

TABLE B-7 SOIL UNITS OF CHON BURI

Landform		Symbol	Soil Series	Subgroup	Family
Marine Deposits	Tidal Flat	Tc-Bpg	Tha Chin-Bang Pakong Complex	Typic Hydraquent and Typic Sulfaquent	fine clayey mixed and mont non acid
	Former Tidal Flat	Sm	Samut. Prakarn series	Typic Tropaquent	fine clayey, mixed non acid
		Bk	Bangkok series	Typic Tropaquent	very fine clayey, mont non acid
		Ptg	Phan Thong series	Typic Tropaquent	fine silty, mixed non acid
		Ca	Cha-am series	Sulfic Tropaquent	very fine clayey, mixed acid
Brackish Water Deposits		Ma	Mahaphot series	Sulfic Tropaquent	very fine clayey, mixed acid
		Rs	Rangsit series	Sulfic Tropaquent	very fine clayey, mixed acid
		Ok	Ongkharak series	Sulfic Tropaquent	very fine clayey, mixed acid
		Dm	Don Muang series	Sulfic Tropaquent	very fine clayey, mixed acid
Riverine Alluvial Deposits	Low Terrace	Cb	Chon Buri series	Typic Tropaqualf	fine loamy, mixed
		Kl	Klaeng series	Typic Plinthaquult	clayey, kaolinitic
		Lgu	Langu series	Typic Tropaqualf	fine clayey, kaolinitic
	Higher Terrace	Pp	Phon Phisai series	Typic Plinthustult	clayey, skeletal, mixed
		Dr	Don Rai series	Oxic Paleustult	fine loamy, mixed
		Kt	Khorat series	Oxic Paleustult	fine loamy, silicious
		Suk	Sattuk series	Oxic Paleustult	fine loamy, silicious
		Suk/ Bbg Mr	Satuk/ Ban Bung association Mae Rim series	Oxic Paleustult	loamy skeletal, mixed

TABLE B-8 SOIL UNITS OF CHON BURI (Con't)

Landform	Symbol	Soil Series	Subgroup	Family	
Residium and Colluvium	Granitic rock	Bbg	Ban Bung series	Vadic(Aquic) Quartzipsamment	coars loamy, silicious fine loamy, mixed clayey, kaolinitic clayey, skeletal, mixed clayey skeletal, mixed fine clayey, mixed clayey skeletal, kaolinitic
		Hg	Hup Kapong series	Ustoxic Dystropept	
		Sh	Sattahip series	Typic Quartzipsamment	
		Nb	Map Bon series	Oxic Paleustult	
		Nm	Nong Not series	Oxic Paleustult	
	Clastic rock	Kb	Kabin Buri series	Typic Paleustult	
		Ch	Chiang Khan series	Oxic Paleustult	
		Ws	Wang Saphung series	Ultic Haplustalt	
		Ty/Ly	Tha Yang/ Lat Ya association	Oxic/Typic Haplustult	
		SC	Slope Complex		

TABLE B-9 SOIL UNITS OF CHACHOENSAO

Landform		Symbol	Soil Series	Subgroup	Family
Marine Deposits	Tidal Flat	Bpg	Bang Pakong series	Typic Sulfaquent	fine clayey mont. non acid
		Tc-Bpg	Thachin-Bang Pakong Complex	Typic Hydraquent Typic Sulfaquent	fine clayey mixed, and mont non acid
	Former Tidal Flat	Sm	Samut Prakarn series	Typic Tropaquept	fine clayey mixed, non acid
		Bk	Bangkok series	Typic Tropaquept	very fine clayey, mont non acid
		Ptg	Phan Thong series	Typic Tropaquept	fine silty, mixed, non acid
		Ca	Cha-am series	Sulfic Tropaquept	very fine clayey, mixed, acid
		Bp	Bang Nam Prieo series	Typic Tropaquept	very fine clayey, mixed, acid
		Cc	Chachoengsao series	Typic Tropaquept	very fine clayey, mont. non acid
Brackish Water Deposits	Na	Mahaphot series	Sulfic Tropaquept	very fine clayey, mixed, acid	
	Rs	Rangsit series	Sulfic Tropaquept	very fine clayey, mixed, acid	
	Ok	Ongkharak series	Sulfic Tropaquept	very fine clayey, mixed, acid	
	Dm	Don Muang series	Sulfic Tropaquept	very fine clayey, mixed, acid	
	NBC	Undifferentiated ridged acid soil	Sulfic Tropaquept	very fine clayey, mixed, acid	

TABLE B-10 SOIL UNITS OF CHACHOENGSAO (Con't)

Landform	Symbol	Soil Series	Subgroup	Family	
Riverine Alluvial Deposits	Low Terrace	Ac-pd	Alluvial Complex-poorly drained		
		Ac-wd	Alluvial Complex-well drained		
		Cb	Chon Buri series	Typic Tropaqualf	fine loamy, mixed
		Kl	Klaeng series	Typic Plinthaquult	clayey, kaolinitic
		Hk	Hinkong series	Aeric Paleaquult	fine silty, mixed
		Pn	Phen series	Typic Plinthaquult	clayey, skeletal, kaolinitic
	Higher Terrace	Kkn	Ko Khanun series	Aeric Plinthaquult	fine loamy, mixed
		Pp	Phon Phisai series	Typic Plinthustult	clayey, skeletal, mixed
		Bka	Bang Khla series	Typic Paleustult	loamy skeletal, mixed
		Dr	Don Rai series	Oxic Paleustult	fine loamy, mixed
		Kt	Khorat series	Oxic Paleustult	fine loamy, silicious
		Suk	Satuk series	Oxic Paleustult	fine loamy, silicious
		Wn	Warin series	Oxic Paleustult	fine loamy, silicious
		Suk/Wn	Satuk/Warin association	Oxic Paleustult	fine loamy, silicious
		Pg	Pang Rai series	Typic Paleustult	clayey, skeletal, kaolinitic
		Nkk	Nong Khok series	Oxic Paleustult	coarse loamy, silicious
		Residuum and Colluvium	Granite rock	Bbg	Ban Bung series
Hg	Hup Kapong series			Ustoxic Dystropept	coarse loamy, silicious
Sh	Sattahip series			Typic Quartzipsamment	
Clastic rock	Mb		Map Bon series	Oxic Paleustult	fine loamy, mixed
	Kb		Kabin Buri series	Typic Paleustult	clayey skeletal, mixed
	Ty/Ly		Tha Yang/Lat Ya association	Oxic/Typic Haplustult	clayey skeletal, kaolinitic
	SC	Slope Complex			

