
COSTS	BASE	+15%	BASE
BENEFITS	BASE	BASE	-15%

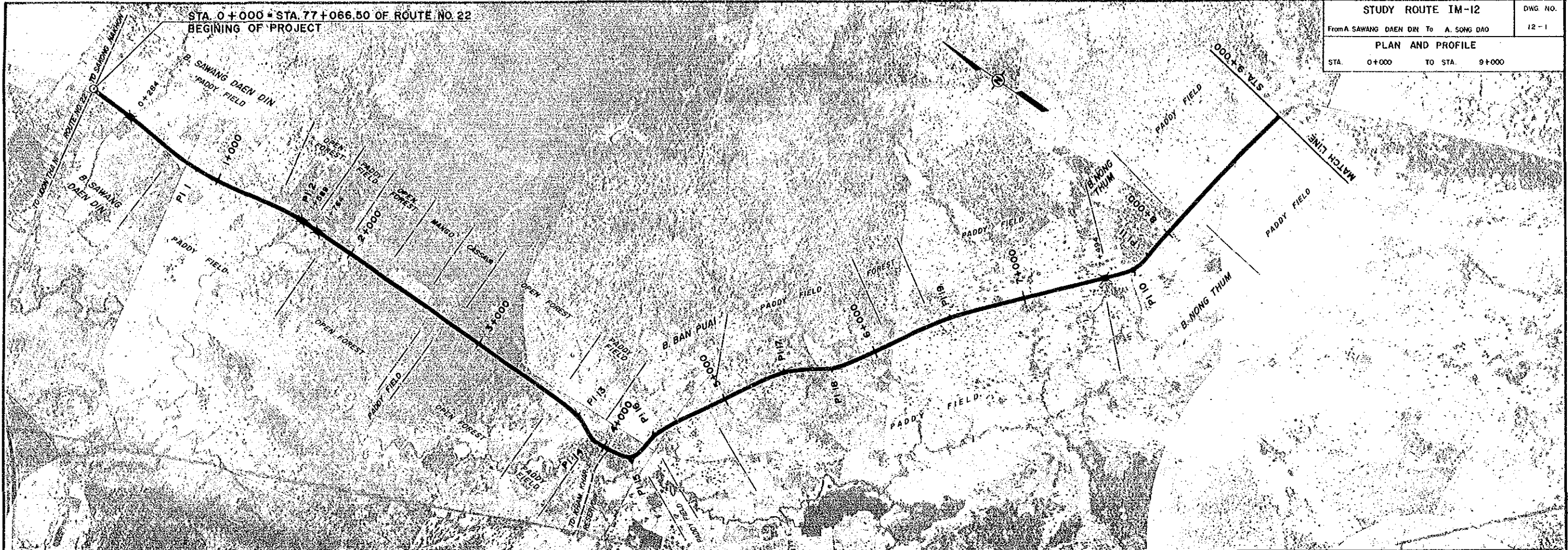
### 12.5.2 Social Impact

The social impact brought about by the improvement of the study route is shown in the following social benefit indicators:

