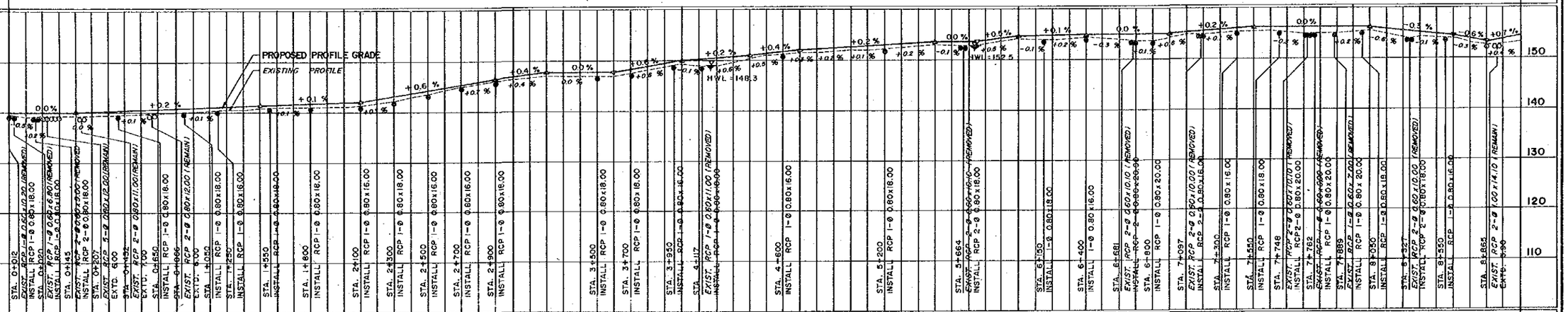
STUDY ROUTE IM-27	DWG. NO.
From A. CHOM PHRA To B. NONG KHAO	27-1
PLAN AND PROFILE	
STA 0+000 TO STA 9+000	

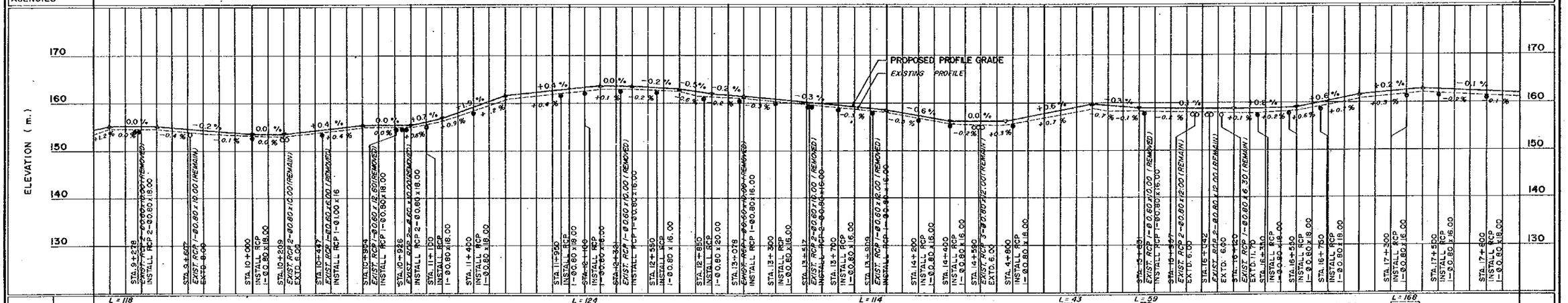
TERRAIN		FLAT
PAVEM'T	Type	LATERITE
	Condition	POOR
FLOODING	Length (m.) / Height (m.)	
RIGHT OF WAY (m.)		
ROUTE NO. AGENCIES		DOH ROUTE NO. 2261



CURVATURE BAND	Existing Alignment	L=97 R=487; L=151 R=1910; L=120 R=819; L=299 R=2865; L=173 R=955; L=212 R=2865; L=212 R=2865; L=241 R=716
	Proposed Alignment	L=97 R=487; L=151 R=1910; L=120 R=819; R=2865; L=299; L=173; R=955; L=212 R=2865; R=2865; L=212; L=241; R=716
STATION (Km.)		0+000 1+000 2+000 3+000 4+000 5+000 6+000 7+000 8+000 9+000

STUDY ROUTE IM-27	DWG NO
From A.CHOM PHRA To B. NONG KHAO	27-2
PLAN AND PROFILE	
STA 9+000 TO STA 18+000	

TERRAIN		FLAT
PAVEMENT	Type	LATERITE
	Condition	POOR / FAIR / POOR
FLOODING	Length (m.) / Height (m.)	
RIGHT OF WAY (m.)		
ROUTE NO. AGENCIES		DOH ROUTE NO. 2261



CURVATURE BAND	Existing Alignment	L=118 R=477			L=124 R=955	L=399 R=2292		L=114 R=441	L=168 R=2865	L=91 R=1910	L=43 R=477 LA=72.5°	L=59 R=573			L=74 R=286	L=168 R=573				
	Proposed Alignment	L=118 R=477		RA=86°	L=124 R=955	L=399 R=2292		L=114 R=441	L=168 R=2865	L=91 R=1910	L=43 R=477 LA=72.5°	L=59 R=573			L=74 R=286	L=168 R=573				
STATION (Km.)		9+000		10+000		11+000		12+000		13+000		14+000		15+000		16+000		17+000		18+000

STUDY ROUTE IM-27	DWG. NO.
From A. CHOM PHRA To B. NONG-KHAO	27-3
PLAN AND PROFILE	
STA 18+000 TO STA 27+000	

TERRAIN: FLAT

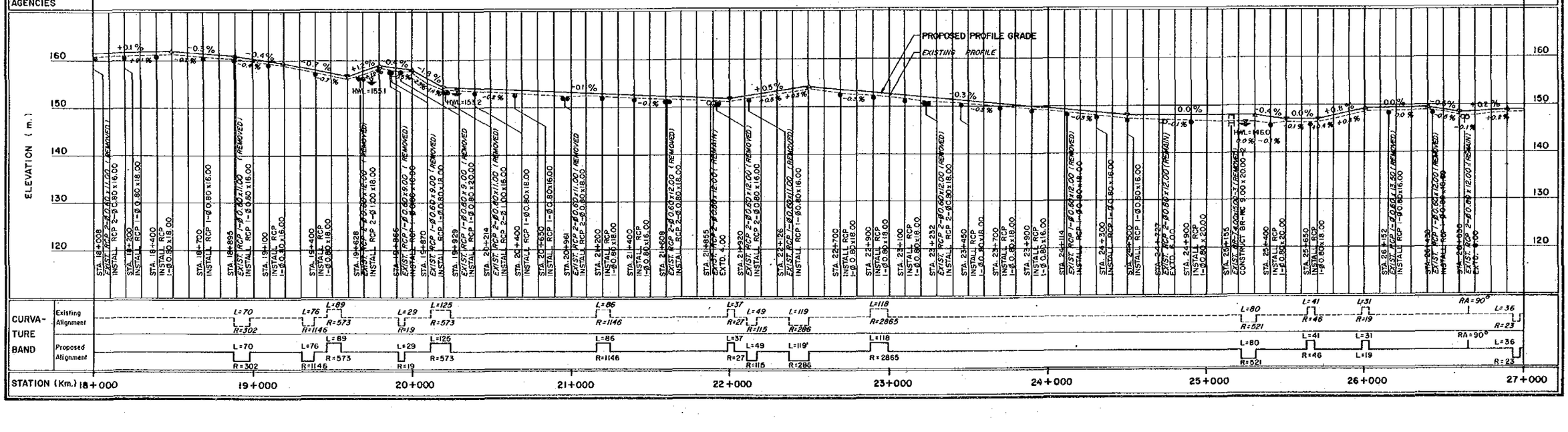
PAVEMENT — Type: LATERITE

PAVEMENT — Condition: POOR

FLOODING — Length (m.) / Height (m.)

RIGHT OF WAY (m.)