TABLE B-11 SOIL UNITS OF PRACHIN BURI

Landform	Symbol	Soil Series	Subgroup	Family	
Former Tidal Flat	Cc	Chachoengsao series	Typic Tropaquept	very fine clayey, mont, non acid	
Brackish Water Deposits	Ma	Mahaphot series	Sulfic Tropaquept	very fine clayey, mixed, acid	
	Rs	Rangsit series	Sulfic Tropaquept	very fine clayey, mixed, acid	
	Rs-a	Rangsit-very acid	Sulfic Tropaquept	very fine clayey, mixed, acid	
Riverine Alluvial Deposits	Low Terrace	AC-pd	Alluvial Complex-poorly drained		
		AC-wd	Alluvial Complex-well drained		
		Cm	Chiang Mai series	Typic Ustifluent	loamy, mixed, non acid
		Pr	Pran Buri series	Ultic Haplustalf	fine loamy mixed
		Rb	Ratchaburi series	Aeric Tropaquept	fine clayey, non acid
		Bin	Bang Pa-in series	Aeric Tropaquept	fine clayey, mixed non acid
		Cb	Chon Buri series	Typic Tropaqualf	fine loamy, mixed
		Kl	Klaeng series	Typic Plinthaquult	clayey kaolinitic
		Hk	Hin Kong series	Aeric Paleaquult	fine silty, mixed
		Re	Roi Et series	Aeric Paleaquult	fine loamy, mixed
		Mak	Makham series	Typic Tropaquept	coarse loamy, silicious non acid
Pn	Phon series	Typic Plinthaquult	clayey skeletal kaolinitic		

TABLE B-12 SOIL UNITS OF PRACHIN BURI (Con't)

Landform	Symbol	Soil Series	Subgroup	Family	
Riverine Alluvial Deposits	Higher Terrace	Pp	Phon Phisai series	Typic Plinthustult	clayey skeletal, mixed
		Bka	Bang Khla series	Typic Paleustult	loamy skeletal, mixed
		Dr	Don Rai series	Oxic Paleustult	fine loamy, mixed
		Kt	Khorat series	Oxic Paleustult	fine loamy, silicious
		Rn	Renu series	Aeric Plinthic Palaquult	fine loamy, mixed
		Suk	Satuk series	Oxic Paleustult	fine loamy, silicious
		Kt/Suk	Khorat/Satuk association		
		Wn	Warin series	Oxic Paleustult	fine loamy, silicious
		Yt	Yasothon series	Oxic Paleustult	fine loamy, silicious
		Ng	Nam Phong series	Ustoxic Quartzipsamment	
Residuum/Colluvium	Limestone	Lb	Lop Buri series	Typic Pellustert	very fine clayey, mont.
		Bng	Bung Chanang series	Fluventic Ustropept	fine clayey, mixed
	Classic rock	Tk	Takhli series	Typic Calcicustoll	very fine clayey, mont.
		Tpk	Thap Phrik series		
		Kb	Kabin Buri series	Typic Paleustult	clayey skeletal, mixed
		Oc	O Lum Chaik series	Typic Tropudalf	fine clayey, kaolinitic
		Hb	Huai Yot series	Typic Troprothent	loamy skeletal, mixed
		Tw	Thap Kwang series	Vertic Haplustalf	
		Ml	Muak Lek series	Lithic Haplustalf	loamy skeletal, mixed
		Ty/Ly	Tha Yang/Lat Ya association	Oxic/Typic Haplustulf	
	SC	Stope Complex			

TABLE B-13 SOIL UNITS OF NAKHON NAYOK

Landform	Symbol	Soil Series	Subgroup	Family	
Brackish Water Deposits	Ma	Mahaphot series	Sulfic Tropaquept	very fine clayey, mixed, acid	
	Rs	Rangsit series	Sulfic Tropaquept	very fine clayey, mixed, acid	
	Rs-a	Rangsit-very acid	Sulfic Tropaquept	very fine clayey, mixed, acid	
	Ok	Ongkharak series	Sulfic Tropaquept	very fine clayey, mixed, acid	
Riverine Alluvial Deposit	Low Terrace	Ac-wd	Alluvial Complex-well drained		
		Cm	Chiang Mai series	Typic Ustifluvent	loamy, mixed, non acid
		Rb	Ratchaburi series	Aeric Tropaquept	fine clayey, mixed, non acid
		Bin	Bang Pa-in series	Aeric Tropaquept	fine clayey, mixed, non acid
		Cb	Chon Buri series	Typic Tropaquept	fine loamy, mixed
	Higher Terrace	Kl	Klaeng series	Typic Plinthaquult	clayey, Kaolinitic
		Hk	Hin Kong series	Aeric Paleaquult	fine silty, mixed
		Dr	Don Rai series	Oxic Paleustult	fine loamy, mixed
		Kt	Khorat series	Oxic Paleustult	fine loamy, silicious
		Kb	Kabin Buri series	Typic Paleustult	clayey skeletal, mixed
Clastic rock	SC	Slope Complex			

