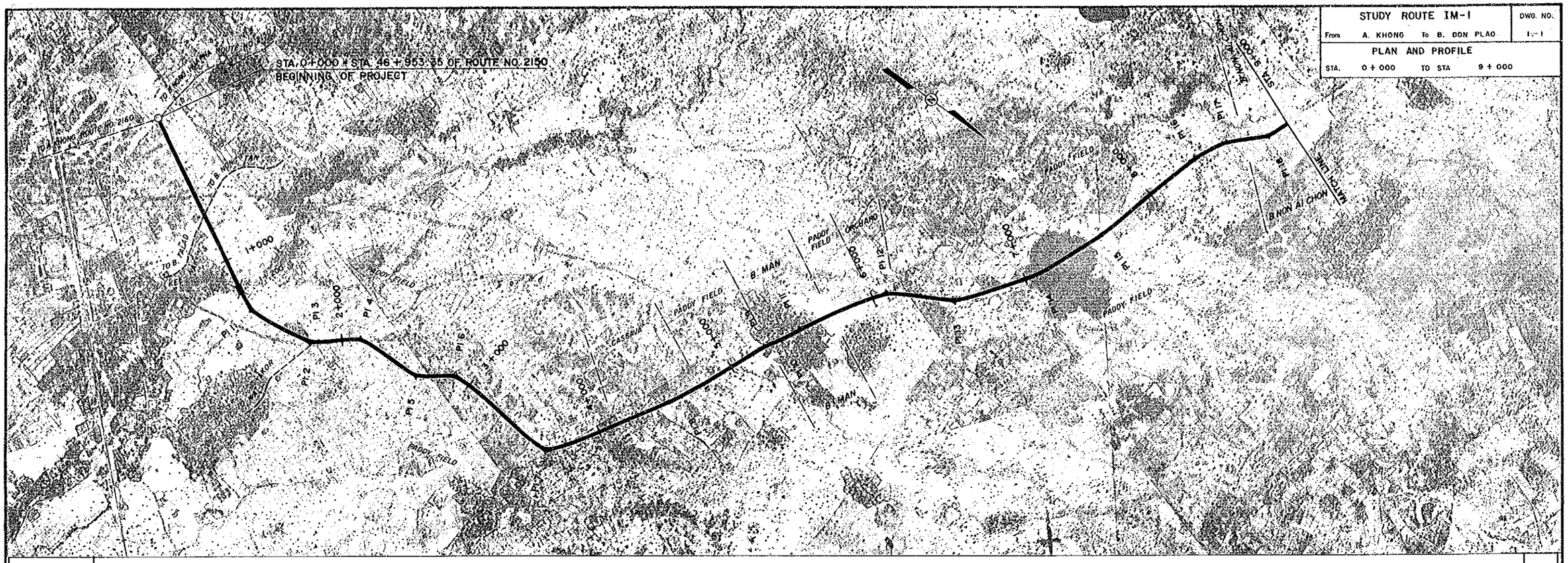
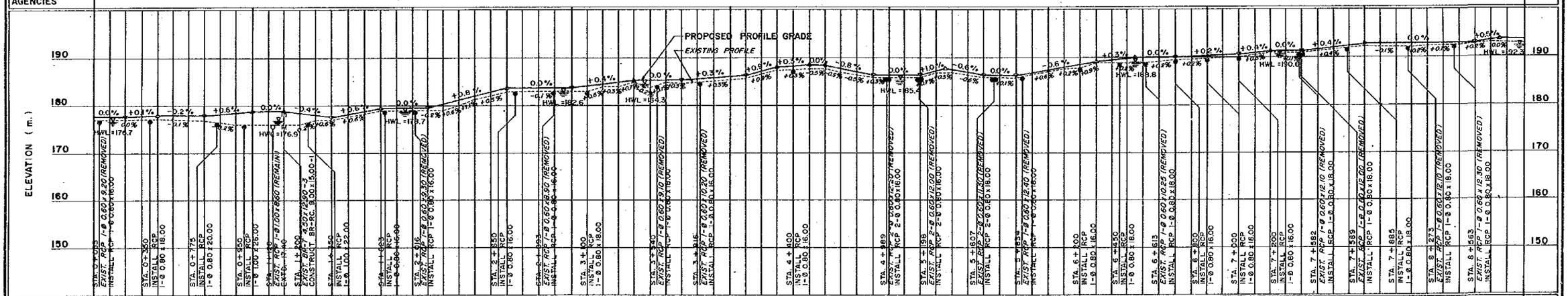
STUDY ROUTE IM-1	DWG. NO.
From A. KHONG To B. DON PLAO	1-1
PLAN AND PROFILE	
STA. 0 + 000 TO STA 9 + 000	



TERRAIN		FLAT
PAVEMENT	Type	LATERITE
	Condition	FAIR
FLOODING	Length (m.)	600
	Height (m.)	1.00
RIGHT OF WAY (m.)		
ROUTE NO. AGENCIES		DOH ROUTE NO. 2160



CURVATURE BAND	Existing Alignment	L = 297 R = 477 | L = 68 R = 573 | L = 90 R = 108 | L = 111 R = 151 | L = 123 R = 155 | L = 50 R = 120 | L = 99 R = 573 | L = 114 R = 396 | L = 163 R = 662 | L = 277 R = 521 | L = 145 R = 302 | L = 157 R = 717 | L = 210 R = 1432 | L = 104 R = 477 | L = 86 R = 239 | L = 155 R = 337
	Proposed Alignment	L = 297 R = 477 | L = 68 R = 573 | L = 90 R = 108 | L = 111 R = 151 | L = 123 R = 155 | L = 146 R = 130 | L = 99 R = 573 | L = 114 R = 396 | L = 114 R = 1303 | L = 163 R = 662 | L = 277 R = 521 | L = 145 R = 302 | L = 157 R = 717 | L = 210 R = 1432 | L = 140 R = 477 | L = 86 R = 239 | L = 155 R = 337
STATION (Km.)		0+000 | 1+000 | 2+000 | 3+000 | 4+000 | 5+000 | 6+000 | 7+000 | 8+000 | 9+000