ROUTE NO. AGENCIES: DOH ROUTE NO. 2261

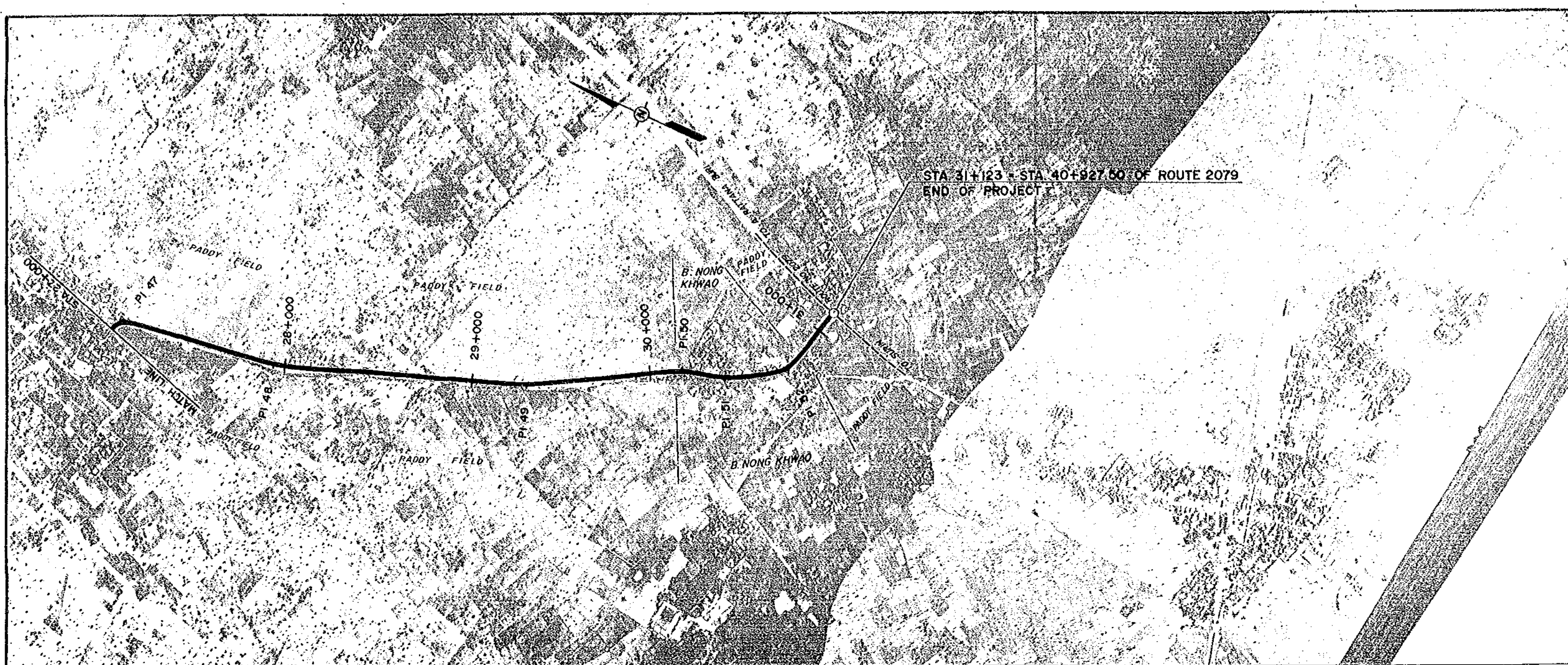


CURVATURE BAND

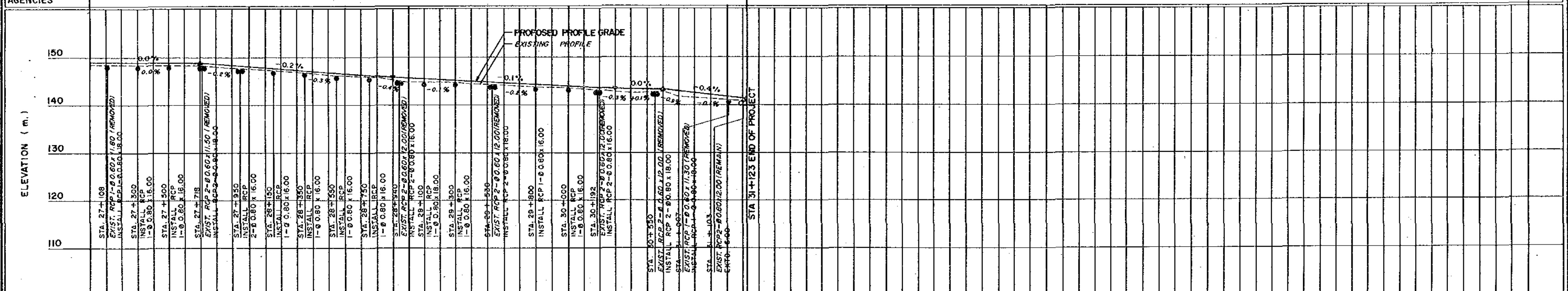
	Existing Alignment	Proposed Alignment
	L=70 R=302	L=70 R=302
	L=76 R=1146 L=89 R=573	L=76 R=1146 L=89 R=573
	L=29 R=19 L=125 R=573	L=29 R=19 L=126 R=573
	L=86 R=1146	L=86 R=1146
	L=37 R=27 L=49 R=115 L=119 R=286	L=37 R=27 L=49 R=115 L=119' R=286
	L=118 R=2865	L=118 R=2865
	L=80 R=521	L=80 R=521
	L=41 R=46 L=31 R=19	L=41 R=46 L=31 R=19
	RA=90° L=36 R=23	RA=90° L=36 R=23

STATION (Km.) 18+000 19+000 20+000 21+000 22+000 23+000 24+000 25+000 26+000 27+000

STUDY ROUTE IM-27	DWG. NO.
From A. CHOM PHRA To B. NONG KHAO	27 – 4
PLAN AND PROFILE	
STA 27 + 000 TO STA 31 + 123	



TERRAIN		FLAT
PAVEM'T	Type	LATERITE
	Condition	POOR
FLOODING	Length (m.) / Height (m.)	
RIGHT OF WAY (m.)		
ROUTE NO. AGENCIES		DOH ROUTE NO. 2261



CURVATURE BAND		
Existing Alignment		L=57 R=48; L=90 R=409; L=249 R=1432; L=95 R=409; L=82 R=409; L=158 R=191
Proposed Alignment		L=57 R=48; L=90 R=409; L=249 R=1432; L=95 R=409; L=82 R=409; L=158 R=191

STATION (Km.) 27+000 28+000 29+000 30+000 31+000

STUDY ROUTE NO. IM-29

Changwat : Buri Ram / Surin

A. Prakhon Chai (J.R.24) – A. Krasang

Length : 47.1 KM.

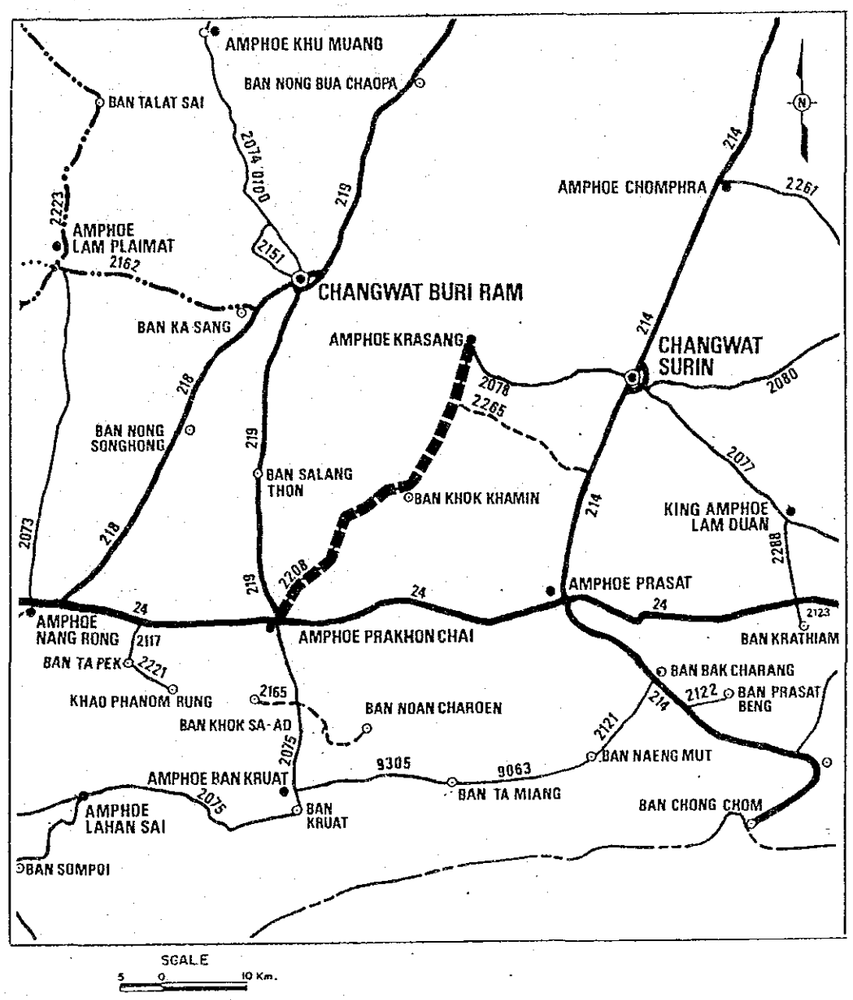
TABLE OF CONTENTS

SUMMARY

STUDY ROUTE IM-29

General		
Changwat	:	Buri Ram/Surin
Origin and Destination	:	A. Prakhon Chai—A. Krasang
Connected Road Network	:	24
Amphoe on Route	:	-
Number of Related Villages	:	5
Influence Area		
Area	:	399 km²
Cultivated Area Ratio to Total Land Area in %	:	72
Population in 1983	:	51,300
Main Crops	:	Paddy
Number of Public Activities		
Public Health Service Centers	:	-
Hospitals Changwat Level	:	-
Amphoe Level	:	2
Schools Primary	:	14
Secondary	:	2
Traffic (ADT)	:	1984-169 1988-302 1994-475 2002-907
Nemenclature of Study Route		
Total Length	:	47.1 km
Improvement Section	:	47.1 km
DOH Road	:	34.1 km
ARD Road	:	13.0 km
Other Road	:	-
New Construction Section	:	-
Design Standard Employed	:	F4
Construction Cost in Baht		
Financial	:	92,690,000
Economic	:	77,553,000
Economic Indicators		
IRR	:	17.1% Ranking: 4
Social Impact		
Social B/C Ratio	:	0.243 Ranking: 7
Recommendations		
Opening Year	:	1988 Overall Ranking: 4