TABLE B-14 AREA COVERAGE OF SOIL UNITS OF CHON BURI PROVINCE

SOIL UNIT	A. Muang (ha)	A. Phanat Nikhom (ha)	A. Ban Bung (ha)	A. Phan Thong (ha)	King A. Bo Thong (ha)	A. Nong Ya (ha)	TOTAL (ha)
Tc-Bpg Tha Chin-Bang Pakong Complex	2,438	-	-	1,125	-	-	3,563
Sm Samut Prakarn series	-	-	-	563	-	-	563
Bk Bangkok series	-	375	-	1,000	-	-	1,375
Ptg Phan Thong series	688	2,000	-	3,813	-	-	6,501
Ca Cha-am series	-	-	-	250	-	-	250
Ma Mahaphot series	-	4,000	-	-	-	-	4,000
Rs Rangsit series	-	2,688	-	2,313	-	-	5,001
Ok Ongkharak series	562	938	-	375	-	-	1,875
Da Don Muang series	62	3,313	-	1,563	-	-	4,938
Cb Chon Buri series	437	14,079	1,500	625	2,625	-	19,266
Kl Klaeng series	-	5,063	-	1,438	-	-	6,501
Lgu Langu series	-	-	-	-	500	-	500
Pp Phon Phisai series	-	63	1,563	-	2,063	1,000	4,689
Dr Don Rai series	-	1,313	-	-	-	-	1,313
Kt Khorat series	-	938	-	-	-	-	938
Suk Satuk series	-	15,750	4,750	-	15,060	1,750	37,310
Suk/Bbg Satuk/Ban Bung association	-	3,500	-	-	-	-	3,500
Hr Mae Rim series	-	500	-	-	-	-	500
Bbg Ban Bung series	2,563	-	24,704	4,525	-	-	31,792
Hg Hup Kapong series	875	-	8,563	-	125	-	9,563
Sh Sattahip series	1,875	6,313	2,250	-	3,063	-	13,501
Mb Map Ron series	-	-	5,188	-	-	2,370	7,558
Na Nong Hot series	-	3,438	3,750	-	2,625	-	9,813
Kb Kabin Buri series	-	1,313	-	-	-	-	1,313
Ch Chiang Khan series	-	-	563	-	-	-	563
Ws Wang Saphung series	-	3,250	-	-	5,813	-	9,063
Ty/Ly Tha Yang/Lat Ya association	-	2,063	-	-	3,938	-	6,001
SC Slope Complex	900	1,813	5,489	-	6,568	-	14,770
TOTAL	10,400	72,710	58,320	17,590	42,380	5,120	206,520

TABLE B-15 AREA COVERAGE OF SOIL UNITS OF CHACHOENGSAO PROVINCE

SOIL UNIT		A. Nuang	A. Bang Khla	A. Ban Pho	A. Bang Pakong	A. Phanom Sarakham	A. Sanan Chai Met	King A. Plaeng Yao	King A. Ratchasan	TOTAL
		(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)
Bpg	Bang Pakong series	-	-	-	1,574	-	-	-	-	1,574
Tc-Bpg	Thachin-Bang Pakong Complex	-	-	-	1,000	-	-	-	-	1,000
Sm	Samut Prakarn series	-	-	500	1,458	-	-	-	-	1,958
Bk	Bangkok series	-	-	3,375	-	-	-	-	-	3,375
Ptg	Phan Thong series	-	-	-	688	-	-	-	-	688
Ca	Cha-am series	200	-	1,125	-	-	-	-	-	1,325
Bp	Bang Nam Prico series	1,300	438	-	-	-	-	-	-	1,738
Cc	Chachoengsao series	1,938	11,336	5,625	750	-	-	500	-	20,149
Ma	Mahaphot series	-	3,063	-	-	6,625	-	-	15,029	24,717
Rs	Rangsit series	-	815	61	-	3,216	-	1,958	3,775	9,801
OK	Ongkharak series	-	750	188	-	-	-	1,188	375	2,501
Om	Don Nuang series	500	3,125	-	-	-	-	-	-	3,625
NBC	Undifferentiated ridged acid soil	2,822	6,125	188	-	-	-	-	563	9,698
AC-pd	Alluvial Complex-poorly drained	-	-	-	-	5,915	281	-	-	6,194
AC-wd	Alluvial Complex-well drained	-	-	-	-	-	2,394	-	-	2,394
Cb	Chon Buri series	-	-	-	-	6,250	-	2,375	-	8,625
Kl	Klaeng series	-	-	438	-	10,214	-	3,221	-	15,875
Hk	Hin Kong series	-	-	-	-	4,474	3,688	-	-	8,162
Pn	Phen series	-	-	-	-	-	2,051	-	-	2,051
Kkn	Ko Khanun series	-	-	-	-	7,686	21,306	-	-	28,992
Pp	Phon Phisai series	-	-	-	-	-	5,306	-	-	5,306
Bka	Bang Khla series	-	-	-	-	4,565	48,024	4,712	-	57,301
Dr	Don Rai series	-	-	3,270	-	8,649	-	1,000	70	12,989
Kt	Khorat series	-	-	-	-	3,901	-	125	-	4,026
Suk	Satuk series	-	-	-	-	8,575	14,865	2,125	-	25,565
Wn	Warin series	-	-	-	-	5,639	4,656	-	-	10,295
Suk/Wn	Satuk/Warin association	-	-	-	-	-	18,450	-	-	18,450
Pg	Pang Rai series	-	-	-	-	6,471	15,325	1,125	-	22,921
Nkk	Nong Khok series	-	-	-	-	-	3,825	-	-	3,825
Bbg	Ban Bung series	-	-	-	-	3,652	4,856	1,000	-	9,508
Hg	Hup Kapong series	-	-	-	-	4,102	600	-	-	4,702
Sh	Sattahip series	-	-	-	-	8,777	3,000	3,688	-	15,465
Nb	Nap Bon series	-	-	-	-	5,102	4,581	-	-	9,683
Nb	Nabin Buri series	-	-	-	-	4,777	39,665	-	-	44,440
Ty/Ly	Tha Yang/Lat Ya association	-	-	-	-	-	26,505	-	-	26,505
SC	Slope Complex	-	-	-	-	3,614	17,138	563	-	21,315
TOTAL		6,760	25,650	14,770	5,450	112,200	236,290	25,560	19,810	444,490