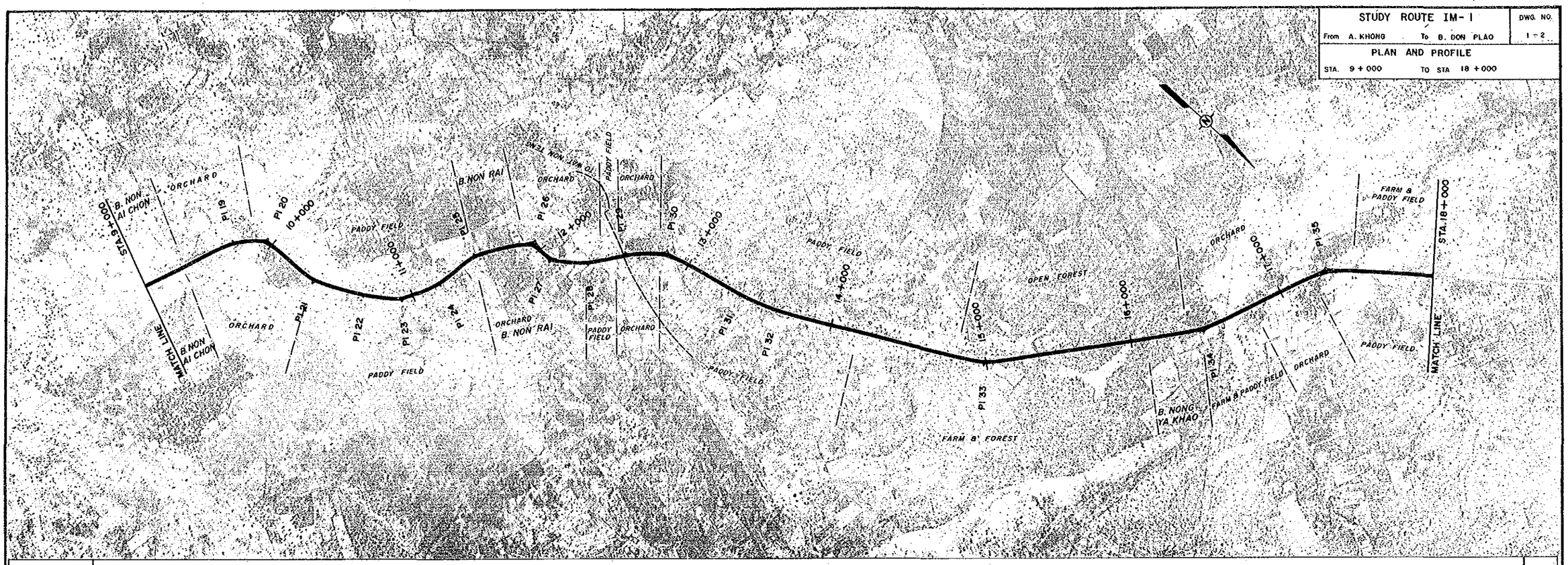
STUDY ROUTE IM-1

DWG. NO. 1-2

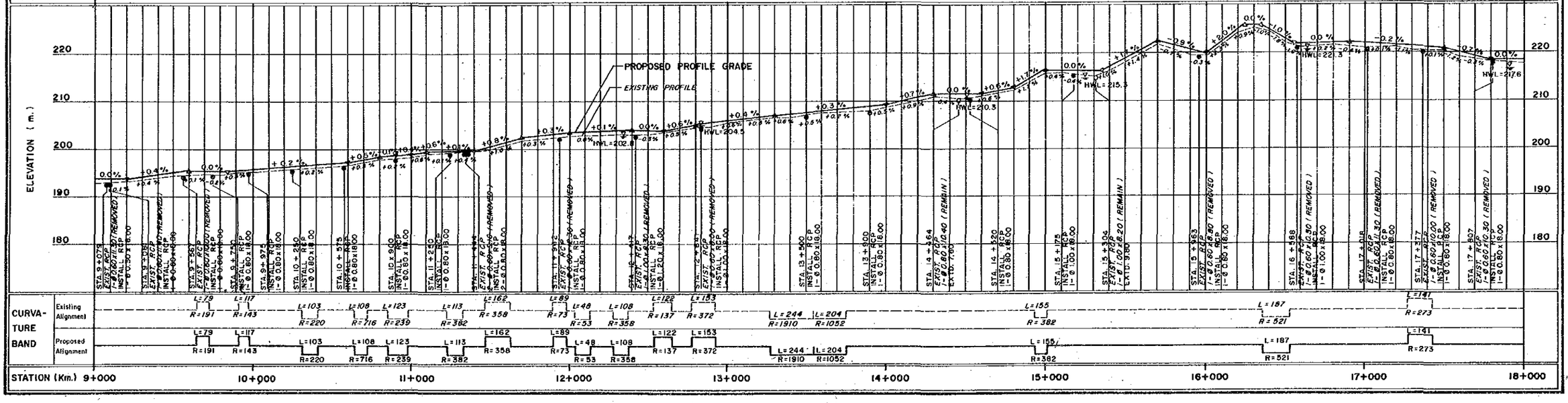
From A. KHONG To B. DON PLAO

PLAN AND PROFILE

STA. 9+000 TO STA 18+000

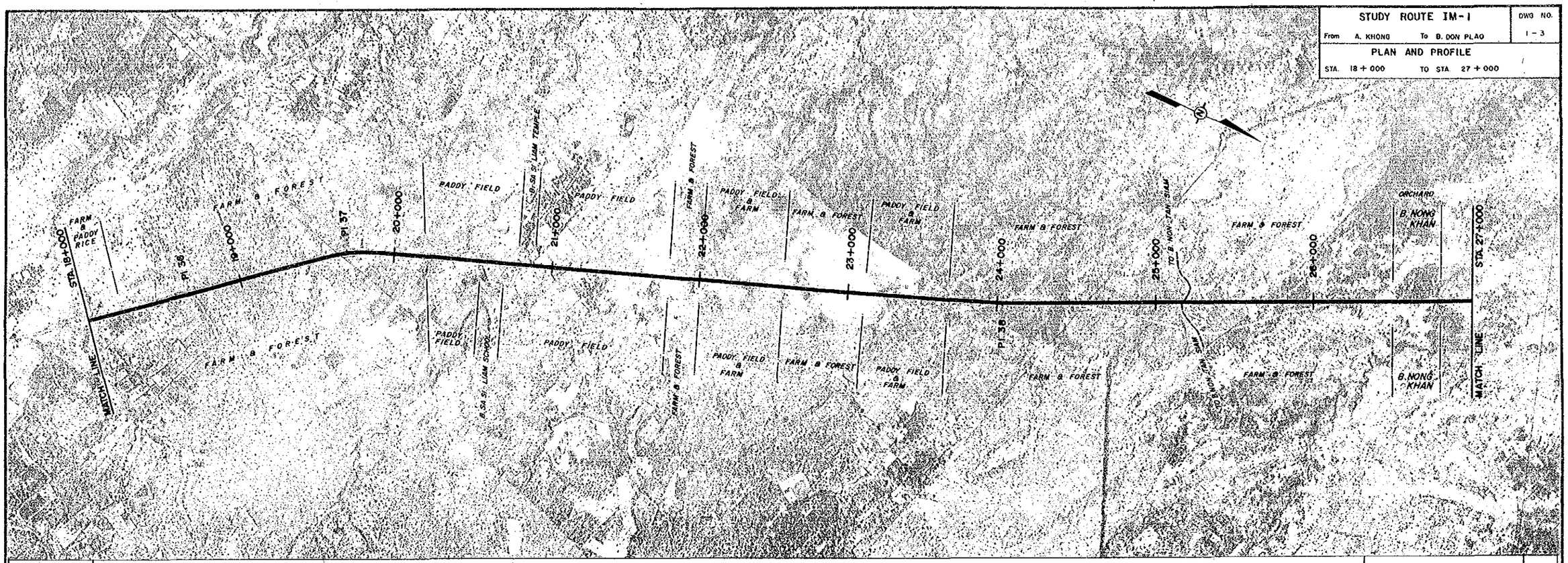


TERRAIN		FLAT
PAVEMENT	Type	LATERITE
	Condition	POOR
FLOODING	Length (m.)	200 / 300
	Height (m.)	1.00 / 0.10
RIGHT OF WAY (m.)		
ROUTE NO. AGENCIES		DOH ROUTE NO 2160

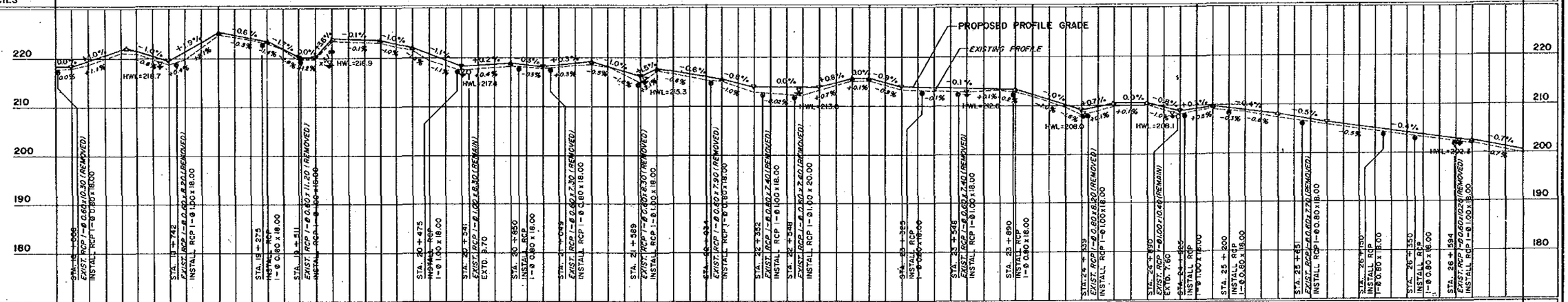


CURVATURE BAND	Existing Alignment	L=79 R=191; L=117 R=143; L=103 R=220; L=108 R=716; L=123 R=239; L=113 R=382; L=162 R=358; L=89 R=73; L=48 R=53; L=108 R=358; L=122 R=137; L=153 R=372; L=244 R=1910; L=204 R=1052; L=155 R=382; L=187 R=521; L=141 R=273
	Proposed Alignment	L=79 R=191; L=117 R=143; L=103 R=220; L=108 R=716; L=123 R=239; L=113 R=382; L=162 R=358; L=89 R=73; L=48 R=53; L=108 R=358; L=122 R=137; L=153 R=372; L=244 R=1910; L=204 R=1052; L=155 R=382; L=187 R=521; L=141 R=273
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-1	DWG NO.
From A. KHONG To B. DON PLAO	1 - 3
PLAN AND PROFILE	
STA. 18 + 000 TO STA. 27 + 000	



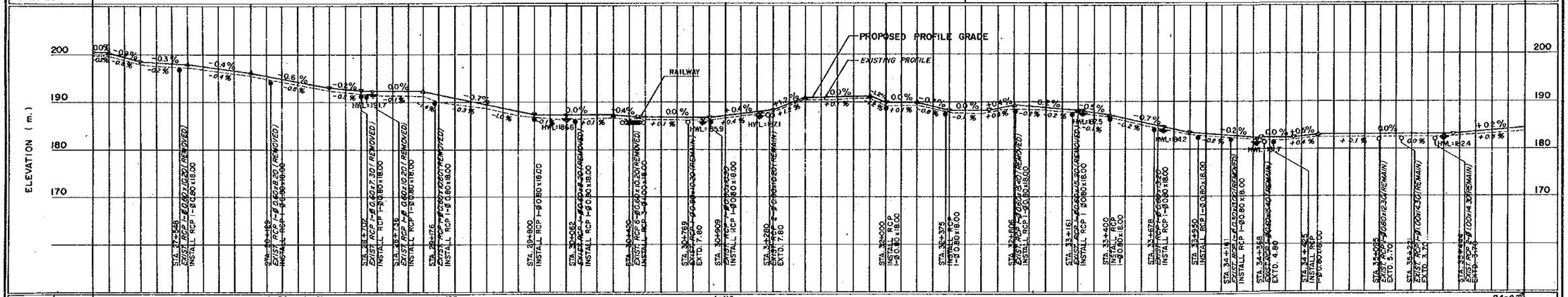
TERRAIN		ROLLING							FLAT	
PAVEM'T	Type	DT	LATERITE							
	Condition	POOR	FAIR		POOR					
FLOODING	Length (m.)					400				
	Height (m.)					1.00				
RIGHT OF WAY (m.)										
ROUTE NO. AGENCIES		DOH ROUTE NO 2160								