LOCATION OF STUDY ROUTE

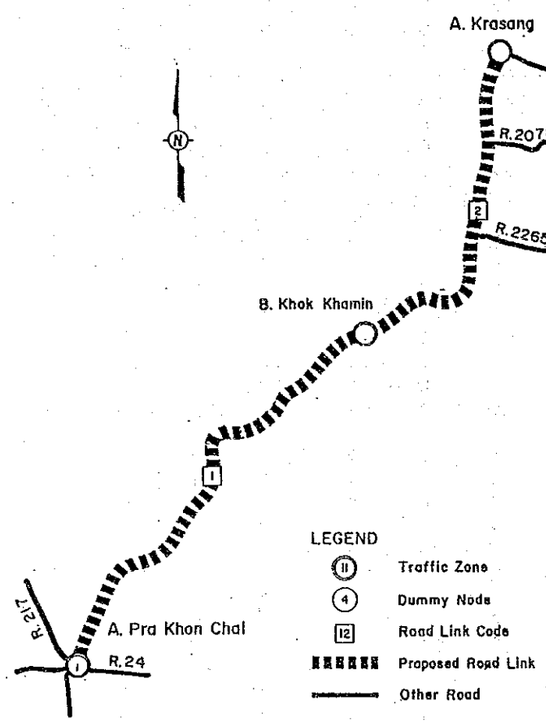


29.1 TRAFFIC

29.1.1 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.

29.1.2 Assumed Road Link



29.1.3 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	30	2	70	31	54	6	12	5	210	217	427
2	1	0	40	2	33	6	26	5	113	130	243
AVE.	18	1	57	19	45	6	18	5	169	180	350

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	3116	59.5	11.9	71.4
2	1091	84.7	17.0	101.7

GROWTH RATE OF PASSENGER MOVEMENT

(UNIT : % P.A.)

YEAR	PER CAPITA INCOME	POPULATION	PASSENGER MOVEMENT
1984 - 1988	3.1	1.4	5.9
1988 - 1994	3.1	1.2	5.7
1994 - 2002	3.1	1.1	5.5

GROWTH RATE OF FREIGHT MOVEMENT

(UNIT : % P.A.)

YEAR	NON-AGRI. FREIGHT	AGRI. FREIGHT	FREIGHT MOVEMENT
1984 - 1988	7.3	0.1	6.2
1988 - 1994	7.0	0.1	6.3
1994 - 2002	6.8	0.1	6.3

RATE OF INDUCED AND DEVELOPED MOVEMENT

(UNIT : %)

YEAR	INDUCED LINK 1	INDUCED LINK 2	DEVELOPED PASSENGER MOVEMENT	DEVELOPED NON-AGRI. FREIGHT MOVEMENT	DEVELOPED AGRI. FREIGHT MOVEMENT
1988	15.0	15.0	0.0	0.0	1.0
1994	15.0	15.0	0.0	0.0	6.9
2002	15.0	15.0	0.0	0.0	15.3

TRAFFIC COMPOSITION

(UNIT : %)

LINK NO.	YEAR	PASSENGER P/C	P/P	L/B	M/B	H/B	FREIGHT P/T	4/T	6/T	10/T
	1984	21.7	32.5	0.9	31.2	13.8	28.1	18.8	37.5	15.6
1	1988	25.5	33.7	1.4	27.1	12.3	24.8	17.0	40.3	17.9
	1994	31.3	35.5	2.1	21.1	10.0	19.7	14.4	44.4	21.4
	2002	39.0	38.0	3.0	13.0	7.0	13.0	11.0	50.0	26.0
	1984	1.8	51.0	0.0	44.9	2.2	11.9	14.3	61.9	11.9
2	1988	10.1	48.1	0.7	37.8	3.3	12.1	13.6	59.3	15.0
	1994	22.5	43.8	1.7	27.2	4.9	12.5	12.5	55.3	19.7
	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 P/C	L/B	M/B	H/B	P/P&T	4/T	6/T	10/T	ADT	M/C	TOTAL
1988	56	3	74	26	102	8	24	8	302	320	621
1994	121	8	92	37	163	9	32	13	475	384	859
2002	317	24	106	57	321	10	47	24	907	475	1382

TRAFFIC VOLUME ON ROUTE IM- 29 LINK COUNT= 2

	YEAR	1988			1994			2002		
	LINK	1	2	AVR.	1	2	AVR.	1	2	AVR.
P/C	N+D	75	12	49	152	41	105	379	133	276
	I	11	2	7	23	6	16	57	20	41
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	87	13	56	174	47	121	436	153	317
L/B	N+D	4	1	3	10	3	7	29	10	21
	I	1	0	0	1	0	1	4	2	3
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	5	1	3	11	3	8	34	12	24
M/B	N+D	80	43	65	102	49	80	126	44	92
	I	12	6	10	15	7	12	19	7	14
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	92	50	74	117	57	92	145	51	106
H/B	N+D	36	4	23	49	9	32	68	24	49
	I	5	1	3	7	1	5	10	4	7
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	42	4	24	56	10	37	78	27	57
P/P&T	N+D	109	61	89	182	88	142	378	142	279
	I	16	9	13	27	13	21	57	21	42
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	125	70	102	209	101	163	435	164	321
4/T	N+D	6	7	7	7	8	8	8	11	9
	I	1	1	1	1	1	1	1	2	1
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	7	8	8	8	10	9	9	13	10
6/T	N+D	15	30	21	21	37	28	34	49	41
	I	2	4	3	3	6	4	5	7	6
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	17	34	24	25	43	32	40	57	47
10/T	N+D	7	8	7	10	13	11	18	26	21
	I	1	1	1	2	2	2	3	4	3
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	8	9	8	12	15	13	21	30	24
ADT	N+D	333	165	262	532	248	413	1041	438	788
	I	50	25	39	80	37	62	156	66	118
	DV	0	0	0	0	0	0	1	1	1
	TOTAL	383	189	302	613	285	475	1198	505	907
M/C	N+D	342	240	299	410	299	364	507	382	455
	I	20	20	20	20	20	20	20	20	20
	DV	0	0	0	0	0	0	0	0	0
	TOTAL	362	260	320	431	320	384	528	403	475
TOTAL	N+D	675	405	561	943	547	776	1548	820	1242
	I	70	45	60	100	57	82	176	86	138
	DV	0	0	0	0	1	1	1	1	1
	TOTAL	745	450	621	1043	605	859	1725	908	1382

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

29.2 AGRICULTURAL DEVELOPMENT

29.2.1 Present Condition

Almost all of the cultivated land in the influence area is covered by paddy fields.

Land use and capability conditions in the area are shown in Table 29.2.1 and Figure 29.2.1. A typical cropping calendar in the area is shown in Figure 29.2.2.

29.2.2 Development Projection

Future agricultural development in the area of influence was projected for the two cases "with and without project". The projected planted area, unit yields by crop, and the consequent production amount are shown in Table 29.2.2.

Based on the above projected production amount, farmgate prices and production costs estimated separately, net production value (NPV) was obtained as shown in Table 29.2.3. The difference in NPV between the two cases is deemed to be the development benefit of the study route.