TABLE B-16 AREA COVERAGE OF SOIL UNITS OF PRACHIN BURI PROVINCE

SOIL UNIT	A.Muang (ha)	A. Ban Sang (ha)	A. Khok Pip (ha)	A. Si Muha Phot (ha)	A.Prachan Takham (ha)	A. Kabin Buri (ha)	A. Na Di (ha)	A.Sa Kaew (ha)	A. Katta Nakhon (ha)	K.A.Khlong Hat & A. Wang Nam Yen (ha)	TOTAL (ha)
Cc Chachoengsao series	-	3,875	-	-	-	-	-	-	-	-	3,875
Ma Mahaphot series	4,815	3,977	3,326	3,750	3,125	-	-	-	-	-	19,491
Rs Rangsit series	9,625	14,088	1,063	-	-	-	-	-	-	-	24,776
Rs-a Rangsit-very acid phase	-	7,500	-	-	-	-	-	-	-	-	7,500
AC-pd Alluvial Complex-poorly drained	-	-	3,188	375	-	10,125	2,250	3,063	-	-	19,001
AC-wd Alluvial Complex-well drained	563	-	625	9,224	3,438	5,688	-	-	-	-	19,538
Ca Chiang Mai series	-	-	-	1,500	-	1,250	-	-	-	-	2,750
Pr Pran Buri series	-	-	-	-	-	-	-	3,000	-	-	3,000
Rb Ratchaburi series	1,250	-	-	1,750	125	-	-	-	-	-	3,125
Bin Bang Pa-in series	1,000	-	-	2,938	3,000	-	-	-	-	-	6,938
Cb Chon Buri series	-	-	-	-	2,875	813	-	-	-	-	3,688
Xl Klaeng series	7,813	-	-	-	11,125	-	-	-	-	-	18,938
HK Hin Kong series	625	-	-	-	-	-	-	-	-	-	625
Re Roi Et series	-	-	-	-	1,063	17,750	8,000	20,813	1,313	-	48,939
Nak Makham series	-	-	-	-	-	2,438	1,625	-	-	-	4,063
Pn Phen series	-	-	-	-	-	5,875	-	4,375	-	-	10,250
Pp Phon Phisai series	-	-	-	-	-	23,184	-	11,250	8,813	-	43,247
Bka Bang Khla series	-	-	-	2,000	-	9,188	-	11,813	-	4,938	27,939
Dr Don Rai series	9,483	-	-	4,063	4,938	1,625	-	-	-	-	20,109
Kt Khorat series	-	-	-	-	313	4,625	4,125	48,625	16,688	-	74,576
Rn Renu series	-	-	-	-	-	4,000	7,438	2,125	3,750	1,813	19,126
Sak Satuk series	-	-	-	-	-	2,438	3,188	-	-	-	5,626
Kt/Suk Khorat/Satuk association	-	-	250	-	-	9,125	11,938	4,688	-	-	26,001
Wn Warin series	-	-	-	-	-	-	313	500	1,688	-	2,501
Yt Yasothon series	-	-	-	-	-	-	-	750	-	-	750
Ng Nam Pong series	-	-	-	-	-	-	250	1,063	6,938	-	8,251
Lb Lop Buri series	-	-	-	-	-	-	-	313	2,063	1,000	3,376
Bng Bung Chanang series	-	-	-	-	-	-	-	-	3,188	1,000	4,188
Tk Takli series	-	-	-	-	-	-	-	375	750	500	1,625
Tpk Thap Phrik series	-	-	-	-	-	-	-	-	2,250	3,000	5,250
Kb Kabin buri series	1,313	-	4,188	6,220	2,188	18,563	-	10,000	1,000	3,500	46,972
Oc O Lum Chiak series	-	-	-	-	-	-	-	-	-	3,875	3,875
Ho Huai Yot series	-	-	-	-	-	-	-	-	3,188	44,250	47,438
Tw Thap Kwang series	-	-	-	-	-	-	-	12,625	10,688	27,025	50,336
Nl Muak Lek series	-	-	-	-	-	-	-	1,375	9,315	-	10,688
Ty/Ly Tha Yang/Lat Ya	-	-	-	-	-	250	2,188	3,375	10,688	1,188	17,689
SC Slope Complex	6,375	-	-	-	45,090	2,563	69,865	67,172	20,982	18,295	250,340
TOTAL	42,860	29,440	15,140	31,820	77,280	119,500	111,180	206,550	104,050	110,380	846,200

TABLE B-17

AREA COVERAGE OF SOIL UNITS OF NAKHON NAYOK PROVINCE

SOIL UNIT		A.Muang (ha)	A. Ban Na (ha)	A.Ongkharak (ha)	A.Pak Phli (ha)	Total (ha)
Ma	Mahaphot series	3,000	1,563	63	313	4,939
Rs	Rangsit series	13,750	5,188	-	38,006	56,944
Rs-a	Rangsit - very acid	5,125	1,375	14,799	1,438	22,737
Ok	Ongkharak series	-	-	688	-	688
AC-wd	Alluvial Complex-well deained	5,000	-	-	-	5,000
Cm	Chiang Mai series	1,625	1,688	-	-	3,313
Rb	Ratchaburi series	1,250	-	-	-	1,250
Bin	Bang Pa-in series	688	-	-	-	688
Cb	Chon Buri series	-	2,563	-	-	2,563
Kl	Klaeng series	15,250	4,000	-	5,188	24,438
Hk	Hin Kong series	-	3,813	-	-	3,813
Dr	Don Rai series	1,125	-	-	44	1,169
Kt	Khorat series	625	-	-	-	625
Kb	Kabin Buri series	438	-	-	63	501
SC	Slope Complex	18,154	2,080	-	688	20,922
TOTAL		66,030	22,270	15,550	45,740	149,590

TABLE B-18 MAJOR PHYSICAL CHARACTERISTICS OF SOILS IN PROJECT AREA

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	a) Drainage b) Permeability
1. Tc : Tha Chin	0-1	Very deep	a) clay, silty clay b) clay, silty clay	a) brown having dark gray mottles b) dark gray or gray	a) very poorly b) slow
2. Bpg : Bang Pakong	0-1	very deep	a) clay b) clay	a) brown to very dark gray with brownish, yellowish red mottles b) dark gray	a) very poorly b) moderate
3. Sm : Smut Prakarn	0-1	very deep	a) clay b) clay	a) gray or brownish gray with brownish mottles b) gray or olive gray with dark brown and yellowish red mottles, greenish gray colour occurs at lower depth	a) poorly b) slow
4. Bk : Bangkok	0-1	very deep	a) clay b) clay with some gypsum	a) dark gray with brownish, yellowish red mottles b) gray, dark gray, dark greenish gray with yellowish brown, brownish and greenish mottles	a) poorly b) slow