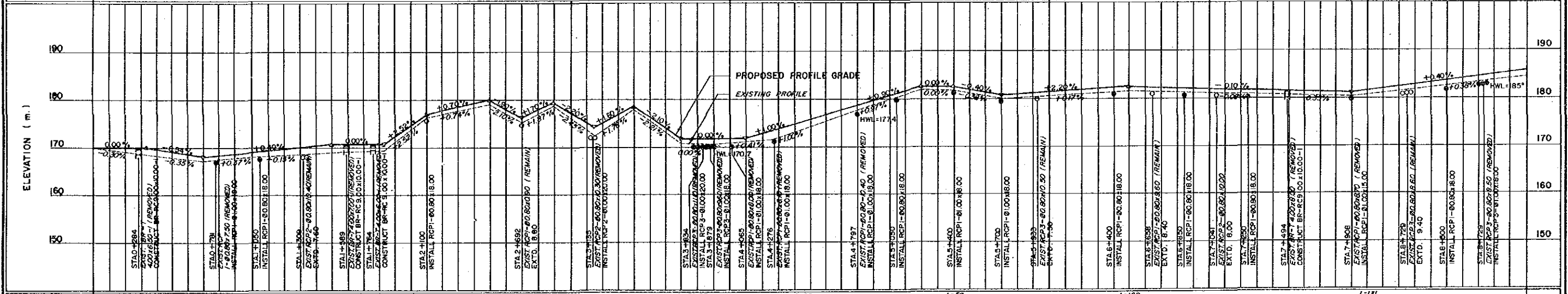
Construction Cost (million baht)	:	29.6
1) General Accessibility Benefit (million baht)	:	1.18
2) Education Benefit (million baht)	:	-
3) Medical Care Benefit (million baht)	:	0.027
4) Total Social Benefits (million baht) (1 + 2 + 3)	:	1.21
5) Social Benefit/Cost Ratio ( $\times 10^{-2}$ )	:	4.08
6) Ranking by Social Benefits	:	15
7) Weighted Production Value Gain/Cost ( $\times 10^{-2}$ )	:	3.15
8) Ranking by 7	:	15
9) Combined Ratio ( $\times 10^{-2}$ )	:	7.23
<b>Overall Ranking</b>	:	<b>15</b>

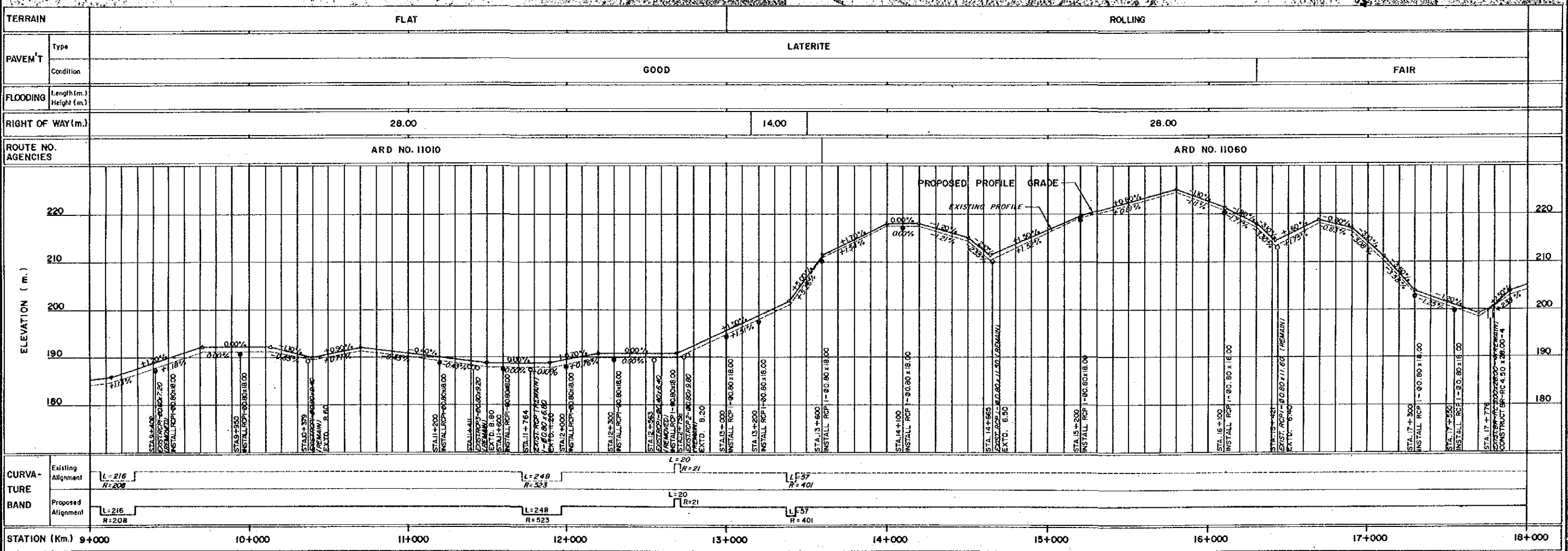
### **12.5.3 Overall Evaluation**

It is concluded and recommended that, considering the overall ranking and possible schedule of the improvement and/or new construction of the study routes, this study route should be improved with the opening year 1988.