FIGURE 29.2.1 LAND USE AND CAPABILITY OF INFLUENCE AREA

STUDY ROUT

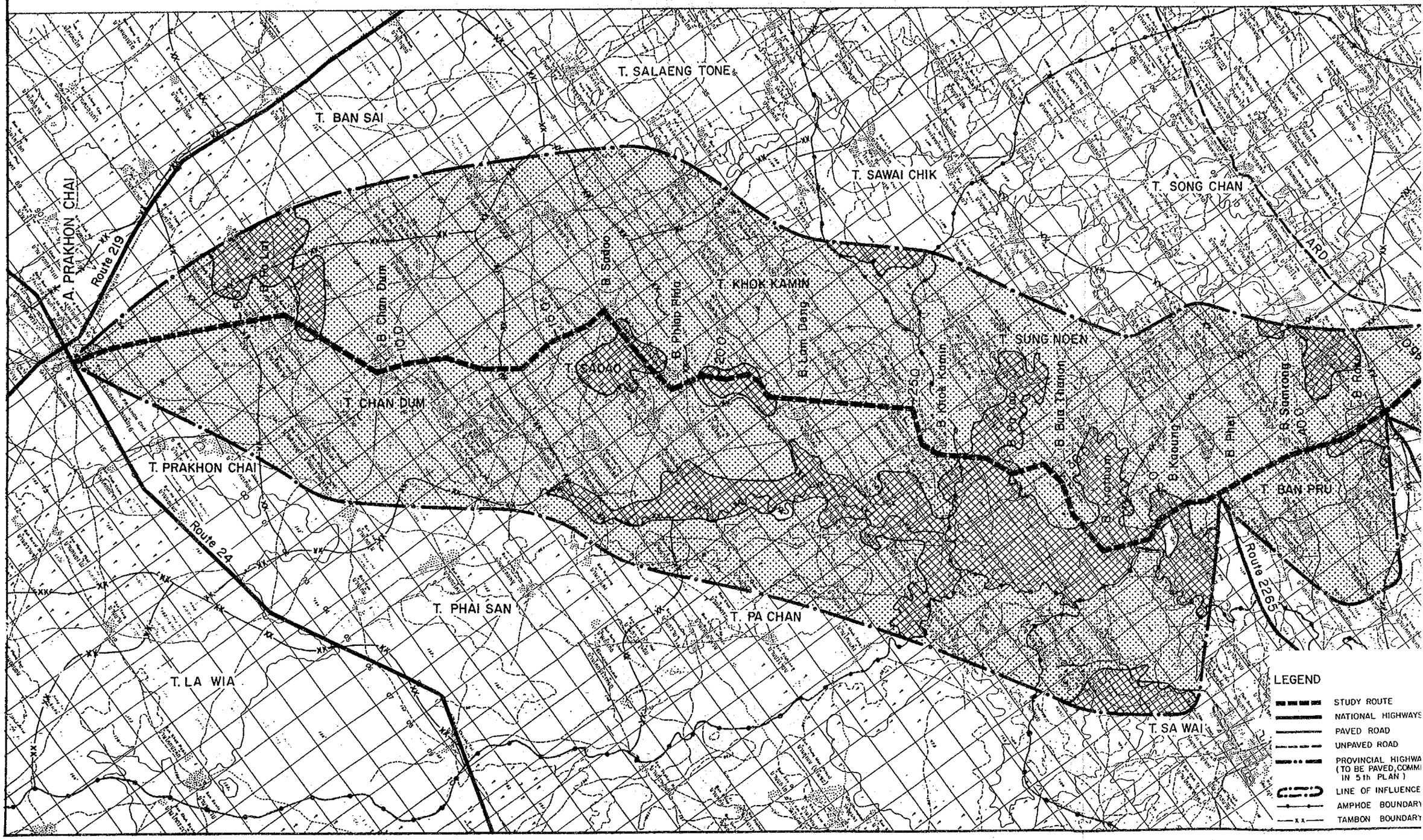


FIGURE 29.2.1 LAND USE AND CAPABILITY OF INFLUENCE AREA

STUDY ROUTE NO. IM-29

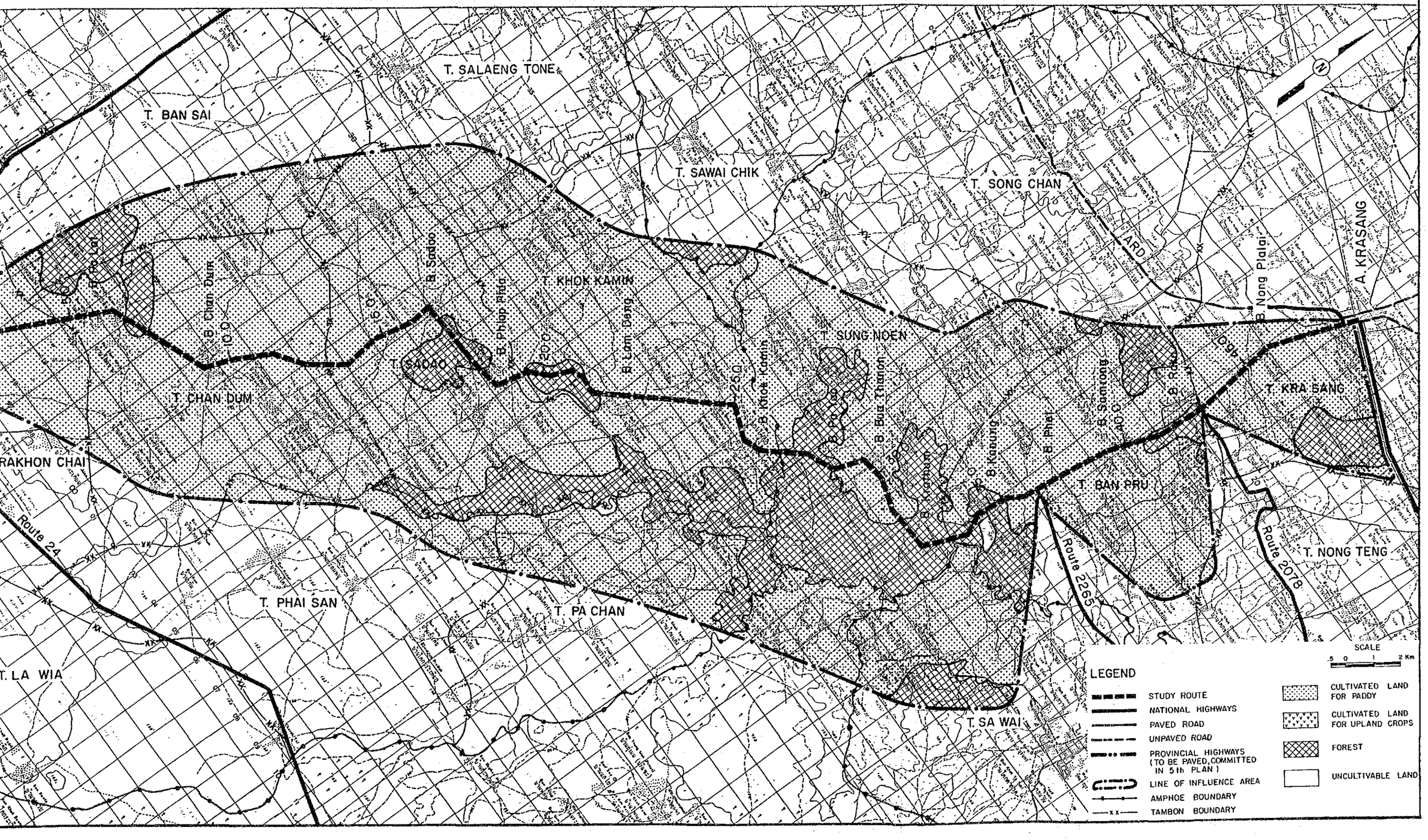
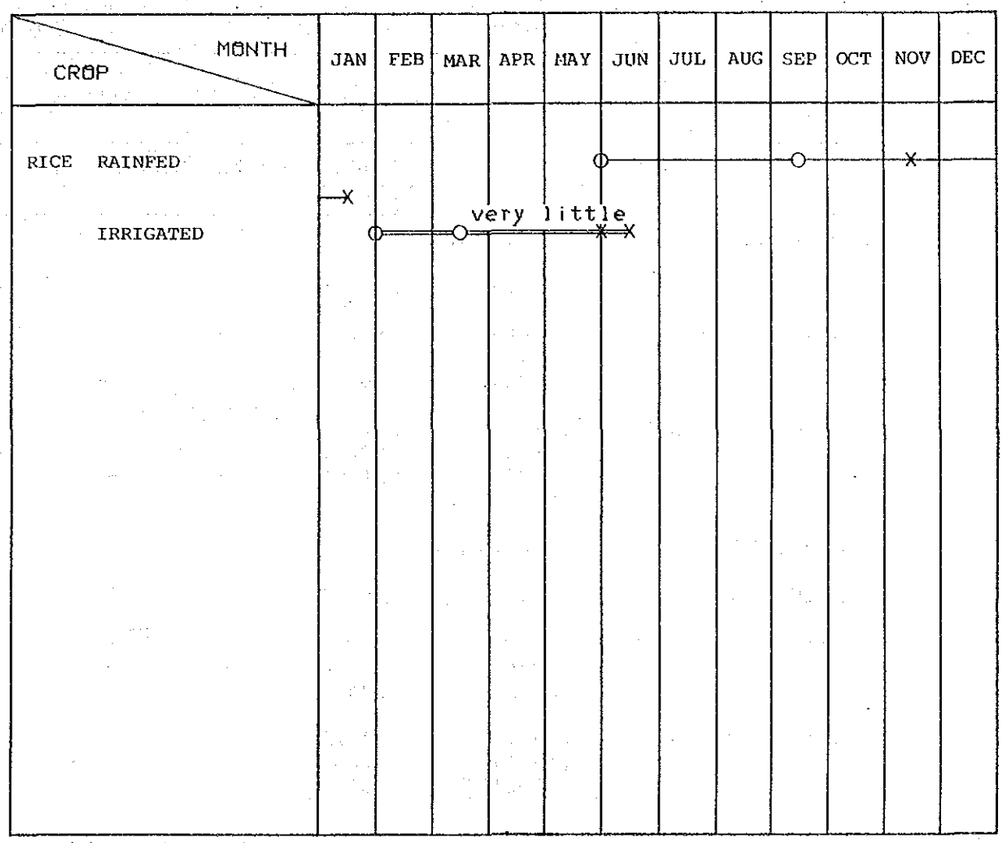


FIGURE 29.2.2 CROPPING CALENDAR

ROUTE IM-29

Related Amphoes: 1405 Krasang
1411 Prakhon Chai
1501 M. Surin
1511 Prasat



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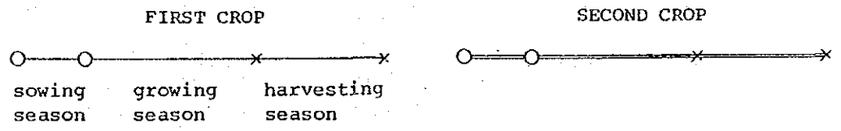


TABLE 29.2.1 CULTIVATED LAND

[UNIT : 1000 RAI (KM2)]