TABLE B-19 MAJOR PHYSICAL CHARACTERISTICS OF SOILS IN PROJECT AREA (Con't)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	a) Drainage b) Permeability
5. Ptg : Phan Thong	0-1	very deep	a) sandy clay loam or clay loam b) sandy clay loam or clay loam	a) very dark gray, black or light gray to gray with strong brown, yellowish red and light olive brown mottles b) light gray, greenish gray with yellowish brown, strong brown and olive brown mottles	a) poorly b) moderate
6. Ca : Cha-am	0-1	very deep	a) clay b) clay	a) brown, dark grayish brown with yellowish mottles b) brownish gray, dark brown, dark gray to greenish gray and dark greenish gray with pale yellowish, straw yellow and yellowish red or strong brown mottles.	a) poorly b) slow
7. Bp : Bang Nam Prieo	0-1	very deep	a) clay b) clay	a) dark to very dark gray with brownish and strong brown mottles b) grayish brown, greenish gray with strong brown, yellowish brown mottles	a) poorly b) slow

TABLE B-20 MAJOR PHYSICAL CHARACTERISTICS OF SOILS IN PROJECT AREA (Con't)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	a) Drainage b) Permeability
8. Cc : Chachoengsao	0-1	very deep	a) clay, silty clay b) clay	a) dark gray or black b) gray with brown or red mottles over greenish gray below 100 cm.	a) poorly b) slow
9. Ma : Mahaphot	0-1	very deep	a) clay b) clay	a) very dark gray to black with brown mottles b) grayish brown or brown with red and yellow mottles (jarosite) at deep subsoil over greenish gray	a) poorly b) slow
10. Rs : Rangsit	0-1	very deep	a) clay b) clay	a) black or very dark gray with brown mottles b) brown or grayish brown with red and yellow mottles (jarosite) at below 40 cm over dark gray below 150 cm.	a) poorly b) slow
11. Rs-a : Rangsit-very acid	0-1	very deep	a) clay b) clay	a) black or very dark gray with brown mottles b) brown or grayish brown with red and yellow mottles over dark gray below 150 cm.	a) poorly b) slow

TABLE B-21 MAJOR PHYSICAL CHARACTERISTICS OF SOILS IN PROJECT AREA (Con't)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	a) Drainage b) Permeability
12. Ok : Ongkharak	0-1	very deep	a) clay to silty clay b) clay	a) very dark gray to black with brown and yellowish red mottles b) brown or grayish brown with yellow mottles (jarosite) shallower than 40 cm. over dark gray below 150 cm.	a) poorly b) slow
13. Dm : Don Muang	0-1	very deep	a) sandy clay, clay loam or clay b) sandy clay loam or sandy clay	a) very dark gray or black with yellowish red, and strong brown mottles b) grayish brown or brown with red or pale red, brownish yellow and yellow mottles (jarosite)	a) poorly b) moderate
14. NBC : Undifferentiated ridged acid soils		very deep	The unit consists of alluvial complex soils which are ridged for orchards and cannot be separated as individual unit		a) well b) slow

TABLE B-22 MAJOR PHYSICAL CHARACTERISTICS OF SOILS IN PROJECT AREA (Con't)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	a) Drainage b) Permeability
15. AC-pd : Alluvial Complex-poorly drained	1	very deep	The unit consists of various types of clayey alluvial soils which could not be separated as individual unit		a) poorly b) slow
16. AC-Wd : Alluvial Complex-well drained	1-2	deep	The unit comprises many sandy alluvial soils which cannot be separated as individual unit		a) well b) moderate
17. Cm : Chiang Mai	1-2	very deep	a) loam or clay loam b) clay loam	a) grayish brown b) yellowish brown with faint mottles in the deep subsoil	a) moderately well b) moderate
18. Pr : Pran Buri	1-2	very deep	a) loam or sandy loam b) sandy loam or clay loam	a) brown or strong brown b) brown or strong brown or yellowish red	a) well b) moderate

TABLE B-23 MAJOR PHYSICAL CHARACTERISTICS OF SOILS IN PROJECT AREA (Con't)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	a) Drainage b) Permeability
19. Rb : Ratchaburi	0-1	very deep	a) clay b) clay	a) dark grayish brown with brown mottles b) dark grayish brown with brown and gray mottles	a) somewhat-poorly b) slow
20. Bin : Bang Pa-in	0-1	very deep	a) clay/silty clay b) clay/silty clay	a) dark grayish brown or brown with brown and yellowish red mottles b) dark grayish brown or brown with brown and red mottles	a) somewhat-poorly b) slow
21. Cb : Chon Buri	0-1	very deep	a) sandy loam or sandy clay loam b) sandy clay loam to sandy clay	a) grayish brown with brown mottles b) light gray or pinkish gray with brown mottles	a) somewhat-poorly b) moderate
22. Kl : Kiaeng	0-1	very deep	a) sandy loam or clay loam b) sandy clay loam to sandy clay over clay	a) grayish brown with brown mottles b) grayish brown to gray with strong brown and red mottles over light gray with red mottles below 100 cm.	a) somewhat-poorly b) moderate

TABLE B-24 MAJOR PHYSICAL CHARACTERISTICS OF SOILS IN PROJECT AREA (Con't)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	a) Drainage b) Permeability
23. Lgu : La-ngu	1-3	very deep	a) clay loam or silty clay loam b) silty clay loam or clay with secondary lime	a) dark gray to dark grayish brown b) gray to light gray with brown and yellow mottles	a) poorly b) slow
24. Hk : Hin Kong	0-1	very deep	a) silt loam b) silty clay loam over silty clay or clay	a) pale brown or brown with brown mottles b) pale brown to pinkish gray with brown mottles over gray with brown and red mottles	a) somewhat-poorly b) slow
25. Re : Roi Et	1-2	deep	a) sandy loam b) loam, sandy clay loam	a) grayish brown, light gray with dark brown, yellowish brown mottles b) pale brown, pinkish gray with dark brown, yellowish brown, strong brown mottles.	a) poorly b) moderately slow

TABLE B-25 MAJOR PHYSICAL CHARACTERISTICS OF SOILS IN PROJECT AREA (Con't)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	a) Drainage b) Permeability
26. Mak : Makham	1-2	deep	a) loam, sandy loam b) clay, sandy clay	a) dark grayish brown, dark brown with strong brown, yellowish brown mottles. b) pinkish gray, white with yellowish brown, yellowish red mottles.	a) poorly b) slow
27. Pn : Phen	1-2	shallow	a) loam, sandy loam with gravel b) gravelly clay	a) grayish brown or brown with strong brown, yellowish brown or yellowish red mottles. b) brown or pale brown or pinkish gray with strong brown, red and yellowish red mottles.	a) poorly b) moderate to slow
28. Kkn : Ko Khanun	0-1	very deep	a) loam b) loam, clay loam	a) brown b) reddish gray or pinkish gray with many red mottles	a) moderately well b) moderate