CURVATURE BAND	Existing Alignment	L=214 R=637						L=205 R=1432		
	Proposed Alignment	L=214 R=637						L=205 R=1432		
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-1			DWG NO.
From A. KHONG	To	D. DON PLAO	1 - 4
PLAN AND PROFILE			
STA 27+000	TO STA	36+000	

TERRAIN		FLAT
PAVEM'T	Type	LATERITE / DT / LATERITE
	Condition	POOR / FAIR / POOR / VERY POOR / FAIR
FLOODING	Length (m.) / Height (m.)	
RIGHT OF WAY (m.)		
ROUTE NO. AGENCIES		DOH ROUTE NO 2160 / ARD



CURVATURE BAND	Existing Alignment	L=54 R=359; L=161 R=521; L=105 R=275.6; L=155 R=1432; L=116 R=198; LA=57°; L=255 R=521; L=172 R=191; RA=92°
	Proposed Alignment	L=54 R=359; L=161 R=521; L=163 R=2865; L=155 R=1432; L=116 R=198; LA=57°; L=255 R=521; L=172 R=191; RA=92°
STATION (Km.)		27+000 / 28+000 / 29+000 / 30+000 / 31+000 / 32+000 / 33+000 / 34+000 / 35+000 / 36+000

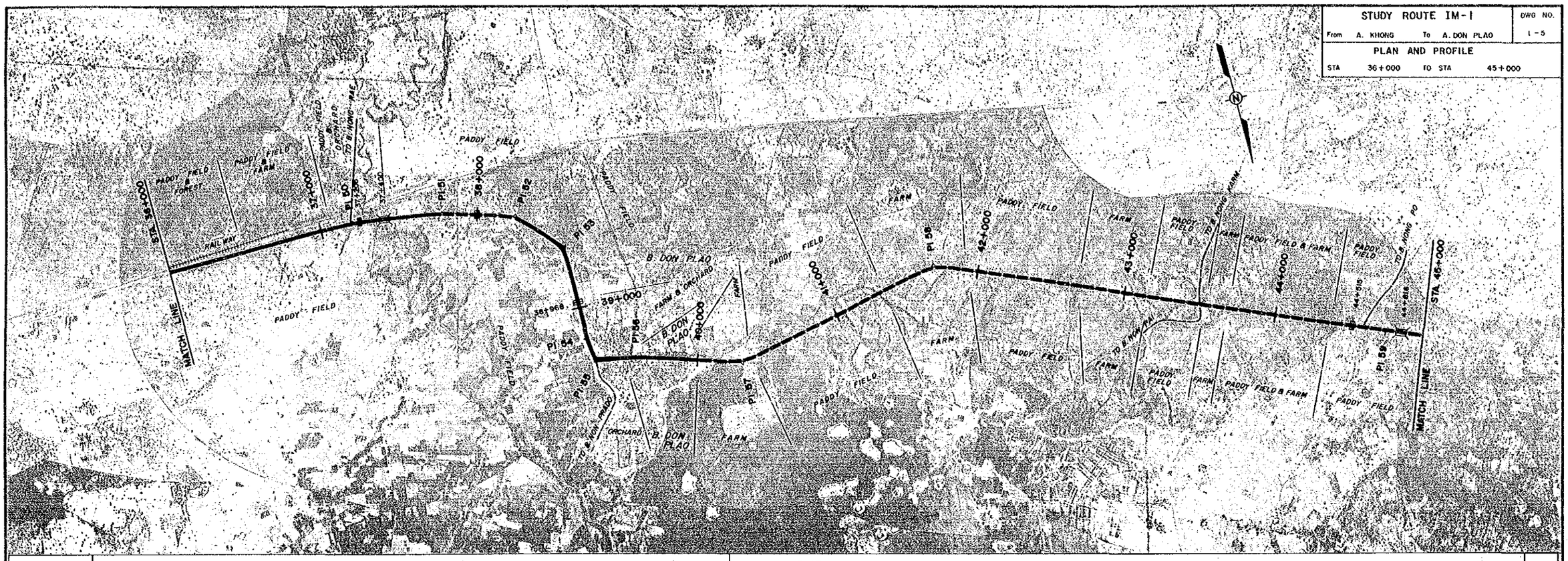
STUDY ROUTE IM-1

From A. KHONG To A. DON PLAO

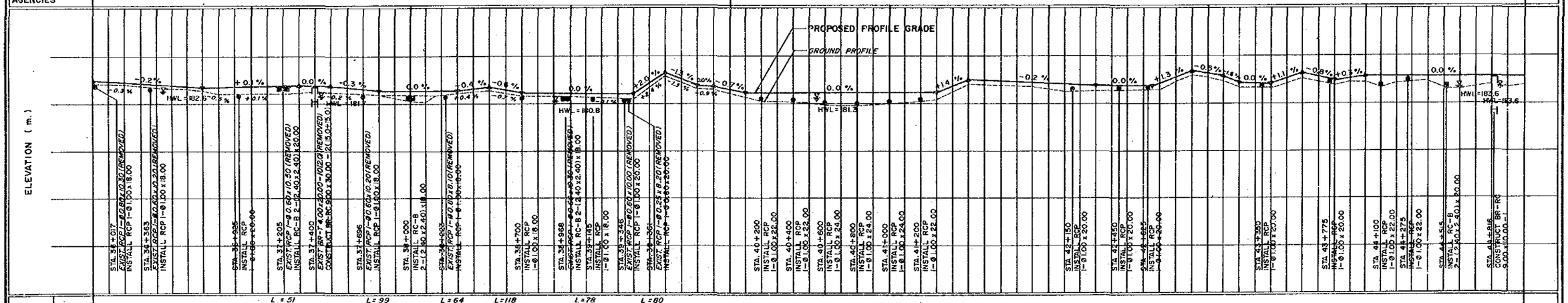
DWG NO. 1-5

PLAN AND PROFILE

STA 36+000 TO STA 45+000



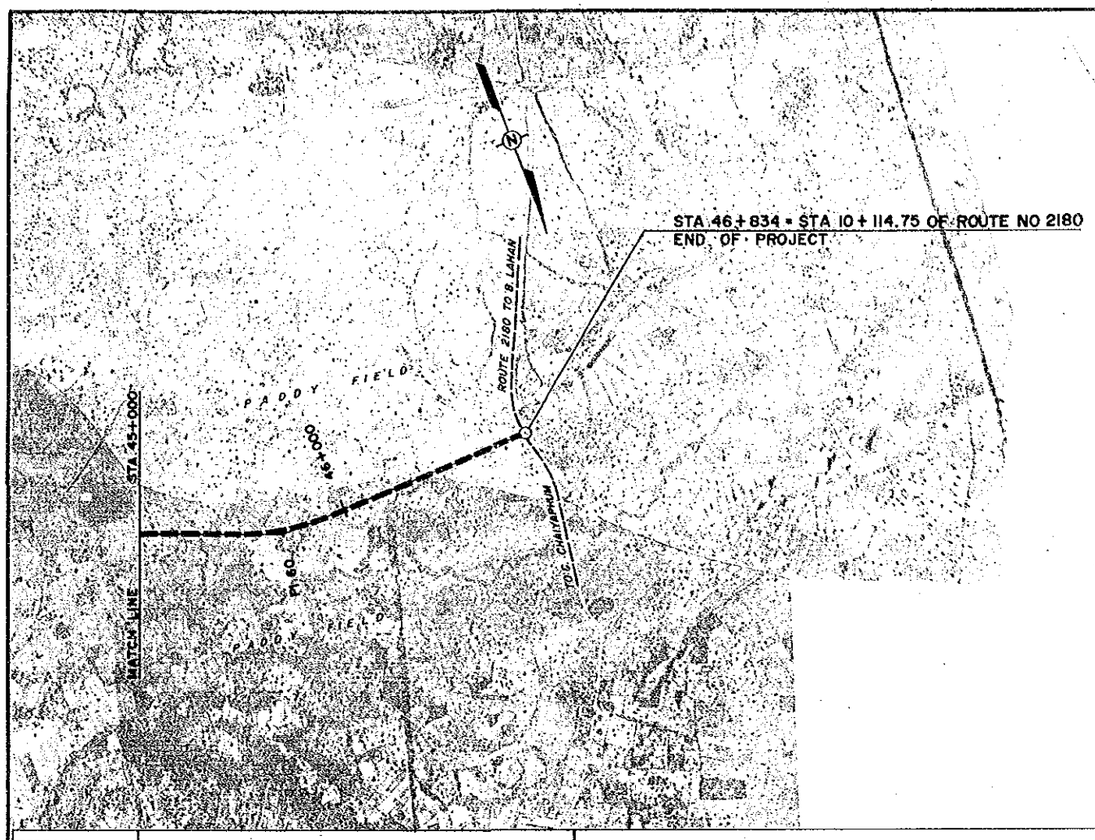
TERRAIN		FLAT
PAVEMENT	Type	LATERITE —
	Condition	FAIR —
FLOODING	Length (m.)	1,200 — 400
	Height (m.)	2.00 — 1.00
RIGHT OF WAY (m.)		—
ROUTE NO. AGENCIES		ARD —