CHANGWAT NAME	AMPHOE NAME	CULTIVATED LAND PADDY FIELD	UPLAND FIELD	TOTAL
BURI RAM	KRASANG	59.68 (95.49)	0.00 (0.00)	59.68 (95.49)
	PRAKHON CHAI	108.32 (173.31)	0.00 (0.00)	108.32 (173.31)
SURIN	M. SURIN	7.36 (11.78)	0.00 (0.00)	7.36 (11.78)
	PRASAT	4.65 (7.44)	0.00 (0.00)	4.65 (7.44)
TOTAL		180.01 (288.02)	0.00 (0.00)	180.01 (288.02)

TABLE 29.2.2 CROP PRODUCTION

ITEM		RICE (PADDY)	MAIZE	SORGHUM	BEANS	GROUND NUTS	CASSAVA	KENAF	SUGAR CANE	COTTON	CASTOR BEANS	UPLAND TOTAL	TOTAL
PLANTED AREA	(1000 RAI)												
BASE YEAR	(1983)	156.43	-	-	-	-	-	-	-	-	-	-	156.43
WITHOUT PROJECT	(1988)	156.43	-	-	-	-	-	-	-	-	-	-	156.43
	(1994)	156.43	-	-	-	-	-	-	-	-	-	-	156.43
	(2002)	156.43	-	-	-	-	-	-	-	-	-	-	156.43
WITH PROJECT	(1988)	157.36	-	-	-	-	-	-	-	-	-	-	157.36
	(1994)	163.07	-	-	-	-	-	-	-	-	-	-	163.07
	(2002)	171.00	-	-	-	-	-	-	-	-	-	-	171.00
CROP YIELD	(KG/RAI)												
BASE YEAR	(1983)	268.9	-	-	-	-	-	-	-	-	-		
WITHOUT PROJECT	(1988)	270.2	-	-	-	-	-	-	-	-	-		
	(1994)	271.8	-	-	-	-	-	-	-	-	-		
	(2002)	274.0	-	-	-	-	-	-	-	-	-		
WITH PROJECT	(1988)	271.2	-	-	-	-	-	-	-	-	-		
	(1994)	278.7	-	-	-	-	-	-	-	-	-		
	(2002)	289.0	-	-	-	-	-	-	-	-	-		
CROP PRODUCTION AMOUNT	(TON)												
BASE YEAR	(1983)	42,064	-	-	-	-	-	-	-	-	-	-	42,064
WITHOUT PROJECT	(1988)	42,273	-	-	-	-	-	-	-	-	-	-	42,273
	(1994)	42,524	-	-	-	-	-	-	-	-	-	-	42,524
	(2002)	42,862	-	-	-	-	-	-	-	-	-	-	42,862
WITH PROJECT	(1988)	42,676	-	-	-	-	-	-	-	-	-	-	42,676
	(1994)	45,445	-	-	-	-	-	-	-	-	-	-	45,445
	(2002)	49,419	-	-	-	-	-	-	-	-	-	-	49,419

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE

TABLE 29.2.3 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)		3,908	-	-	-	-	-	-	-	-	-		
WITH PROJECT	(1988 - 2002)		3,932	-	-	-	-	-	-	-	-	-		
CROP PRODUCTION COST	(BAHT/RAI)													
BASE YEAR	(1983)		705	-	-	-	-	-	-	-	-	-		
WITHOUT PROJECT	(1988)		708	-	-	-	-	-	-	-	-	-		
	(1994)		711	-	-	-	-	-	-	-	-	-		
	(2002)		716	-	-	-	-	-	-	-	-	-		
WITH PROJECT	(1988)		709	-	-	-	-	-	-	-	-	-		
	(1994)		724	-	-	-	-	-	-	-	-	-		
	(2002)		743	-	-	-	-	-	-	-	-	-		
NET PRODUCTION VALUE	(1000 BAHT)													
WITHOUT PROJECT	(1988)		54,449	-	-	-	-	-	-	-	-	-	-	54,449
	(1994)		54,962	-	-	-	-	-	-	-	-	-	-	54,962
	(2002)		55,500	-	-	-	-	-	-	-	-	-	-	55,500
WITH PROJECT	(1988)		56,231	-	-	-	-	-	-	-	-	-	-	56,231
	(1994)		60,629	-	-	-	-	-	-	-	-	-	-	60,629
	(2002)		67,262	-	-	-	-	-	-	-	-	-	-	67,262
NET VALUE ADDED	(1000 BAHT)													
	1988		1,782	-	-	-	-	-	-	-	-	-	-	1,782
	1994		5,667	-	-	-	-	-	-	-	-	-	-	5,667
	2002		11,762	-	-	-	-	-	-	-	-	-	-	11,762

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE

29.3 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 29.3.1. Data for additional VOCs are shown in Table 29.3.2.

VOC savings, obtained as the balance of total link VOCs between the two cases, were calculated as shown in Table 29.3.3.

TABLE 29.3.1 ROAD LENGTH BY ROAD CLASS

(UNIT : KM)

LINK NO.	WITHOUT PROJECT CASE						WITH PROJECT CASE
	PAVED	LATERITE			EARTH	TOTAL	PAVED
		GOOD	FAIR	POOR			
1	-	16.2	11.1	-	-	27.3	27.3
2	-	17.7	2.1	-	-	19.8	19.8

TABLE 29.3.2 DATA FOR ADDITIONAL VOC COST

(UNIT OF LENGTH : M)

LINK NO.	CASE	CURVE									GRADE					VILLAGE		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	NO.	LENGTH				
1	WITHOUT	261	265	59	185	251	119	84	330	809	4290	200	-	-	-	6	5250	3	7	-	-
	WITH	261	265	59	185	251	119	84	330	809	5850	-	-	-	-	6	5250	-	-	-	-
2	WITHOUT	79	199	141	176	249	100	421	784	1533	5545	-	-	-	-	-	-	3	-	4	1
	WITH	79	199	141	176	249	100	421	784	1533	5695	-	-	-	-	-	-	-	-	-	1

TABLE 29.3.3 VEHICLE OPERATING COST SAVING

(UNIT : 1000 BAHT)

LINK NO.	1988			1994			2002		
	WITHOUT	WITH	SAVING	WITHOUT	WITH	SAVING	WITHOUT	WITH	SAVING
1	22,664	14,848	7,816	32,845	21,763	11,082	55,776	37,656	18,120
2	7,774	5,024	2,750	11,145	7,151	3,994	18,220	11,658	6,563
TOTAL	30,438	19,871	10,567	43,990	28,914	15,077	73,996	49,313	24,683

N O T E
(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

29.4 ENGINEERING

29.4.1 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 29.4.1 and Table 29.4.1, respectively.

Rock aggregate sources were assumed as shown below:

No.	Source	Description of Sample	Est. Quantity m^3
29/CS-1	KM. 2+600 Lt close to Buri Ram-Prakhon Chai (Sila Pet Quarry)	Basalt	Plentiful
29/CS-2	KM. 3+000 Lt close to Buri Ram-Prakhon Chai (Sila Chai Quarry)	Basalt	Plentiful
29/CS-3	KM. 3+500 Lt close to Buri Ram-Prakhon Chai (Nisit Sawat Quarry)	Basalt	Plentiful

The borehole location, boring log and summary of boring test results are shown in Figures 29.4.2 and 29.4.3 and Table 29.4.2, respectively.