TABLE B-26 MAJOR PHYSICAL CHARACTERISTICS OF SOILS IN PROJECT AREA (Con't)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	a) Drainage b) Permeability
29. Pp : Phon Phisai	2-6	shallow	a) loam, sandy loam with gravel (laterite) b) gravelly clay loam or clay	a) very dark grayish brown or dark brown b) yellowish brown or strong brown	a) moderately well b) slow
30. Bka : Bang Khla	2	deep	a) gravelly sandy loam, gravelly sandy clay loam b) gravelly sandy clay loam (laterite)	a) dark yellowish brown, brown b) brown, yellowish red	a) well b) moderate
31. Dr : Don Rai	1-4	deep	a) sandy loam sandy clay loam b) sandy clay	a) grayish brown, dark grayish brown b) pale brown with yellowish red, strong brown mottles	a) moderately well b) moderate
32. Kt : Khorat	2-6	deep	a) sandy loam b) sandy clay loam	a) grayish brown, dark grayish brown b) brown, pale brown with strong brown and reddish yellow mottles.	a) moderately well b) moderate

TABLE B-27 MAJOR PHYSICAL CHARACTERISTICS OF SOILS IN PROJECT AREA (Con't)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	a) Drainage b) Permeability
33. Rn : Renu	1-4	deep	a) sandy loam b) clay, sandy clay loam	a) brown, grayish brown with strong brown, yellowish brown mottles b) pale brown, pinkish gray with yellowish red, red mottles.	a) somewhat poorly b) moderate
34. Suk : Satuk	2-8	deep	a) sandy loam b) sandy clay loam	a) dark grayish brown, dark brown b) strong brown, yellowish brown	a) well b) moderate
35. Wn : Warin	2-8	deep	a) sandy loam b) sandy clay loam	a) dark brown, brown, grayish brown b) yellowish red or reddish yellow	a) well b) moderate
36. Yt : Yasothorn	2-8	deep	a) sandy loam b) sandy clay loam	a) dark brown, reddish brown b) yellowish red, red	a) well b) rapid
37. Ng : Nam Phong	3-10	deep	a) sand, loamy sand b) sand, loamy sand	a) dark grayish brown, grayish brown, light brown b) pink, light brown	a) well to excessively b) rapid

TABLE B-28 MAJOR PHYSICAL CHARACTERISTICS OF SOILS IN PROJECT AREA (Con't)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	a) Drainage b) Permeability
38. Pg : Pang Rai	0-1	deep	a) sandy loam b) gravelly clay (laterite)	a) dark yellowish brown b) yellowish red, red	a) well b) moderate
39. Nkk : Nong Khok	3	deep	a) sandy loam b) sandy loam with gravels	a) dark brown or strong brown b) yellowish red.	a) well b) rapid
40. Mr : Mae Rim	4-20	shallow	a) gravelly sandy loam b) gravelly sandy clay (gravels mainly rounded quartzite)	a) very dark grayish brown, light yellowish brown b) reddish yellow.	a) well b) moderate
41. Bbg : Ban Bung	0-2	deep	a) sandy loam or loamy sand b) loamy sand	a) grayish brown, brown or strong brown b) pinkish gray, light brown or light reddish brown	a) excessively b) rapid
42. Hg : Hup Kapong	1-2	deep	a) sandy loam b) sandy loam	a) dark brown to very dark grayish brown b) yellowish brown or strong brown	a) moderately well b) rapid

TABLE B-29 MAJOR PHYSICAL CHARACTERISTICS OF SOILS IN PROJECT AREA (Con't)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	a) Drainage b) Permeability
43. Sh : Sattahip	2-4	deep	a) sand b) sand	a) grayish brown, brown, light brown b) pinkish gray, pink, light reddish brown	a) somewhat excessively b) rapid
44. Mb : Map Bon	2-8	deep	a) sandy loam b) medium sandy clay loam	a) brown, pale brown, light yellowish brown b) strong brown, reddish yellow	a) well b) moderate
45. Nm : Nong Mot	3-10	deep	a) sandy loam b) medium sandy clay	a) very dark brown to brown b) strong brown over yellowish red, red	a) well b) moderate
46. Lb : Lop Buri	2	deep	a) clay b) clay	a) black, very dark gray b) black, very dark gray	a) poorly b) slow
47. Bng : Bung Chanung	2-5	moderately deep	a) clay loam, clay b) clay	a) dark reddish brown, dark brown b) reddish brown, yellowish red	a) well b) moderate

TABLE B-30 MAJOR PHYSICAL CHARACTERISTICS OF SOILS IN PROJECT AREA (Con't)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	Drainage a) Permeability b) Permeability
48. Tk : Takhli	2-4	deep	a) clay loam, clay b) clay, silty clay with lime concretion	a) black, very dark gray b) very dark grayish brown, dark gray	a) well b) moderate
49. Tpk : Thap Phrik	4-5	deep	a) clay b) clay	a) dark yellowish brown b) dark reddish brown, yellowish brown	a) well b) moderate
50. Kb : Kabin Buri	3-8	shallow	a) slightly gravelly clay loam or clay b) very gravelly clay over sheet laterite	a) dark brown or dark yellowish brown b) brown to yellowish red	a) moderately well b) moderately low.
51. Ch : Chiang Khan	3-8	shallow	a) gravelly loam b) very gravelly (gravels mainly lateritic shale)	a) dark reddish brown, reddish brown b) dark red, red	a) well b) rapid

TABLE B-31 MAJOR PHYSICAL CHARACTERISTICS OF SOILS IN PROJECT AREA (Con't)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	a) Drainage b) Permeability
52. Ws : Wang Saphung	3-10	deep	a) silt loam, clay loam b) weathering shale (50-100 cm.)	a) dark brown to brown b) brown or yellow and mixed colours of weathering shale	a) well b) moderate
53. Oc : O Lum Chiak	2-6	moderately deep	a) clay loam, clay b) clay	a) dark brown, dark reddish brown b) yellowish red, red	a) well b) slow
54. Ho : Huai Yot	8-30	shallow	a) loam, silt/loam b) very gravelly loam or clay loam	a) brown, dark yellowish brown b) strong brown, yellowish brown	a) well b) slow
55. Tw : Thap Kwang	2-4	deep	a) loam b) clay	a) very dark grayish brown, dark brown b) dark brown, grayish brown, with reddish brown, gray mottles	a) moderately well b) moderate to slow