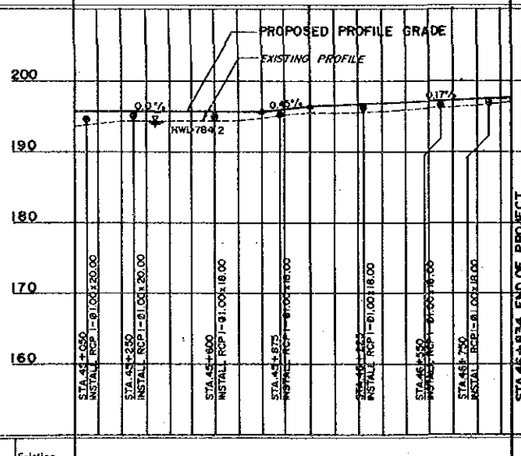
CURVATURE BAND	Existing Alignment	L=51 R=337; L=99 R=284; L=199 R=284; L=64 R=151; L=118 R=155; L=78 R=637; L=80 R=819; LA=100°; L=294 R=573; L=402 R=573; L=167 R=146
	Proposed Alignment	L=51 R=337; L=130 R=818; L=64 R=151; L=118 R=155; L=78 R=637; L=80 R=819; LA=100°; L=294 R=573; L=402 R=573; L=167 R=146

STATION (Km.) 36+000 37+000 38+000 39+000 40+000 41+000 42+000 43+000 44+000 45+000

STUDY ROUTE IM-1	DWG NO.
From A. KHONG To B. DON PLAO	I - 6
PLAN AND PROFILE	
STA 45+000 TO STA. 46+834	



TERRAIN		FLAT
PAVEMENT	Type	—
	Condition	—
FLOODING	Length (m.) / Height (m.)	
RIGHT OF WAY (m.)		—
ROUTE NO. AGENCIES		—



CURVATURE BAND	Existing Alignment	
	Proposed Alignment	L = 236, R = 573
STATION (Km.)		45+000 46+000

STUDY ROUTE NO. IM - 4

Changwat : Khon Kaen

A. Chonnabot (J.R. 2057) – B. Don Han

Length : 24.0 KM.

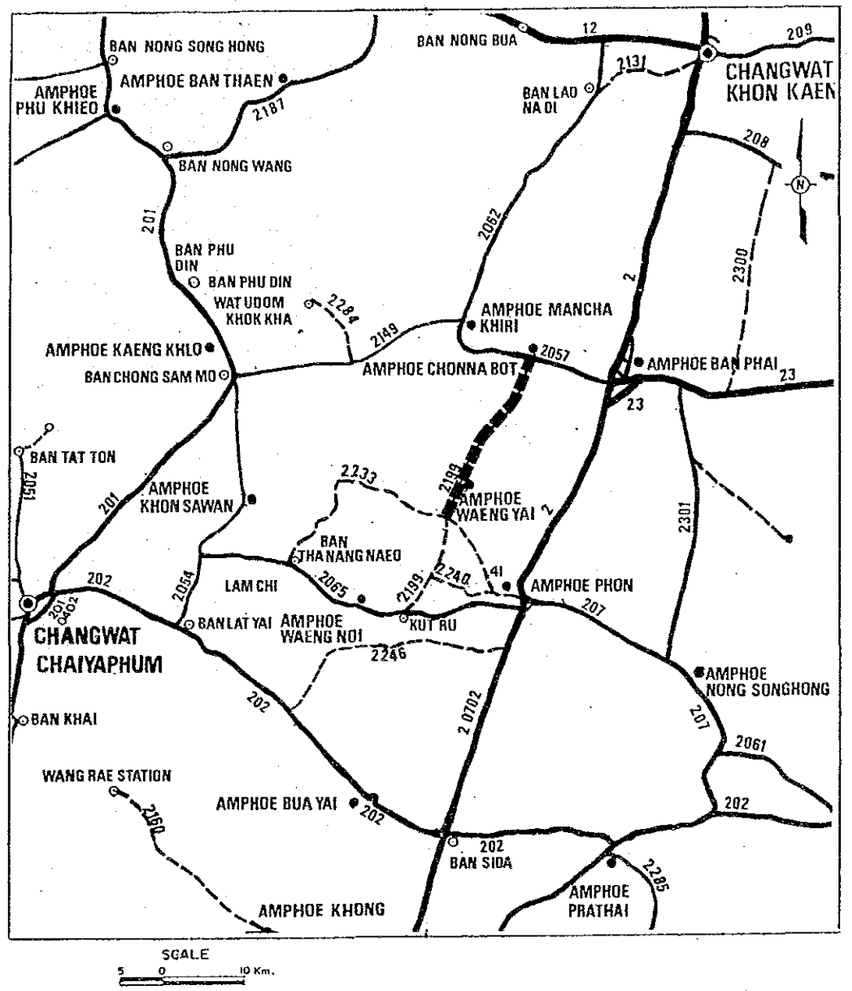
TABLE OF CONTENTS

SUMMARY

STUDY ROUTE IM-4

General		
Changwat	:	Khon Kaen
Origin and Destination	:	A. Chonnabot—B. Dom Han
Connected Road Network	:	2057—2233
Amphoe on Route	:	A. Waeng Yai
Number of Related Villages	:	4
Influence Area		
Area	:	235 km^2
Cultivated Area Ratio to Total Land Area in %	:	94
Population in 1983	:	27,100
Main Crops	:	Paddy & Maize
Number of Public Activities		
Public Health Service Centers	:	1
Hospitals Changwat Level	:	-
Amphoe Level	:	1
Schools Primary	:	18
Secondary	:	1
Traffic (ADT)	:	1984—288 1988—478 1994—629 2002—904
Nomenclature of Study Route		
Total Length	:	24.0 km
Improvement Section	:	24.0 km
DOH Road	:	24.0 km
ARD Road	:	-
Other Road	:	-
New Construction Section	:	-
Design Standard Employed	:	F4
Construction Costs in Baht		
Financial	:	36,433,000
Economic	:	30,463,000
Economic Indicators		
IRR	:	22.2% Ranking: 1
Social Impact		
Social B/C Ratio	:	0.413 Ranking: 1
Recommendations		
Opening Year	:	1988 Overall Ranking: 1

LOCATION OF STUDY ROUTE

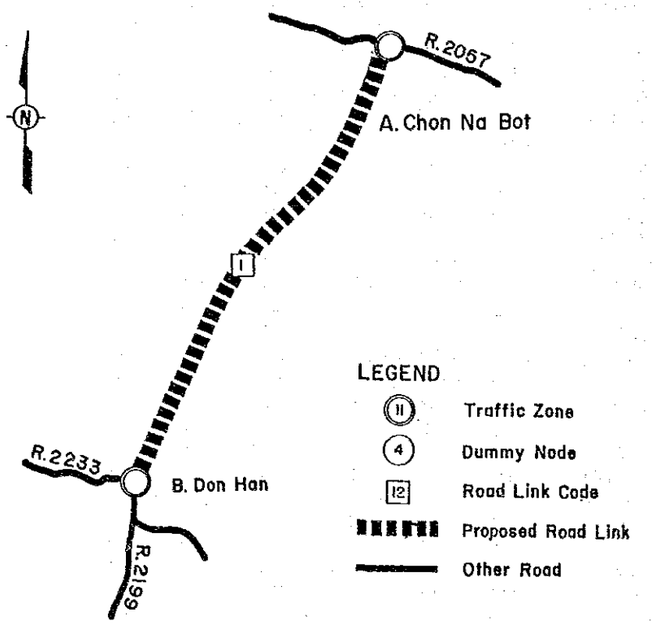


4.1 TRAFFIC

4.1.1 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.

4.1.2 Assumed Road Link



4.1.3 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	5	0	35	6	46	11	10	1	114	245	359
2	20	8	151	0	137	15	16	3	350	418	768
AVE.	12	4	87	3	87	13	13	2	219	322	542

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	1189	38.0	5.7	43.7
2	3974	70.3	10.5	80.8

GROWTH RATE OF PASSENGER MOVEMENT

(UNIT : % P.A.)

YEAR	PER CAPITA INCOME	POPULATION	PASSENGER MOVEMENT
1984 - 1988	3.1	1.3	5.7
1988 - 1994	3.1	1.1	5.6
1994 - 2002	3.1	1.0	5.4

GROWTH RATE OF FREIGHT MOVEMENT

(UNIT : % P.A.)