TERRAIN		FLAT				ROLLING				FLAT											
PAVEM'T	Type	LATERITE				LATERITE				LATERITE											
	Condition	GOOD				FAIR				LATERITE											
FLOODING	Length (m.)					50				100											
	Height (m.)					0.10				0.04											
RIGHT OF WAY (m.)		14.00				28.00				14.00				28.00							
ROUTE NO. AGENCIES		A R D NO. 11010																			
CURVATURE BAND	Existing Alignment	L=423.34 R=1368.31		L=114.67 R=620.09		L=56.95 R=164.43		L=25 R=16		L=52 R=137		L=109 R=744		L=131 R=1635							
	Proposed Alignment	L=423.34 R=1368.31		L=114.67 R=620.09		L=56.95 R=164.43		L=25 R=16		L=52 R=137		L=109 R=744		L=131 R=1635							
STATION (Km.)		0+000		1+000		2+000		3+000		4+000		5+000		6+000		7+000		8+000		9+000	







<b>TERRAIN</b>	FLAT	
<b>PAVEM'T</b>	Type	LATERITE
	Condition	FAIR
<b>FLOODING</b>	Length (m.)	
	Height (m.)	
<b>RIGHT OF WAY (m.)</b>		
<b>ROUTE NO. AGENCIES</b>	ARD NO. 11060	
<b>ELEVATION (m.)</b>		
<b>CURVA-TURE BAND</b>	Existing Alignment	
	Proposed Alignment	
<b>STATION (Km.)</b>	18+000	19+000

STUDY ROUTE NO. IM-19

Changwat : Roi Et

A. Selaphum (J.R. 23) - B. Kham Phon Sung (J.R. 2136)

Length : 46.3 KM.



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**SUMMARY**

**STUDY ROUTE IM-19**

**General**

Changwat : Roi Et  
 Origin and Destination : A. Selaphum— B. Kham Phon Sung  
 Connected Road Network : 23— 2136  
 Amphoe on Route : -  
 Number of Related Villages : 9

**Influence Area**

Area : 375.2 km<sup>2</sup>  
 Cultivated Area Ratio to Total Land Area in % : 81  
 Population in 1983 : 48,400  
 Main Crops : Paddy & Cassava  
 Number of Public Activities  
 Public Health Service Centers : -  
 Hospitals Changwat Level : -  
 Amphoe Level : 2  
 Schools Primary : 8  
 Secondary : 2

Traffic (ADT) : 1984—155 1988—235  
 1994—303 2002—431

**Nomenclature of Study Route**

Total Length : 46.3 km  
 Improvement Section : 46.3 km  
 DOH Road : 46.3 km  
 ARD Road : -  
 Other Road : -  
 New Construction Section : -  
 Design Standard Employed : F4