FIGURE 29.4.1 SOIL AND MATERIAL SOURCES

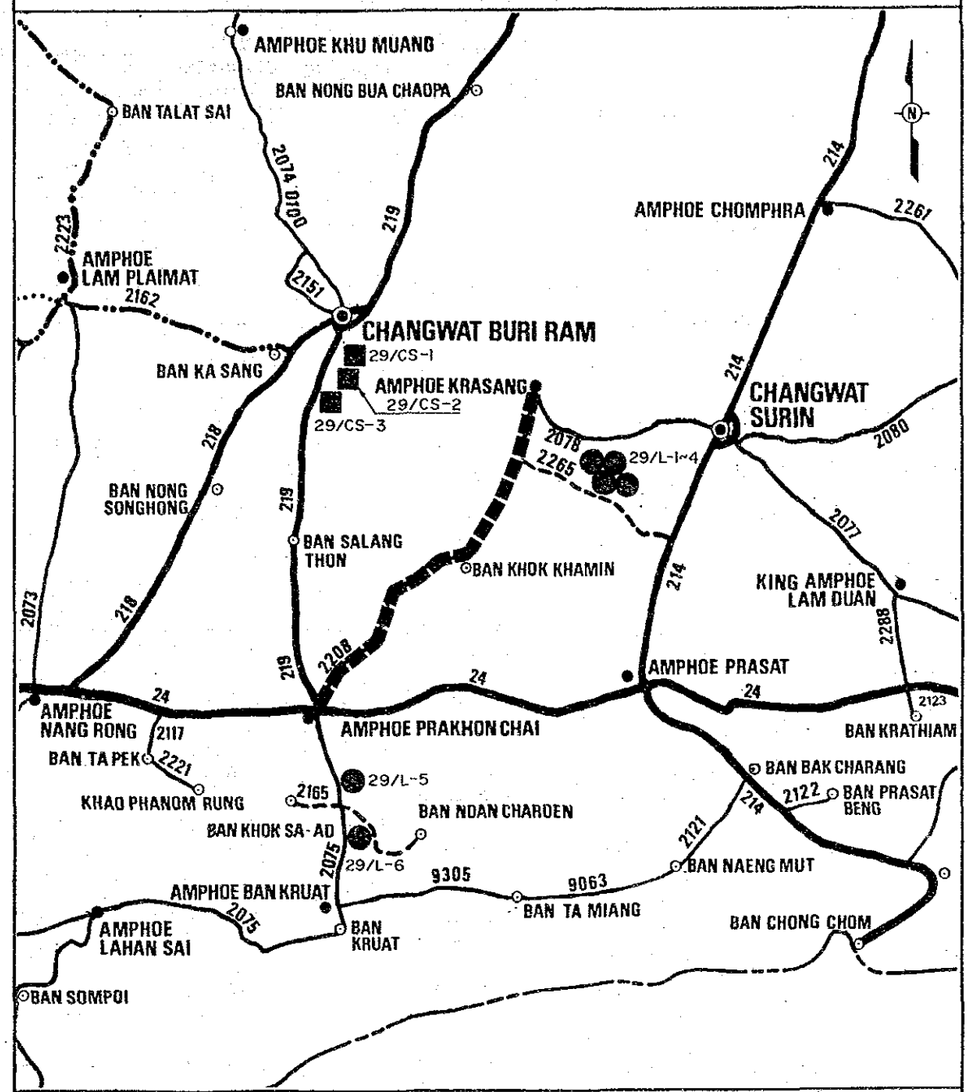


Table 29.4.1 PHYSICAL CHARACTERISTICS OF MATERIALS

No.	Source	Description of Sample	Est. Quantity m^3	AASHTO Classification	Sieve Analysis % Passing								Plasticity		Comp. DH-T Stand.		Lab. C.B.R		Durability	
					50.0	25.0	19.0	9.5	#4	#10	#40	#200	LL	PT	Opt. 95%	gm/cc	CBR 95%	Swell %	Abr.	Dur.
	SUBGRADE																			
29/SG-1.	KM. 4+000 Lt 12 M.			A-4					100	98.0	92.6	49.0	N-P		15.0	1.820	15.5	-		
29/SG-2.	KM. 10+000 Rt 12 M.			A-4					100	99.0	98.0	71.2	23.8	5.3	11.7	1.917	14.3	-		
29/SG-3.	KM. 17+000 Rt 13 M.			A-4						100	99.4	52.4	N-P		11.0	1.882	26.7	-		
29/SG-4.	KM. 24+000 Lt 12 M.			A-4						100	99.2	53.6	N-P		11.4	1.867	19.5	-		
29/SG-5.	KM. 31+000 Lt 12 M.			A-6					100	99.2	97.6	61.2	35.2	13.1	14.0	1.772	10.2	-		
29/SG-6.	KM. 38+000 Rt 13 M.			A-4						100	98.8	50.0	N-P		11.7	1.890	17.7	-		
29/SG-7.	KM. 45+000 Rt 14 M.			A-6					100	99.4	98.0	64.0	34.3	14.4	13.7	1.777	6.3	-		
	LATERITE																			
29/L-1	KM. 46+000 Lt 3,000 M. Surin - Tha Tum	Yellow laterite	200,000	A-2-4	100	96.2	-	64.5	-	30.8	25.9	20.1	32.1	8.9	7.0	2.100	15.4	0.42		
29/L-2	KM. 12+000 Lt 10 KM. Surin - Krasang	Laterite	100,000	A-2-4		100	94.0	75	39.0	29.0	25.0		N.P.						48.8	54.1
	Sand-mixed Source S2 L1:S2 = 7:3 by weight	Laterite and sand		A-2-4		100	96.0	82	57.0	32.0	18.0		N.P.		10.2	1.709	15.0	0.51		
29/L-3	KM. 12+000 Lt 10.5 KM. Surin - Krasang	Laterite		A-2-4	100	99	91.0	65	40.0	53.0	29.0		22.3	4.2					49.6	61.8
	Sand-mixed source S2 L2:S2 = 3:2 by weight	Laterite and sand		A-2-4	100	99	95.0	79	64.0	35.0	18.0		13.8	2.6	9.8	2.008	35.0	-		
29/L-4	KM. 12+000 Lt 10.8 KM. Surin - Krasang	Laterite		A-2-4		100	89.0	61	33.0	28.0	25.0		N.P.						50.6	45.0
	Sand-mixed Source S2 L3:S2 = 3:2 by weight	Laterite and sand		A-2-4		100	94.0	77	59.0	32.0	16.0		N.P.		11.0	1.770	20.2	-		
29/L-5	KM. 4+000 Lt 500 M. Prakhon Chai - B. Kruat	Red laterite	10,000	A-2-4	-	100	-	85.6	-	29.4	27.4	19.6	27.4	8.8	10.7	2.330	37.2	0.26		
29/L-6	KM. 4+000 Rt 1,500 M. Khok Sa-ad - Pha Chea - Noun Charoen	Yellow laterite	10,000	A-2-4	-	100	-	89.2	-	31.0	28.7	20.1	27.6	9.4	9.3	2.231	35.0	0.26		