YEAR	NON-AGRI. FREIGHT	AGRI. FREIGHT	FREIGHT MOVEMENT
1984 - 1988	7.1	0.5	6.3
1988 - 1994	6.9	0.6	6.3
1994 - 2002	6.7	0.6	6.3

RATE OF INDUCED AND DEVELOPED MOVEMENT

(UNIT : %)

YEAR	INDUCED	DEVELOPED		
	LINK 1	PASSENGER MOVEMENT	NON-AGRI. FREIGHT MOVEMENT	AGRI. FREIGHT MOVEMENT
1988	15.0	0.0	0.0	1.0
1994	15.0	0.0	0.0	11.5
2002	15.0	0.0	0.0	16.6

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
	1984	1.6	70.6	1.0	26.8	0.0	36.2	10.1	31.9	21.7
1	1988	9.9	63.4	1.4	23.7	1.6	31.1	10.3	35.9	22.7
	1994	22.4	52.5	2.1	19.1	3.9	23.3	10.6	41.9	24.1
	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	38	5	91	6	272	10	34	21	477	394	872
1994	114	11	97	20	294	13	51	29	628	434	1062
2002	285	22	95	51	300	19	85	44	901	487	1387

TRAFFIC VOLUME ON ROUTE IM- 4 LINK COUNT= 1

YEAR		1988		1994		2002	
LINK		1	AVR.	1	AVR.	1	AVR.
P/C	N+D	33	33	99	99	248	248
	I	5	5	15	15	37	37
	DV	0	0	0	0	0	0
	TOTAL	38	38	114	114	285	285
L/B	N+D	5	5	9	9	19	19
	I	1	1	1	1	3	3
	DV	0	0	0	0	0	0
	TOTAL	5	5	11	11	22	22
M/B	N+D	79	79	84	84	83	83
	I	12	12	13	13	12	12
	DV	0	0	0	0	0	0
	TOTAL	91	91	97	97	95	95
H/B	N+D	5	5	17	17	45	45
	I	1	1	3	3	7	7
	DV	0	0	0	0	0	0
	TOTAL	6	6	20	20	51	51
P/P&T	N+D	237	237	256	256	261	261
	I	36	36	38	38	39	39
	DV	0	0	0	0	0	0
	TOTAL	273	273	295	295	301	301
4/T	N+D	8	8	11	11	16	16
	I	1	1	2	2	2	2
	DV	0	0	0	0	0	0
	TOTAL	10	10	13	13	19	19
6/T	N+D	29	29	44	44	75	75
	I	4	4	7	7	11	11
	DV	0	0	0	0	1	1
	TOTAL	34	34	51	51	86	86
10/T	N+D	19	19	25	25	39	39
	I	3	3	4	4	6	6
	DV	0	0	0	0	0	0
	TOTAL	21	21	29	29	45	45
ADT	N+D	416	416	546	546	785	785
	I	62	62	82	82	118	118
	DV	0	0	1	1	1	1
	TOTAL	478	478	629	629	904	904
M/C	N+D	374	374	414	414	467	467
	I	20	20	20	20	20	20
	DV	0	0	0	0	0	0
	TOTAL	395	395	434	434	487	487
TOTAL	N+D	790	790	960	960	1252	1252
	I	83	83	102	102	138	138
	DV	0	0	1	1	1	1
	TOTAL	873	873	1064	1064	1392	1392

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

4.2 AGRICULTURAL DEVELOPMENT

4.2.1 Present Condition

Almost all the cultivated land in the influence area is covered by paddy fields. Although there are very few upland fields, maize and cassava were the major upland crops planted in the 1983 crop year.

Land use and capability conditions in the area are shown in Table 4.2.1 and Figure 4.2.1. A typical cropping calendar in the area is shown in Figure 4.2.2.

4.2.2 Development Projection

Future agricultural development in the area of influence was projected for the two cases of "with and without project". The projected planted area, unit yields by crop, and the consequent production amount are shown in Table 4.2.2.

Based on the above projected production amount, farmgate prices and production costs estimated separately, net production value (NPV) was obtained as shown in Table 4.2.3. The difference in NPV between the two cases is deemed to be the development benefit of the study route.

FIGURE 4.2.1 LAND USE AND CAPABILITY OF INFLUENCE AREA STUDY ROUTE NO. IM-4

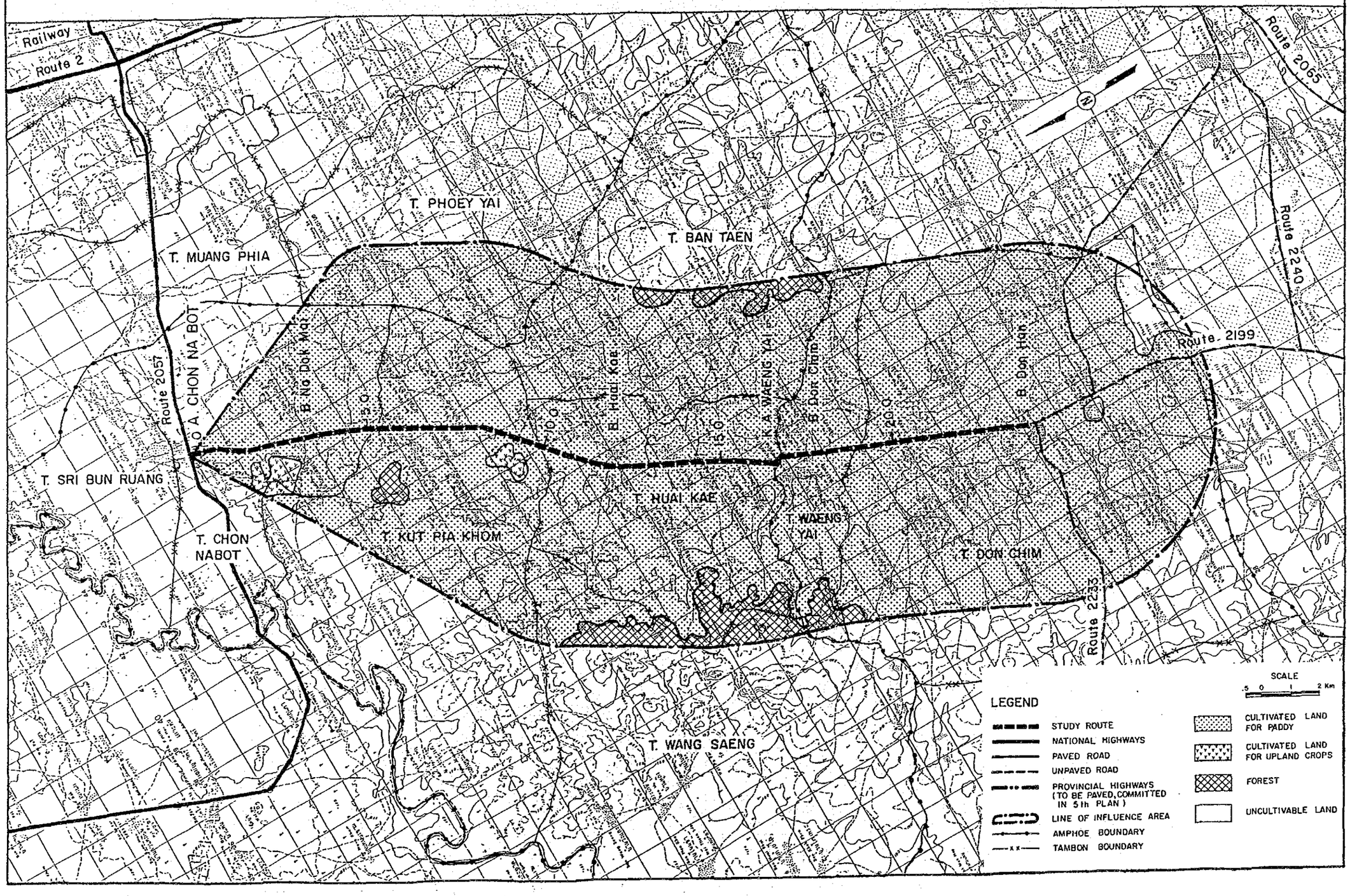
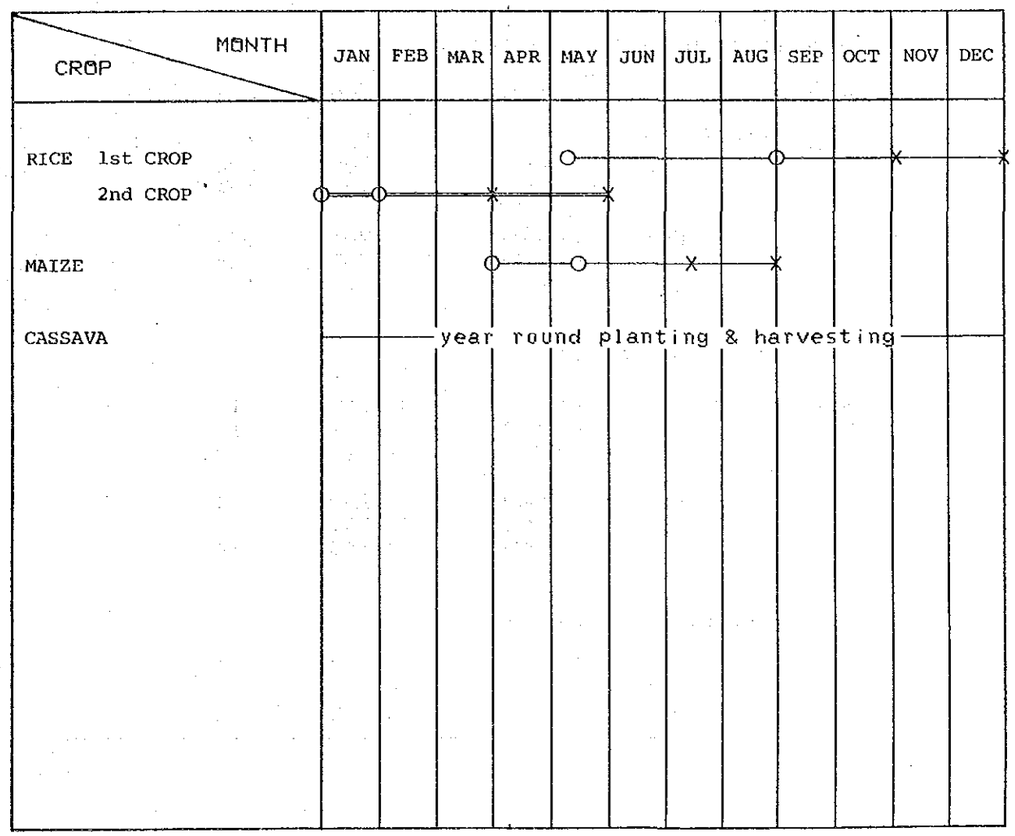