TABLE B-32 MAJOR PHYSICAL CHARACTERISTICS OF SOILS IN PROJECT AREA (Con't)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	a) Drainage b) Permeability
56. M1 : Muak Lek	4-20	shallow	a) loam, silty loam b) clay loam, silty clay loam (very gravelly shale)	a) dark brown, dark grayish brown b) brown, dark brown, dark yellowish brown	a) well b) moderate
57. Ty : Tha Yang	4-20	shallow	a) gravelly sandy loam b) very gravelly sandy clay, parent rock occurs at shallower than 50 cm.	a) dark grayish brown, dark brown b) strong brown, reddish brown, yellowish red	a) well b) moderate to rapid
58. Ly : Lat Ya	4-20	moderately deep	a) gravelly sandy loam b) very gravelly sandy clay, parent rock occurs below 50 cm.	a) dark grayish brown, dark brown b) strong brown, reddish brown, yellowish red.	a) well b) moderate to rapid

TABLE B-33 MAJOR CHEMICAL CHARACTERISTICS (FERTILITY LEVEL)

OF SOILS IN PROJECT AREA

Soil Series	OM	BS	CEC	P	K	PH	Fertility
	0-30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	Level a) 0-30 cm b) 30 cm
1. Tc : Tha Chin	H	a) H b) H	a) H b) H	a) H b) H	a) H b) H	a) 6.0-8.0 b) 7.5-8.0	a) H b) H
2. Bpg : Bang Pakong	H	a) H b) H	a) H b) H	a) H b) H	a) H b) H	a) 5.0-8.0 b) 7.0-8.0	a) H b) H
3. Sm : Smut Prakarn	M to H	a) M-H b) M-H	a) H b) H	a) M-H b) M-H	a) H b) H	a) 5.0-8.0 b) 5.0-8.0	a) M-H b) M-H
4. Bk : Bangkok	L	a) M b) H	a) H b) H	a) L-M b) M	a) H b) H	a) 5.0-8.0 b) 6.5-8.0	a) M b) M
5. Ptg : Phan Thong	L	a) H b) H	a) M b) M	a) L b) M	a) H b) H	a) 7.0-8.0 b) 7.8-8.0	a) M b) M
6. Ca : Cha-am	L to H	a) L b) L-M	a) L-H b) L-M	a) L b) L	a) L b) L	a) 3.0-3.5 b) 3.0-3.5	a) L-M b) L-M
7. Bp : Bang Nam Priceo	M	a) M b) M	a) H b) H	a) L b) L	a) H b) H	a) 5.0-5.5 b) 4.5-5.0	a) M b) M
8. Cc : Chachoengsao	M	a) M b) M	a) H b) H	a) L b) L	a) H b) H	a) 4.5-5.0 b) 4.5-5.5	a) M b) M
9. Ma : Mahaphot	L to M	a) L b) M	a) H b) H	a) L b) L	a) H b) H	a) 4.5-5.0 b) 4.0-4.5	a) M b) M
10. Rs : Rangsit	M	a) L b) L	a) M-H b) H	a) L b) L	a) H b) H	a) 4.5-5.0 b) 4.0-4.5	a) L-M b) M

TABLE B-34 MAJOR CHEMICAL CHARACTERISTICS (FERTILITY LEVEL)
OF SOILS IN PROJECT AREA (Con't)

Soil Series	OM	BS	CEC	P	K	PH	Fertility
	0-30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	Level a) 0-30 cm b) 30 cm
11. Rs-a : Rangsit-very acid	L	a) L b) L	a) M b) H	a) L b) L	a) H b) H	a) < 4.5 b) < 4.5	a) L b) H
12. Ok : Ongkharak	L-M	a) M b) M	a) H b) H	a) L b) L	a) H b) H	a) 4.0-4.5 b) 4.0-4.5	a) M b) M
13. Dm : Don Muang	L	a) M b) M	a) H b) H	a) L b) L	a) H b) H	a) 4.0-4.5 b) 4.0-4.5	a) M b) M
14. NBC : Undifferentiated ridged acid soil	L	a) H b) H	a) H b) H	a) H b) H	a) H b) H	a) 5.5-6.0 b) 4.0-4.5	a) H b) H
15. AC-pd : Alluvial Complex-poorly drained	L	a) M b) H	a) L b) L	a) L b) M	a) M b) H	a) 5.0-5.5 b) 5.0-6.0	a) L b) M
16. Ac-wd : Alluvial Complex-well drained	L	a) L b) L	a) L b) L	a) L b) L	a) L b) L	a) 5.5-6.0 b) 5.0-5.5	a) L b) L
17. Cm : Chiang Mai	L	a) L-M b) M	a) M b) L	a) L b) L	a) L b) L	a) 5.0-5.5 b) 4.5-5.0	a) L b) L
18. Pr : Pran Buri	L	a) M b) M	a) M b) L	a) L b) L	a) L b) L	a) 5.0-5.5 b) 4.5-5.0	a) L b) L
19. Rb : Ratchaburi	M	a) H b) H	a) H b) H	a) M b) M	a) H b) H	a) 5.5-6.0 b) 5.0-5.5	a) H b) H

TABLE B-35 MAJOR CHEMICAL CHARACTERISTICS (FERTILITY LEVEL)

OF SOILS IN PROJECT AREA (Con't)