**Construction Cost in Baht**

Financial : 91,998,000  
 Economic : 76,824,000

**Economic Indicators**

IRR : 15.7% Ranking: 5

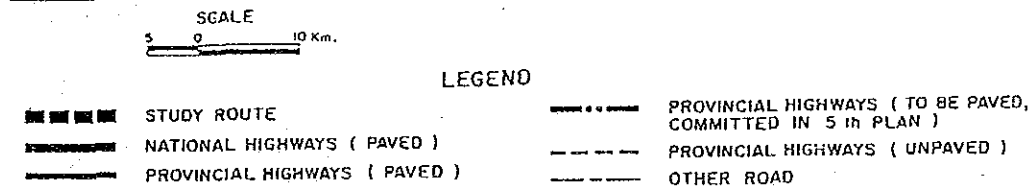
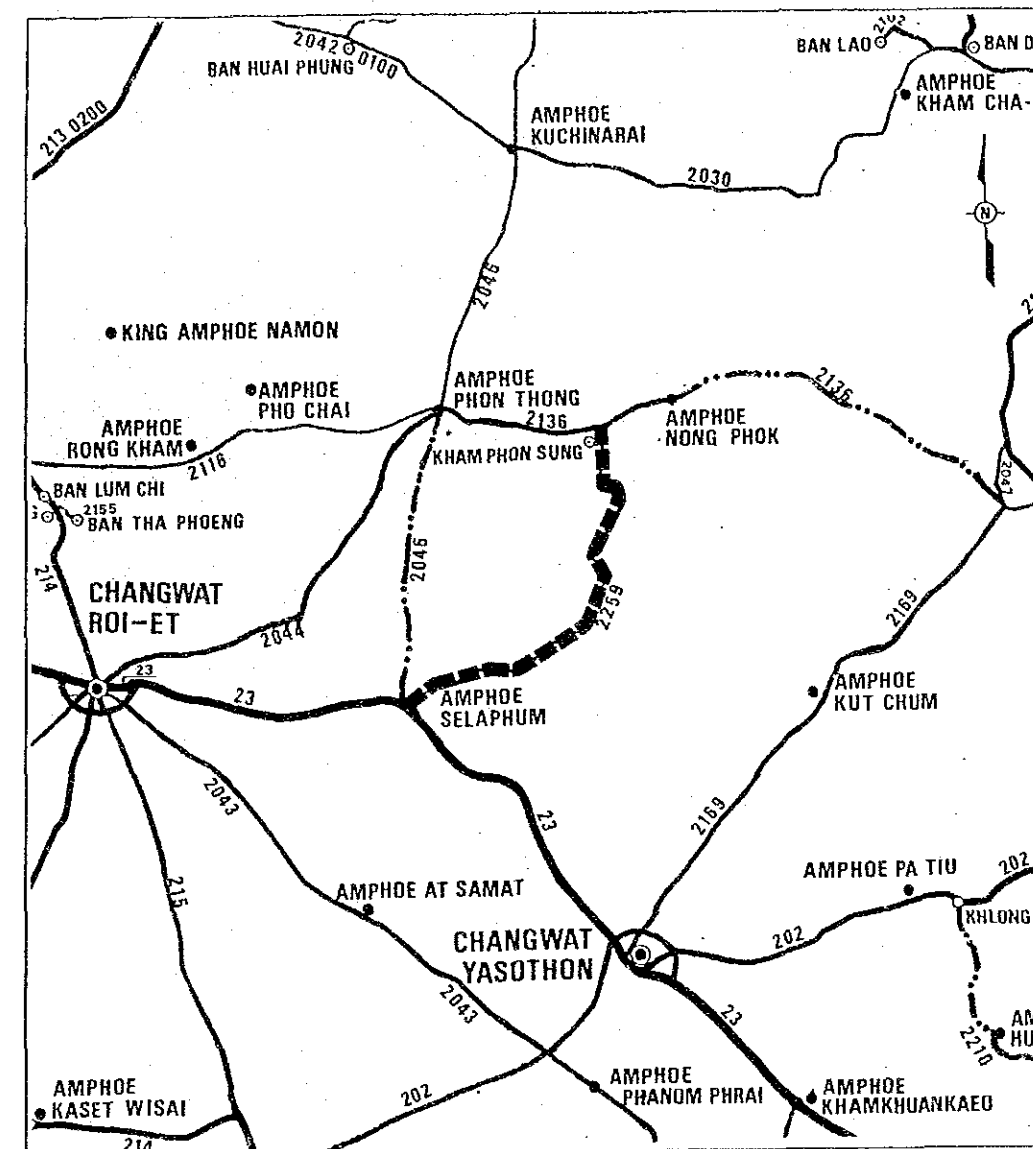
**Social Impact**