FIGURE 4.2.2 CROPPING CALENDAR

ROUTE IM-4

Related Amphoes: 0613 Ban Phai
0614 Chonnabot
0615 K.A.Waeng Yai



Note:

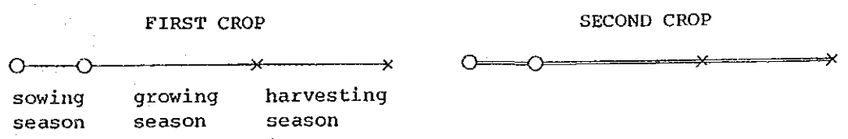


TABLE 4.2.3 NET PRODUCTION VALUE

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)	3,705	2,112	-	-	-	824	-	-	-	-		
WITH PROJECT	(1988 - 2002)	3,717	2,124	-	-	-	832	-	-	-	-		
CROP PRODUCTION COST	(BAHT/RAI)												
BASE YEAR	(1983)	700	624	-	-	-	775	-	-	-	-		
WITHOUT PROJECT	(1988)	700	624	-	-	-	777	-	-	-	-		
	(1994)	700	624	-	-	-	778	-	-	-	-		
	(2002)	700	624	-	-	-	781	-	-	-	-		
WITH PROJECT	(1988)	701	624	-	-	-	777	-	-	-	-		
	(1994)	707	624	-	-	-	783	-	-	-	-		
	(2002)	715	624	-	-	-	791	-	-	-	-		
NET PRODUCTION VALUE	(1000 BAHT)												
WITHOUT PROJECT	(1988)	31,113	12	-	-	-	262	-	-	-	-	274	31,387
	(1994)	31,113	12	-	-	-	266	-	-	-	-	278	31,391
	(2002)	31,113	12	-	-	-	268	-	-	-	-	280	31,393
WITH PROJECT	(1988)	31,760	14	-	-	-	269	-	-	-	-	283	32,043
	(1994)	35,283	14	-	-	-	277	-	-	-	-	291	35,574
	(2002)	37,145	14	-	-	-	288	-	-	-	-	302	37,447
NET VALUE ADDED	(1000 BAHT)												
1988		647	2	-	-	-	7	-	-	-	-	9	656
1994		4,170	2	-	-	-	11	-	-	-	-	13	4,183
2002		6,032	2	-	-	-	20	-	-	-	-	22	6,054

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE

4.3 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 4.3.1. Data for additional VOCs are shown in Table 4.3.2.

VOC savings, obtained as the balance of total link VOCs between the two cases, were calculated as shown in Table 4.3.3.

TABLE 4.3.1 ROAD LENGTH BY ROAD CLASS

(UNIT : KM)

LINK NO.	WITHOUT PROJECT CASE						WITH PROJECT CASE
	PAVED	LATERITE			EARTH	TOTAL	PAVED
		GOOD	FAIR	POOR			
1	-	14.3	7.2	2.5	-	24.0	24.0

TABLE 4.3.2 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	-	-	330	75	220	100	111	1093	1410	7500	1350	-	-	-	5	1900	5	1	-	-
	WITH	-	-	-	160	171	-	111	897	1606	4600	1600	200	100	-	5	1900	-	-	-	-

TABLE 4.3.3 VEHICLE OPERATING COST SAVING

(UNIT : 1000 BAHT)

LINK NO.	1988			1994			2002		
	WITHOUT	WITH	SAVING	WITHOUT	WITH	SAVING	WITHOUT	WITH	SAVING
1	18,651	13,201	5,449	24,762	17,288	7,474	36,296	24,886	11,410
TOTAL	18,651	13,201	5,449	24,762	17,288	7,474	36,296	24,886	11,410

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

TABLE 4.2.1 CULTIVATED LAND

[UNIT : 1000 RAI (KM2)]

CHANGWAT NAME	AMPHOE NAME	CULTIVATED LAND PADDY FIELD	UPLAND FIELD	TOTAL
KHON HAEN	BAN PHAI	6.94 (11.10)	0.00 (0.00)	6.94 (11.10)
	CHONNABOT	71.76 (114.82)	0.84 (1.34)	72.60 (116.16)
	WAENG YAI	59.00 (94.40)	0.00 (0.00)	59.00 (94.40)
TOTAL		137.70 (220.32)	0.84 (1.34)	138.54 (221.66)

TABLE 4.2.2 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)	85.37	0.39	-	-	-	0.39	-	-	-	-	0.78	86.15
WITHOUT PROJECT	(1988)	85.37	0.39	-	-	-	0.39	-	-	-	-	0.78	86.15
	(1994)	85.37	0.39	-	-	-	0.39	-	-	-	-	0.78	86.15
	(2002)	85.37	0.39	-	-	-	0.39	-	-	-	-	0.78	86.15
WITH PROJECT	(1988)	86.12	0.39	-	-	-	0.39	-	-	-	-	0.78	86.90
	(1994)	94.30	0.39	-	-	-	0.39	-	-	-	-	0.78	95.08
	(2002)	97.36	0.39	-	-	-	0.39	-	-	-	-	0.78	98.14
CROP YIELD	(KG/RAI)												
BASE YEAR	(1983)	287.3	310.0	-	-	-	1750.0	-	-	-	-		
WITHOUT PROJECT	(1988)	287.3	310.0	-	-	-	1758.8	-	-	-	-		
	(1994)	287.3	310.0	-	-	-	1769.3	-	-	-	-		
	(2002)	287.3	310.0	-	-	-	1783.5	-	-	-	-		
WITH PROJECT	(1988)	287.8	310.0	-	-	-	1762.3	-	-	-	-		
	(1994)	290.9	310.0	-	-	-	1794.2	-	-	-	-		
	(2002)	295.0	310.0	-	-	-	1837.8	-	-	-	-		
CROP PRODUCTION AMOUNT	(TON)												
BASE YEAR	(1983)	24,527	121	-	-	-	683	-	-	-	-	803	25,330
WITHOUT PROJECT	(1988)	24,527	121	-	-	-	686	-	-	-	-	807	25,334
	(1994)	24,527	121	-	-	-	690	-	-	-	-	811	25,338
	(2002)	24,527	121	-	-	-	696	-	-	-	-	816	25,343
WITH PROJECT	(1988)	24,786	121	-	-	-	687	-	-	-	-	808	25,594
	(1994)	27,429	121	-	-	-	700	-	-	-	-	821	28,249
	(2002)	28,721	121	-	-	-	717	-	-	-	-	838	29,559

NOTE : SYMBOL "-" MEANS ZERO OR NEGLIGIBLE

4.4 ENGINEERING

4.4.1 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 4.4.1 and Table 4.4.1, respectively.

Rock aggregate sources were assumed as shown below:

No.	Source	Description of Sample	Est. Quantity m^3
4/CS-1	KM. 90+800 Lt 1,500 M. Chum Pae Rung Rueng Quarry	Limestone	Plentiful
4/CS-2	KM. 105+600 Lt 6,000 M. Sila Sri Buri Quarry	Limestone	Plentiful
4/CS-3	KM. 109+300 Lt 6,000 M. Sila Esarn Quarry	Limestone	Plentiful