FIGURE 29.4.2 BOREHOLE LOCATION

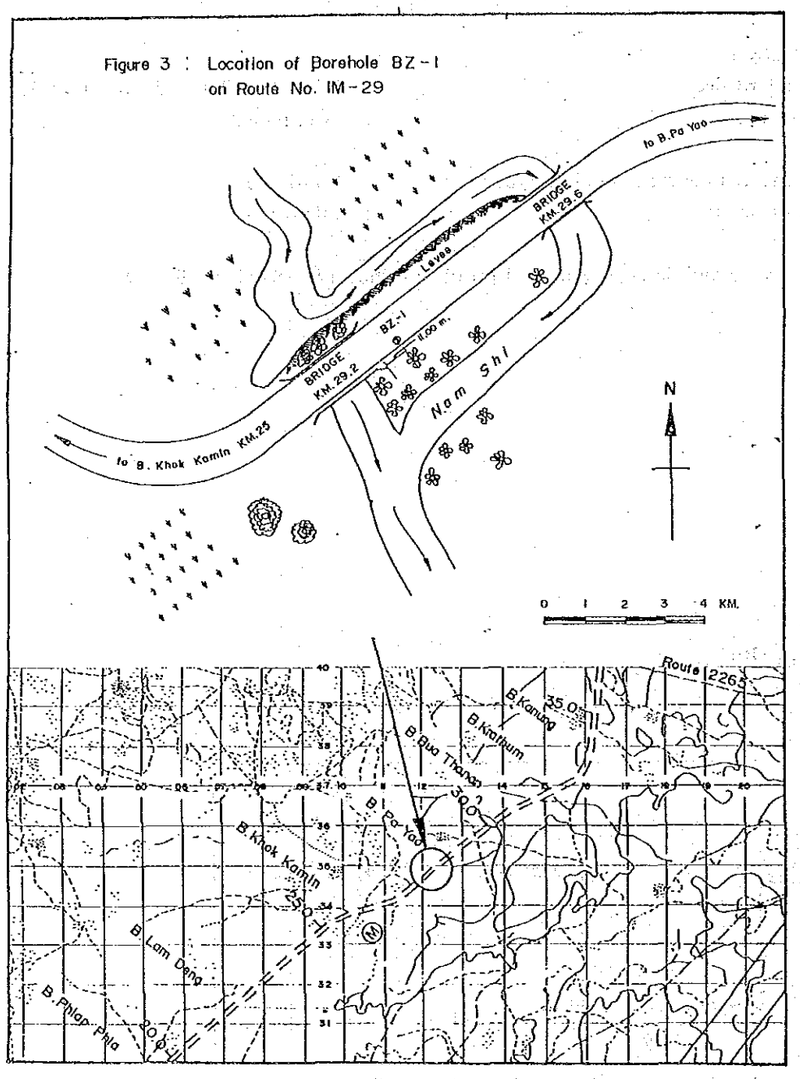


FIGURE 29.4.3 BORING LOG

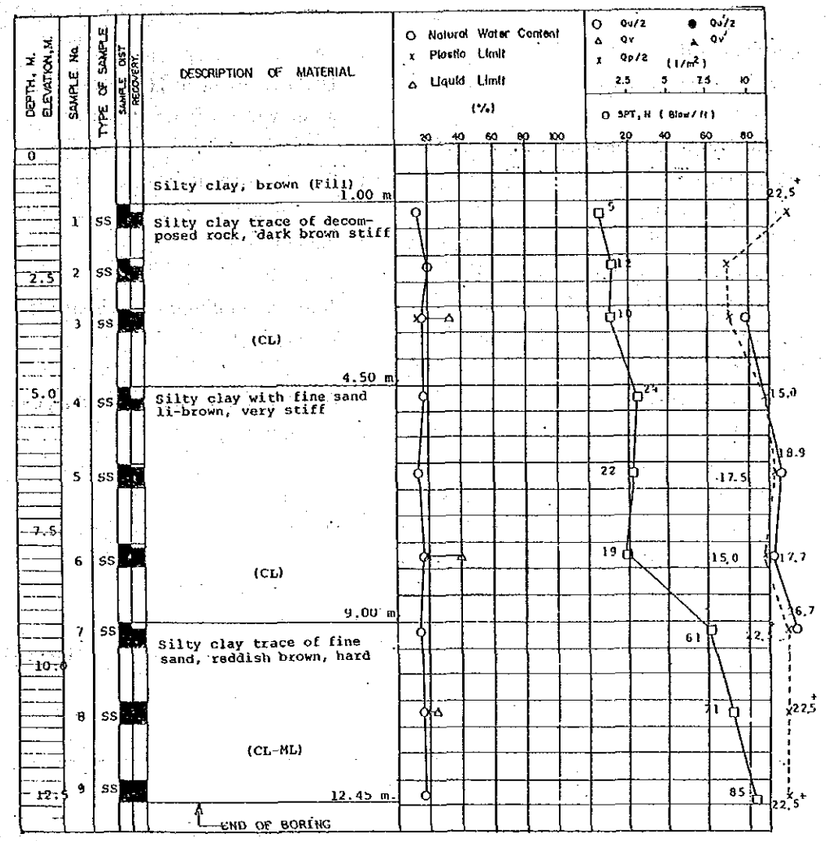


TABLE 29.4.2 SUMMARY OF TEST RESULTS

SAMPLE No.	DEPTH M. FROM	DEPTH M. TO	WATER CONTENT %	ATTERBERG LIMIT % LL	ATTERBERG LIMIT % PL	ATTERBERG LIMIT % PI	WET UNIT WEIGHT t/m³	SIEVE ANALYSIS % FINER No. 3/8"	No. 4	No. 10	No. 40	No. 200	CLASSIFICATION	UNDRAINED SHEAR STRENGTH t/m² UNCONFINED SHEAR Qu/2	Qu'/2	FIELD VANE SHEAR Qv	Qv'	POCKET PENETRATION ½Qp	STANDARD PENETRATION (N)		
SS-1	1.00	1.45	11.5				-						CL	-				22.5+	5		
SS-2	2.00	2.45	20.4				2.05						CL	-				8.7	12		
SS-3	3.00	3.45	16.3	30.8	14.2	16.6	2.13				100	87	CL	9.8				8.7	10		
SS-4	4.50	4.95	17.0				-						CL	-				15.0	24		
SS-5	6.00	6.45	13.5				2.18						CL	18.9				17.5	22		
SS-6	7.50	7.95	16.9	39.6	20.1	19.5	2.19	99	99	98	97	82	CL	17.7				15.0	19		
SS-7	9.00	9.45	14.4				2.02						CL	26.7				22.5+	61		
SS-8	10.50	10.95	14.6	23.3	18.3	5.0	2.84			100	99	95	CL-ML	-				22.5+	71		
SS-9	12.00	12.45	16.0				2.16						CL-ML	-				22.5+	85		

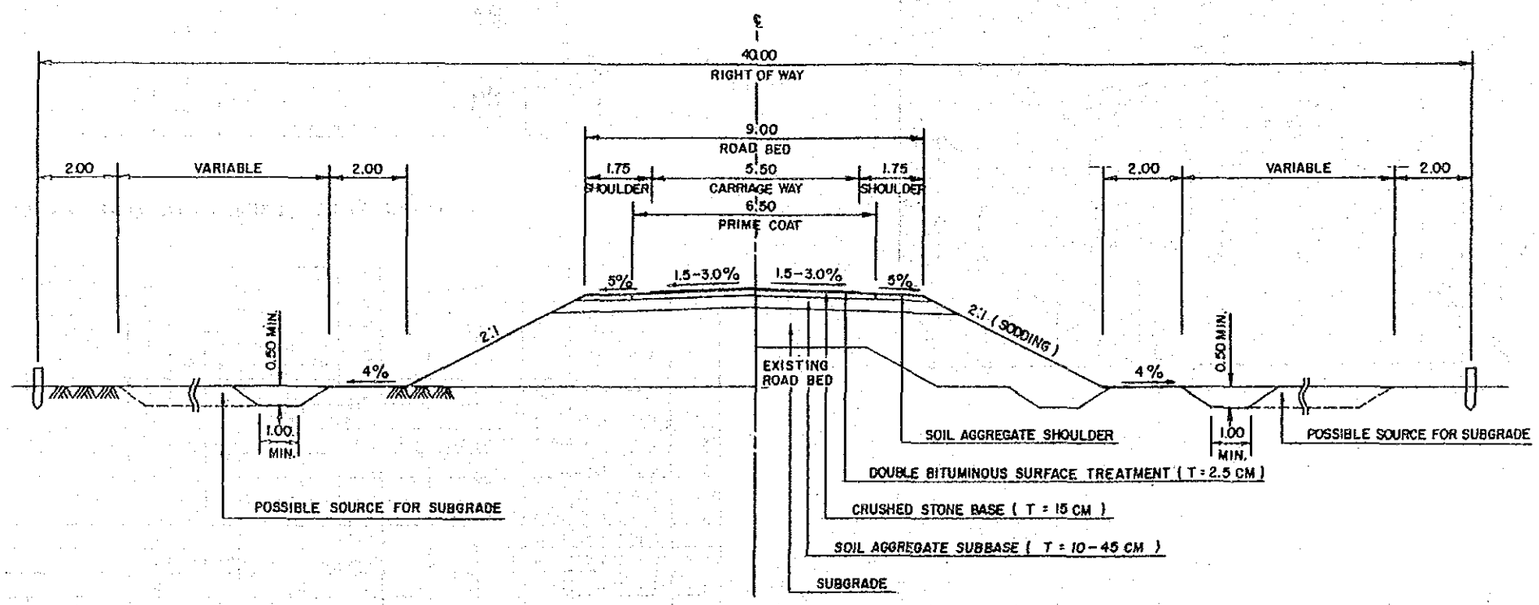
29.4.2 Preliminary Design

29.4.2.1. Design Criteria

Design Standard	:	F4
Geometric Design Criteria	:	DOH (Provincial Highway)
Typical Cross Section	:	as shown in Figure 29.4.4
Minimum Height of Embankment in Flooding Section	:	0.7 m above flood level
Pavement Structure		
DBST	:	2.5 cm
Crushed Aggregate Base CBR≥ 80%	:	15.0 cm
Soil Aggregate Subbase CBR≥ 25%	:	10.0 cm (minimum requirement)
Selected Materials CBR≥ 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 × 1.5, 2.4 × 2.4 & 3.0 × 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 29-1/29-6.

FIGURE 29.4.4 TYPICAL CROSS SECTION



29.4.2.3 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			
Traffic/road link	1	2	3	4	1	2	3	4
Heavy bus	42	4	—	—	56	10	—	—
Medium truck	17	34	—	—	25	43	—	—
Heavy truck	8	9	—	—	12	15	—	—

- Cumulative number of ESA in one direction by road link

Road link	1	2	3	4
7 years (10^6)	0.068	0.061	-	-

2) Design CBR values

Road link	1	2	3	4
Design CBR (%)	15.8	7.9	-	-

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

29.4.2.4 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
2 + 640	Timber Bridge	5.0 x 20.0	RC Bridge	9.0 x 30.0
3 + 481	" "	4.0 x 20.0	" "	9.0 x 20.0
3 + 530	Box Culvert	2-1.25 x 2.1 x 10.5	Extd. 11.5 m	
4 + 899	Timber Bridge	4.0 X 20.0	RC Bridge	9.0 x 20.0
7 + 945	" "	4.0 x 12.0	" "	9.0 x 15.0
8 + 945	" "	4.0 x 25.0	" "	9.0 x 30.0
13 + 707	Box Culvert	2-1.25 x 1.8 x 11.5	Extd. 6.5 m	
19 + 843	Timber Bridge	4.0 x 25.0	RC Bridge	9.0 x 30.0
20 + 844	" "	4.0 x 10.0	" "	9.0 x 15.0
28 + 255	RC Bridge	3.5 x 36.0	" "	4.5 x 36.0
28 + 676	" "	3.5 x 32.0	" "	4.5 x 32.0
36 + 175	" "	3.5 x 12.0	" "	4.5 x 12.0
36 + 342	" "	3.5 x 22.0	" "	4.5 x 22.0

29.4.3 Quantities and Construction and Road Maintenance Costs

The required construction costs were estimated based on the results of the preliminary design as shown in Table 29.4.3. Financial costs with breakdown into local and foreign currency portions, economic costs and residual values were estimated as follows and in 29.4.4:

		(baht)
IM - 29	L = 47.1 km	
	Financial cost	: 92,690,000
	Economic cost	: 77,553,000
	Residual value	: 33,913,000

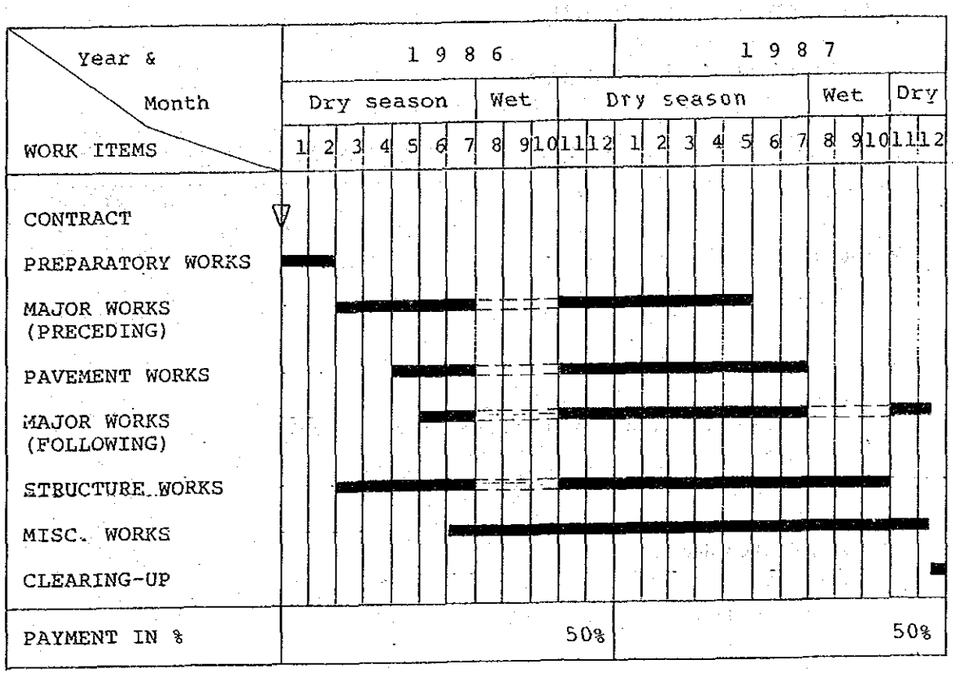
The required road maintenance costs are shown in Table 29.4.4.