Social B/C Ratio : 0.171 Ranking: 11

**Recommendations**

Opening Year : 1988 Overall Ranking: 6

**LOCATION OF STUDY ROUTE**

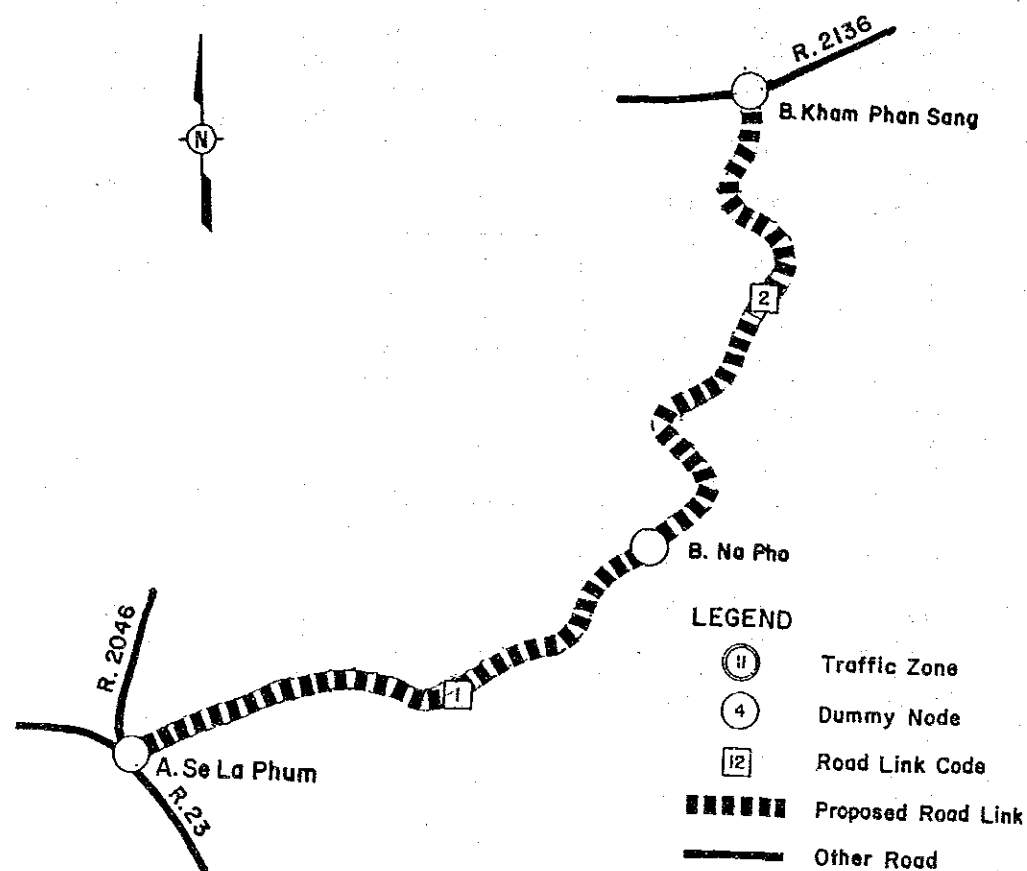


## 19.1 TRAFFIC

### 19.1.1 Method Employed in Traffic Forecasting

The growth rate method was employed in forecasting traffic because no diverted traffic after improvement was expected on this study route.

### 19.1.2 Assumed Road Link



### 19.1.3 Traffic Forecast

- 1) Items necessary for forecasting traffic were:
- Traffic volume in base year
  - Passenger and freight movement in base year
  - Growth rates of passenger and freight movement
  - Rate of induced and developed movement
  - Traffic composition

TRAFFIC VOLUME IN BASE YEAR

LINK	TYPE OF VEHICLE								ADT	M/C	TOTAL
	P/C	L/B	M/B	H/B	P/P&T	4/T	6/T	10/T			
1	12	43	40	0	71	8	28	5	207	333	540
2	5	20	11	0	36	5	18	0	95	137	232
AVE.	9	32	26	0	55	7	23	3	155	242	396

PASSENGER AND FREIGHT MOVEMENT IN BASE YEAR

PROPOSED ROAD LINK	PASSENGER MOVEMENT (TRIPS PER DAY)	FREIGHT MOVEMENT (TONNAGE PER DAY)		
		NON-AGRI.	AGRI.	TOTAL
1	1563	44.0	66.5	110.5
2	559	19.2	29.0	48.3

GROWTH RATE OF PASSENGER MOVEMENT

(UNIT : % P.A.)

YEAR	PER CAPITA INCOME	POPULATION	PASSENGER MOVEMENT
1984 - 1988	3.1	1.1	5.5
1988 - 1994	3.1	0.9	5.4
1994 - 2002	3.1	0.8	5.3

GROWTH RATE OF FREIGHT MOVEMENT

(UNIT : % P.A.)