FIGURE 4.4.1 SOIL AND MATERIAL SOURCES

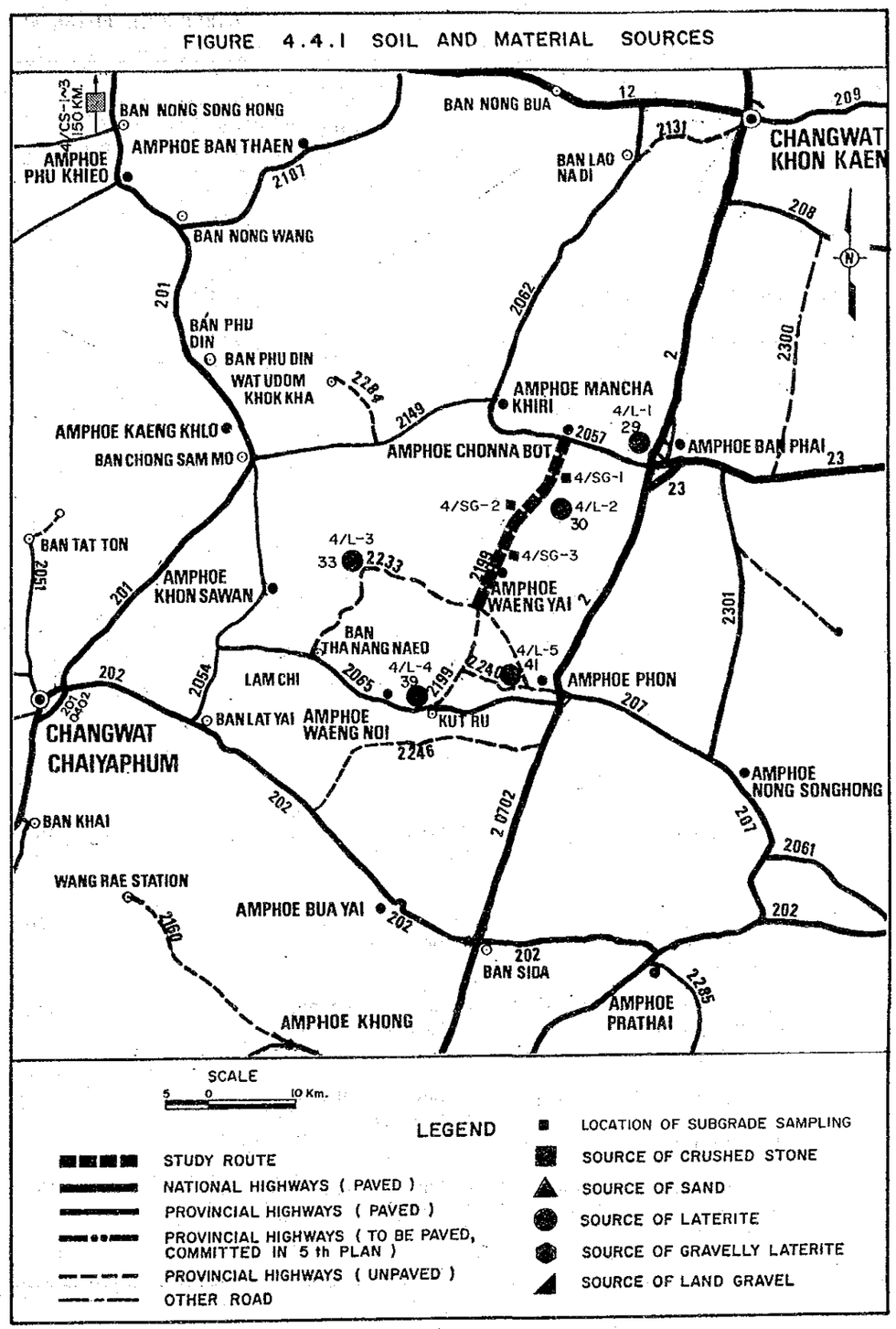


TABLE 4.1.1 PHYSICAL CHARACTERISTICS OF MATERIALS

No.	Source	Description of Sample	Est. Quantity m^3	AASHTO Classification	Sieve Analysis % Passing 50.0	25.0	19.0	9.5	#4	#10	#40	#200	Plasticity LL	PI	Comp. DH-T Stand. Opt. 95%	gm/cc	Lab. CBR 95%	C.B.R. Swell %	Durability Abr.	Dur.
SUBGRADE																				
4/SG-1.	KM. 5+000 Lt 12 M.			A-4						100.0	93.0	90.0	N-P		13.0	1.799	13.0	-		
4/SG-2.	KM. 10+00 Rt 10 M.			A-4					100.0	99.2	98.0	73.8	N-P		11.5	1.829	15.0	0.40		
4/SG-3.	KM. 15+000 Lt 13 M.			A-4						100.0	98.4	76.6	N-P		11.6	1.857	15.5	0.18		
LATERITE																				
4/L-1	KM. 3+000 Rt 3,000 M. Ban Pai - Chonnabot	Yellow laterite	3,000	-	100	-	76.4	-	29.9	21.8	18.1	37.5	10.8	7.3	2.184	42.6	0.20			
4/L-2	KM. 9+000 Lt 6.0 KM. Chonnabot - Kood Ru	Brown laterite	70,000	-	100	-	75.3	-	38.3	26.5	14.2	31.2	7.9	8.0	2.206	21.6	0.54			
4/L-3	KM. 21+650 Rt 100 M. A. Pol - Ban Han - Ta Nang Naew	Brown laterite	50,000		100		82.1		45.6	42.1	20.7	N.P.		7.9	2.138	24.6	0.38			
4/L-4	KM. 20+000 Rt 5,000 M. Nong Kam - Ta Nang Naew	Brown laterite	10,000		100		82.8		35.4	22.6	8.8	N.P.		8.5	2.144	58.2	0.54			
4/L-5	KM. 5+000 Rt 1,000 M. A. Pol - Khok Klang	Brown laterite	20,000		100		94.0		43.5	31.3	19.1	27.6	6.3	8.2	2.146	26.3	0.60			

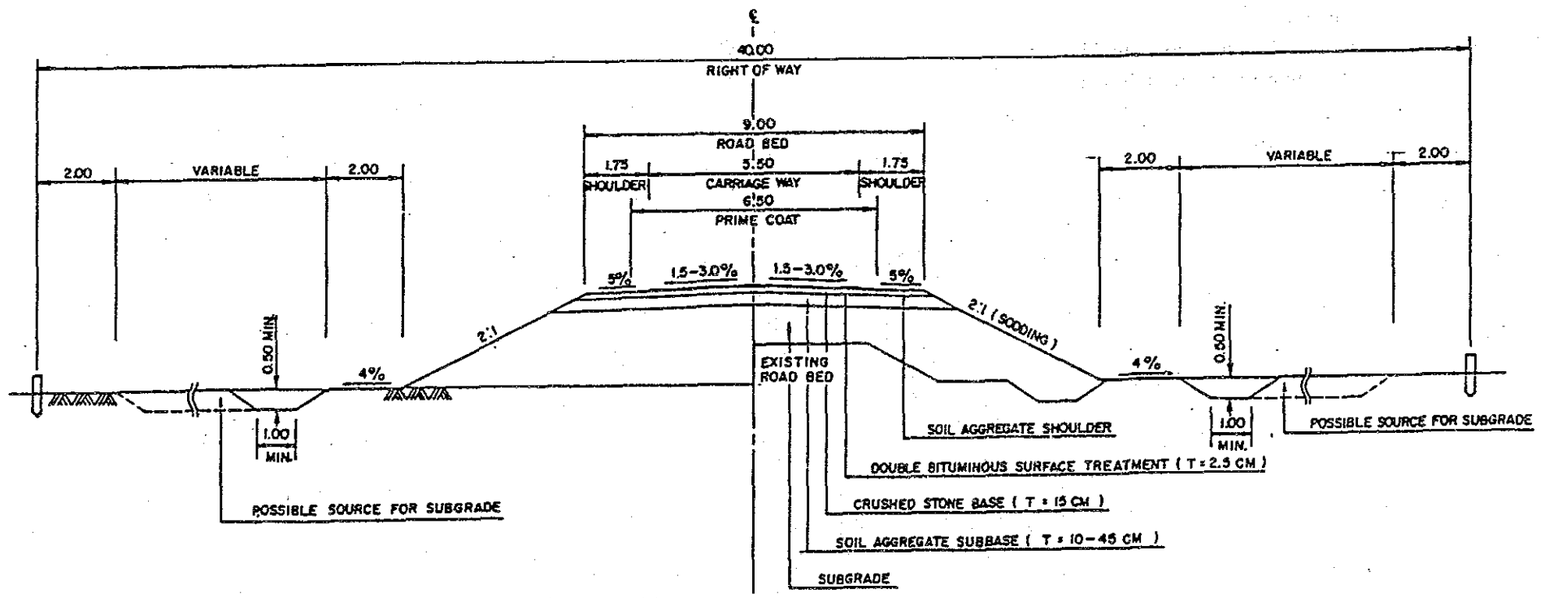
4.4.2 Preliminary Design

4.4.2.1 Design Criteria

Design Standard		: F4
Geometric Design Criteria		: DOH (Provincial Highway)
Typical Cross Section		: as shown in figure 4.4.2
Minimum Height of Embankment in Flooding Section		: 0.7 m above flood level
Pavement Structure		
DBST		: 2.5 cm
Crushed Aggregate Base	CBR ≥ 80%	: 15.0 cm
Soil Aggregate Subbase	CBR ≥ 25%	: 10.0 cm (minimun 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 4-1/4-3.