29.4.4 Construction and Disbursement Schedules

IM - 29 Length = 47.1 km

Construction Schedule

Assumption: Completion date December 31, 1987



Yearly Disbursement Schedule

Assumption: Annual rise in prices

Year / Currency	Base year 1984	(1985)	1986	1987
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 - 29)

(Unit : Million Baht)

	1986			1987			Total		
	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total
Construction Cost	23.1	23.2	46.3	23.1	23.3	46.4	46.2	46.5	92.7
Price Contingency	4.9	3.1	8.0	7.6	4.8	12.4	12.5	7.9	20.4
Total	28.0	26.3	54.3	30.7	28.1	58.8	58.7	54.4	113.1
	(1.04)	(0.97)	(2.01)	(1.14)	(1.04)	(2.18)	(2.17)	(2.01)	(4.19)

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

Table 29.4.3 CONSTRUCTION QUANTITIES AND COSTS
(ROUTE IM - 29 Length = 47.1 km)

DBST

Item	Unit	Financial Unit Rate B	Quantity	Financial Cost 1000 B			Economic Cost		Residual Value	
				Total	Local	Foreign	%	1000 B	%	1000 B
EARTHWORK							83		90	
Clearing & Grubbing	ha	10,000	109	1,090						
Roadway Excavation, Unclassified	m3	19	7,200	137						
Embankment, Common Soil	m3	38	449,500	17,081						
Embankment, Selected Material	m3	70	0	0						
Replacement of Soft Spot	m3	88	3,900	343						
Sub Total				18,651	9,512	9,139		15,480		13,932
SUBBASE & BASE COURSES							83		50	
Subbase, Soil Aggregate	m3	112	44,300	4,962						
Aggregate Base*	m3	320	45,900	14,688						
Cement Stabilized Base	m3	390	0	0						
Shoulder, Soil Aggregate	m3	120	17,600	2,112						
Sub Total				21,762	11,751	10,010		18,062		9,031
SURFACE COURSES							85		50**	
Asphaltic Prime/Tack Coat	m2	12	306,200	3,674						
Double Bituminous Surface Treatment*	m2	38	259,100	9,846						
Asphaltic Concrete Surfacing**	t	750	0	0						
Sub Total				13,520	5,949	7,571		11,492		0
STRUCTURES							83		50	
RC Pipe Culvert (D 1.0m Equivalent)	m	2,000	2,814	5,628						
RC Box Culvert (2.4mx2.4m Equivalent)	m	18,800	31	583						
RC Bridge(W=9.0m L=10m Equivalent)	m	46,500	231	10,742						
Sub Total				16,952	8,476	8,476		14,070		7,035
Total (a)				70,885	35,688	35,197		59,105		29,999
INCIDENTALS							83		0	
Miscellaneous Work ((a)x7%)	ls			4,962	2,481	2,481		4,118		0
CONTRACT AMOUNT (b)				75,847	38,169	37,678		63,223		29,999
PHYSICAL CONTINGENCIES ((b)x10%) (c)	ls			7,585	3,817	3,768		6,322		3,000
ENGINEERING AND SUPERVISION							85		0	
(((b)+(c))x10%) (d)	ls			8,343	3,337	5,006		7,092		0
LAND ACQUISITION							100		100	
Highly Developed Land	ha	50,000	18	900						
Less Developed Land	ha	15,000	1	15						
Sub Total (e)	ls			915	915	0		915		915
PROJECT COST ((b)+(c)+(d)+(e))				92,690	46,238	46,451		77,553		33,913
AVERAGE COST PER KM				1,968						

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

TABLE 29.4.4 ROAD MAINTENANCE COST SAVING

LINK NO.	YEAR	WITHOUT PROJECT CASE: AVERAGE DAILY TRAFFIC <ADT> (VEHICLE)	LENGTH OF LINK <L> (KM)	FACTOR FOR ADT <A1>	ROAD CHARA. FACTOR <KA>	UNIT MAINTE. COST <U> (BAHT/KM)	TOTAL MAINTE. COST <T> (1000 BAHT)	WITH PROJECT CASE: AVERAGE DAILY TRAFFIC <ADT> (VEHICLE)	LENGTH OF LINK <L> (KM)	FACTOR FOR ADT <X3>	ROAD CHARA. FACTOR <KB>	UNIT MAINTE. COST <U> (BAHT/KM)	TOTAL MAINTE. COST <T> (1000 BAHT)	ROAD MAINTE. COST SAVING (1000 BAHT)
1	1988	312.0	27.3	0.56	1.50	15,834	432	357.9	27.3	0.00	1.17	13,129	358	74
	1994	515.8	27.3	0.95	1.78	18,704	511	572.3	27.3	0.00	1.17	13,129	358	152
	2002	1072.1	27.3	0.95	1.78	18,704	511	1118.9	27.3	0.03	1.17	13,144	359	152
2	1988	162.5	19.8	0.21	1.26	13,274	263	177.0	19.8	0.00	1.17	13,129	260	3
	1994	253.7	19.8	0.43	1.41	14,836	294	266.2	19.8	0.00	1.17	13,129	260	34
	2002	474.2	19.8	0.94	1.77	18,610	368	471.3	19.8	0.00	1.17	13,129	260	109
TOTAL	1988	249.1	47.1			14,758	695	281.9	47.1			13,129	618	77
	1994	405.6	47.1			17,078	804	443.6	47.1			13,129	618	186
	2002	820.8	47.1			18,664	879	846.6	47.1			13,138	619	260

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 $KA = 1.11 + 0.70 * A1$
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 $X3 = -0.2034 + 0.000409 * (ADT / LANE)$; LANE = 2

29.5 EVALUATION

29.5.1 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 - 29

(1000 BAHT)

YEAR	COST	BENEFITS				DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	TOTAL COST	TOTAL BENEFIT
1986	38,777	0	0	0	0	48,642	0
1987	38,776	0	0	0	0	43,429	0
1988	0	1,782	10,567	77	12,425	0	11,094
1989	0	2,430	11,318	95	13,843	0	11,035
1990	0	3,077	12,070	113	15,260	0	10,862
1991	0	3,725	12,822	131	16,677	0	10,599
1992	0	4,372	13,573	150	18,095	0	10,268
1993	0	5,020	14,325	168	19,512	0	9,885
1994	0	5,667	15,077	186	20,930	0	9,467
1995	16,735	6,429	16,277	195	22,901	7,570	9,250
1996	0	7,191	17,478	205	24,873	0	8,970
1997	0	7,953	18,679	214	26,845	0	8,644
1998	0	8,715	19,880	223	28,817	0	8,284
1999	0	9,476	21,081	232	30,789	0	7,903
2000	0	10,238	22,281	242	32,761	0	7,508
2001	0	11,000	23,482	251	34,733	0	7,107
2002	-33,913	11,762	24,683	260	36,705	-6,196	6,706
TOTAL	60,375	98,835	253,593	2,742	355,170	93,445	137,582
DISCOUNTED	93,445	35,106	101,414	1,062	137,582		

NET PRESENT VALUE	:	44,136
BENEFIT/COST RATIO	:	1.47
INTERNAL RATE OF RETURN	:	17.1 %
FIRST YEAR RATE OF RETURN	:	12.0 %
OPTIMUM OPENING YEAR	:	1988

SENSITIVITY TESTS

ITEM	CASE		
	BASE	1	2
NET PRESENT VALUE	44,136	30,120	23,499
BENEFIT/COST RATIO	1.47	1.28	1.25
INTERNAL RATE OF RETURN	17.1 %	15.2 %	14.9 %
FIRST YEAR RATE OF RETURN	12.0 %	10.5 %	10.2 %
COSTS	BASE	+15%	BASE
BENEFITS	BASE	BASE	-15%

29.5.2 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)	:	77.6
1) General Accessibility Benefit (million baht)	:	4.43
2) Education Benefit (million baht)	:	2.13
3) Medical Care Benefit (million baht)	:	0.101
4) Total Social Benefits (million baht) (1 + 2 + 3)	:	6.66
5) Social Benefit/Cost Ratio ($\times 10^{-2}$)	:	8.58
6) Ranking by Social Benefits	:	11
7) Weighted Production Value Gain/Cost ($\times 10^{-2}$)	:	15.67
8) Ranking by 7	:	2
9) Combined Ratio ($\times 10^{-2}$)	:	24.25
Overall Ranking	:	7

29.5.3 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.