YEAR	NON-AGRI. FREIGHT	AGRI. FREIGHT	FREIGHT MOVEMENT
1984 - 1988	6.9	0.0	2.9
1988 - 1994	6.7	0.0	3.4
1994 - 2002	6.5	0.0	4.0

RATE OF INDUCED AND DEVELOPED MOVEMENT

(UNIT : %)

YEAR	INDUCED		DEVELOPED		
	LINK		PASSENGER	NON-AGRI.	AGRI.
	1	2	MOVEMENT	FREIGHT	FREIGHT
1988	15.0	15.0	0.0	0.0	0.2
1994	15.0	15.0	0.0	0.0	1.3
2002	15.0	15.0	0.0	0.0	2.7

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	1984	9.7	48.7	21.5	20.0	0.0	21.2	15.4	53.8	9.6
	1988	16.2	46.3	17.4	18.5	1.6	19.3	14.4	53.0	13.3
	1994	26.0	42.8	11.2	16.1	3.9	16.6	12.9	51.7	18.7
	2002	39.0	38.0	3.0	13.0	7.0	13.0	11.0	50.0	26.0
2	1984	9.3	55.7	22.6	12.4	0.0	20.7	17.2	62.1	0.0
	1988	15.9	51.8	18.2	12.5	1.6	19.0	15.9	59.4	5.8
	1994	25.8	45.9	11.7	12.7	3.9	16.4	13.8	55.4	14.4
	2002	39.0	38.0	3.0	13.0	7.0	13.0	11.0	50.0	26.0

2) The following were output:

- Forecasted ADT
- Traffic volumes

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			
1988	30	33	32	3	99	7	26	5	235	280	515
1994	66	29	39	10	118	7	26	9	303	314	617
2002	146	11	49	26	150	6	29	15	431	363	794

TRAFFIC VOLUME ON ROUTE IM- 19 LINK COUNT= 2

YEAR	LINK	1988			1994			2002		
		1	2	AVR.	1	2	AVR.	1	2	AVR.
P/C	N+D	37	15	26	80	31	57	181	65	127
	I	6	2	4	12	5	9	27	10	19
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	42	17	30	92	35	66	208	74	146
L/B	N+D	39	17	29	35	14	25	14	5	10
	I	6	3	4	5	2	4	2	1	1
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	45	19	33	40	16	29	16	6	11
M/B	N+D	42	12	28	50	15	34	60	22	42
	I	6	2	4	7	2	5	9	3	6
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	48	13	32	57	17	39	69	25	49
H/B	N+D	4	1	3	12	5	9	33	12	23
	I	1	0	0	2	1	1	5	2	3
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	4	2	3	14	5	10	37	13	26
P/P&T	N+D	115	53	86	141	59	103	185	67	130
	I	17	8	13	21	9	15	28	10	19
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	132	61	99	163	68	118	213	77	150
4/T	N+D	8	4	6	7	4	6	7	3	5
	I	1	1	1	1	1	1	1	0	1
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	9	5	7	8	4	7	9	4	6
6/T	N+D	28	16	23	29	15	23	33	15	25
	I	4	2	3	4	2	3	5	2	4
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	32	19	26	34	17	26	39	17	29
10/T	N+D	7	2	4	11	4	7	17	8	13
	I	1	0	1	2	1	1	3	1	2
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	8	2	5	12	4	9	20	9	15
ADT	N+D	279	120	205	365	146	263	531	195	374
	I	42	18	31	55	22	39	80	29	56
	DV	0	0	0	0	0	0	1	0	0
	TOTAL	321	138	235	421	168	303	612	225	431
M/C	N+D	316	194	259	356	223	294	410	265	342
	I	20	20	20	20	20	20	20	20	20
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	337	214	280	376	243	314	430	285	363
TOTAL	N+D	595	314	464	721	368	557	941	460	717
	I	62	38	51	75	42	60	100	50	76
	DV	0	0	0	0	0	0	1	0	1
	TOTAL	657	352	515	797	411	617	1042	510	794

NOTE

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