FIGURE 4.4.2 TYPICAL CROSS SECTION



PROVINCIAL HIGHWAY (CLASS F4)

4.4.2.3 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	6	—	—	—	20	—	—	—
Medium truck	34	—	—	—	51	—	—	—
Heavy truck	21	—	—	—	29	—	—	—

- Cumulative number of ESA in one direction by road link

Road link	1	2	3	4
7 years (10^6)	0.089	-	-	-

2) Design CBR values

Road link	1	2	3	4
Design CBR (%)	13.7	-	–	-

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	-	-	-

4) Overlay required in 7 years

DBST resurfacing

4.4.2.4 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
16 + 336	Timber Bridge	4.0 x 10.2	Box Culvert	3-2.7 x 2.7 x 13.5

4.4.3 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 4.4.2. Financial costs with breakdown into local and foreign currency portions, economic costs and residual values were estimated as follows and in 4.4.4:

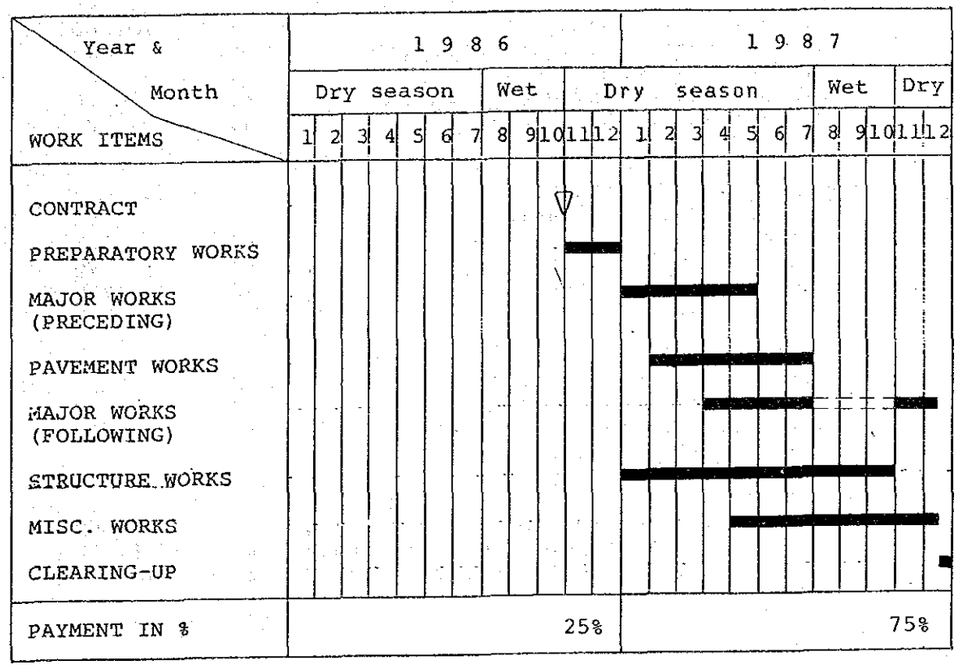
IM—4	L=24.0 km		(baht)
	Financial cost	:	36,433,000
	Economic cost	:	30,463,000
	Residual value	:	11,093,000

The required road maintenance cost savings are shown in Table 4.4.3.

4.4.4 Construction and Disbursement Schedules

IM—4 **Length = 24.0 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 - 4)

(Unit : Million Baht)

	1986			1987			Total		
	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total
Construction Cost	4.5	4.6	9.1	13.5	13.8	27.3	18.0	18.4	36.4
Price Contingency	0.9	0.6	1.5	4.5	2.9	7.4	5.4	3.5	8.9
Total	5.4	5.2	10.6	18.0	16.7	34.7	23.4	21.9	45.3
	(0.20)	(0.19)	(0.39)	(0.67)	(0.62)	(1.29)	(0.87)	(0.81)	(1.68)

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

TABLE 4.4.2 CONSTRUCTION QUANTITIES AND COSTS
(ROUTE IM—4 Length = 24.0 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	55	550						
Roadway Excavation, Unclassified	m3	19	0	0						
Embankment, Common Soil	m3	38	91,500	3,477						
Embankment, Selected Material	m3	70	0	0						
Replacement of Soft Spot	m3	88	1,300	114						
Sub Total				4,141	2,112	2,029		3,437		3,094
SUBBASE & BASE COURSES							83		50	
Subbase, Soil Aggregate	m3	112	22,600	2,531						
Aggregate Base*	m3	429	23,400	10,039						
Cement Stabilized Base	m3	390	0	0						
Shoulder, Soil Aggregate	m3	120	9,000	1,080						
Sub Total				13,650	7,371	6,279		11,329		5,665
SURFACE COURSES							85		50**	
Asphaltic Prime/Tack Coat	m2	12	156,000	1,872						
Double Bituminous Surface Treatment*	m2	40	132,000	5,280						
Asphaltic Concrete Surfacing**	t	750	0	0						
Sub Total				7,152	3,147	4,005		6,079		0
STRUCTURES							83		50	
RC Pipe Culvert (D 1.0m Equivalent)	m	2,000	1,119	2,238						
RC Box Culvert (2.4mx2.4m Equivalent)	m	18,800	51	959						
RC Bridge(W=9.0m L=10m Equivalent)	m	46,500	0	0						
Sub Total				3,197	1,598	1,598		2,653		1,327
Total (a)				28,140	14,228	13,912		23,499		10,085
INCIDENTALS							83		0	
Miscellaneous Work ((a)x7%)	ls			1,970	985	985		1,635		0
CONTRACT AMOUNT (b)				30,110	15,213	14,897		25,134		10,085
PHYSICAL CONTINGENCIES ((b)x10%) (c)	ls			3,011	1,521	1,490		2,513		1,008
ENGINEERING AND SUPERVISION							85		0	
(((b)+(c))x10%) (d)	ls			3,312	1,325	1,987		2,815		0
LAND ACQUISITION							100		100	
Highly Developed Land	ha	50,000	0	0						
Less Developed Land	ha	15,000	0	0						
Sub Total (e)	ls			0	0	0		0		0
PROJECT COST ((b)+(c)+(d)+(e))				36,433	18,059	18,374		30,463		11,093
AVERAGE COST PER KM				1,518						

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

TABLE 4.4.3 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	386.0	24.0	0.73	1.61	16,994	408	446.2	24.0	0.00	1.14	12,793	307	101
	1994	536.1	24.0	0.95	1.77	18,599	446	585.7	24.0	0.00	1.14	12,793	307	139
	2002	831.3	24.0	0.95	1.77	18,599	446	840.7	24.0	0.00	1.14	12,793	307	139
TOTAL	1988	386.0	24.0			16,994	408	446.2	24.0			12,793	307	101
	1994	536.1	24.0			18,599	446	585.7	24.0			12,793	307	139
	2002	831.3	24.0			18,599	446	840.7	24.0			12,793	307	139

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 $KA = 1.10 + 0.70 * A1$
WITH PROJECT CASE $KB = 1.14 + 0.05 * X3$

(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

4.5 EVALUATION

4.5.1 Economic Evaluation

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

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

COST AND BENEFIT STATEMENT OF ROUTE IM - 4

(1000 BAHT)

YEAR	COST	BENEFITS				DISCOUNTED(12%)	
	CONST. COST	AGRI. BENEFIT	VOC SAVING	RMC SAVING	TOTAL	TOTAL COST	TOTAL BENEFIT
1986	7,616	0	0	0	0	9,554	0
1987	22,847	0	0	0	0	25,589	0
1988	0	656	5,449	101	6,206	0	5,541
1989	0	1,244	5,787	107	7,138	0	5,690
1990	0	1,832	6,124	114	8,069	0	5,744
1991	0	2,420	6,461	120	9,001	0	5,720
1992	0	3,007	6,799	127	9,933	0	5,636
1993	0	3,595	7,136	133	10,864	0	5,504
1994	0	4,183	7,474	139	11,796	0	5,336
1995	8,752	4,417	7,966	139	12,522	3,959	5,057
1996	0	4,651	8,458	139	13,248	0	4,777
1997	0	4,885	8,950	139	13,974	0	4,499
1998	0	5,119	9,442	139	14,700	0	4,226
1999	0	5,352	9,934	139	15,426	0	3,959
2000	0	5,586	10,426	139	16,151	0	3,702
2001	0	5,820	10,918	139	16,877	0	3,453
2002	-11,093	6,054	11,410	139	17,603	-2,027	3,216
TOTAL	28,122	58,820	122,732	1,956	183,508	37,074	72,062
DISCOUNTED	37,074	21,295	49,918	849	72,062		

NET PRESENT VALUE : 34,987

BENEFIT/COST RATIO : 1.94

INTERNAL RATE OF RETURN : 22.2 %

FIRST YEAR RATE OF RETURN : 15.8 %

OPTIMUM OPENING YEAR : 1988

SENSITIVITY TESTS

ITEM	CASE		
	BASE	1	2
NET PRESENT VALUE	34,987	29,426	24,178
BENEFIT/COST RATIO	1.94	1.69	1.65
INTERNAL RATE OF RETURN	22.2 %	19.8 %	19.4 %
FIRST YEAR RATE OF RETURN	15.8 %	13.7 %	13.4 %
COSTS	BASE	+15%	BASE
BENEFITS	BASE	BASE	-15%

4.5.2 *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) : 30.5

1) General Accessibility Benefit (million baht) : 2.09
2) Education Benefit (million baht) : 1.19
3) Medical Care Benefit (million baht) : 0.048
4) Total Social Benefits (million baht) (1+2+3) : 3.33
5) Social Benefit/Cost Ratio ($\times 10^{-2}$) : 10.93
6) Ranking by Social Benefit : 10
7) Weighted Production Value Gain/Cost ($\times 10^{-2}$) : 30.33
8) Ranking by 7 : 1
9) Combined Ratio ($\times 10^{-2}$) : 41.26

Overall Ranking : 1

4.5.3 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 constructed with the opening year 1988.