Soil Series	OM	BS	CEC	P	K	PH	Fertility
	0-30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	Level a) 0-30 cm b) 30 cm
20. Bin : Bang Pa-in	M	a) L b) L	a) M b) H	a) L b) L	a) L b) L	a) 5.5-6.0 b) 5.0-5.5	a) L b) L
21. Cb : Chon Buri	L	a) L-M b) L-M	a) L b) L	a) L b) L	a) L b) L	a) 5.5-6.5 b) 5.5-7.0	a) L b) L
22. Kl : Klaeng	L	a) L b) L	a) L-M b) M	a) L b) L	a) L-M b) L	a) 5.0-6.0 b) 5.0-5.5	a) L b) L
23. Lgu : La-ngu	L	a) M b) M	a) M b) M	a) L b) L	a) L b) L	a) 5.5-6.5 b) 7.0-8.5	a) L b) L
24. Hk : Hin Kong	L	a) L b) L	a) L b) L	a) L b) L	a) L b) L	a) 4.5-5.0 b) 4.5-6.0	a) L b) L
25. Re : Roi Et	L	a) M b) M	a) L b) L	a) M b) L	a) M b) L	a) 5.0-5.5 b) 5.0-5.5	a) M b) L
26. Mak : Ma Kham	M	a) M b) M	a) L b) L	a) L b) L	a) L b) L	a) 5.0-5.5 b) 5.0-5.5	a) L b) L
27. Pn : Phen	L	a) L b) L	a) L b) M	a) L b) L	a) L b) H	a) 5.0-6.5 b) 5.0-6.5	a) L b) M
28. Kkn : Ko Khanun	L	a) L b) L	a) L b) L	a) L b) L	a) L b) L	a) 4.5-5.0 b) 4.5-5.0	a) L b) L

TABLE B-36 MAJOR CHEMICAL CHARACTERISTICS (FERTILITY LEVEL)

OF SOILS IN PROJECT AREA (Con't)

Soil Series	OM	BS	CEC	P	K	PH	Fertility
	0-30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	Level a) 0-30 cm b) 30 cm
29. Pp : Phon Phisai	M	a) L b) M	a) M b) M	a) L-M b) L	a) H b) H	a) 5.5-6.0 b) 5.0-5.5	a) M b) M
30. Bka : Bang Khla	M	a) M b) M	a) M b) L	a) L b) L	a) L b) L	a) 5.5-6.0 b) 5.5-6.0	a) M b) L
31. Dr : Don Rai	L	a) L b) L	a) L b) L	a) L b) L	a) L b) L	a) 5.0-5.5 b) 5.0-5.5	a) L b) L
32. Kt : Khorat	L	a) L b) L	a) L b) L	a) L b) L	a) L b) L	a) 5.0-5.5 b) 5.0-5.5	a) L b) L
33. Rn : Renu	L	a) H b) M	a) L b) L	a) L b) L	a) L b) L	a) 5.0-5.5 b) 5.0-5.5	a) L b) L
34. Suk : Satuk	L	a) L-M b) L	a) L-M b) L	a) L b) L	a) L-M b) L-M	a) 5.0-5.5 b) 5.0-5.5	a) L b) L
35. Wn : Warin	L	a) L b) L	a) L b) L	a) L b) L	a) M b) M	a) 5.5-6.0 b) 5.0-5.5	a) L b) L
36. Yt : Yasothorn	L	a) H b) M	a) L b) L	a) L b) L	a) H b) L	a) 5.0-5.5 b) 4.5-5.0	a) L b) L
37. Ng : Nam Phong	L	a) H b) H	a) L b) L	a) L b) L	a) L b) L	a) 5.5-6.5 b) 6.0-6.5	a) L b) L

TABLE B-37 MAJOR CHEMICAL CHARACTERISTICS (FERTILITY LEVEL)

OF SOILS IN PROJECT AREA (Con't)

Soil Series	OM	BS	CEC	P	K	PH	Fertility
	0-30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	Level a) 0-30 cm b) 30 cm
38. Pg : Pang Rai	L	a) L b) L	a) L b) L	a) L b) L	a) L b) L	a) 5.5-6.0 b) 5.0-5.5	a) L b) L
39. Nkk : Nong Khok	L	a) L b) L	a) L b) L	a) L b) L	a) M b) L	a) 5.0-5.5 b) 5.0-5.5	a) L b) L
40. Mr : Mae Rim	M	a) L b) L	a) L b) L	a) L b) L	a) M b) L	a) 4.5-5.0 b) 4.5-5.5	a) L b) L
41. Bbg : Ban Bung	L	a) M b) H	a) L b) L	a) L-M b) L	a) L b) L	a) 5.5-8.0 b) 6.0-8.0	a) L-M b) L
42. Hg : Hup Kapong	L-M	a) L-M b) L-M	a) L-M b) L	a) L b) L	a) L-H b) L-H	a) 4.5-5.0 b) 5.0-5.5	a) L-M b) L-M
43. Sh : Sattahip	L	a) M b) M	a) L b) L	a) L b) L	a) L b) L	a) 6.0-8.0 b) 6.0-6.5	a) L b) L
44. Mb : Map Bon	L	a) M b) M	a) L b) L	a) L-M b) L	a) L b) L	a) 5.5-7.0 b) 5.5-6.0	a) L b) L
45. Nm : Nong Mot	M	a) L b) L	a) L b) L	a) L b) L	a) L b) L	a) 4.5-5.0 b) 4.5-5.0	a) L b) L
46. Lb : Lop Buri	L	a) H b) H	a) H b) H	a) L b) L	a) H b) M	a) 6.5-7.5 b) 7.0-8.0	a) M b) M

TABLE B-38 MAJOR CHEMICAL CHARACTERISTICS (FERTILITY LEVEL)

OF SOILS IN PROJECT AREA (Con't)

Soil Series	OM	BS	CEC	P	K	PH	Fertility
	0-30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	Level a) 0-30 cm b) 30 cm
47. Bng : Bung Chanung	H	a) H b) H	a) H b) H	a) L b) L	a) H b) H	a) 6.5-7.0 b) 7.0-7.5	a) H b) M
48. Tk : Takhli	H	a) H b) M-H	a) H b) H	a) L b) M-H	a) H b) H	a) 6.5-7.0 b) 6.0-8.0	a) H b) H
49. Tpk : Thap Phrik	M	a) M b) M	a) M b) L	a) L b) L	a) L b) L	a) 6.0-6.5 b) 6.5-7.5	a) M b) L
50. Kb : Kabin Buri	M	a) L b) L	a) L-M b) L	a) L b) L	a) L-M b) L	a) 5.0-6.0 b) 5.0-6.0	a) L-M b) L
51. Ch : Chiang Khan	M	a) L b) L	a) L b) L	a) L b) L	a) L b) L	a) 5.5-6.5 b) 5.5-6.5	a) L b) L
52. Ws : Wang Saphung	M	a) L b) L	a) L b) M	a) L b) L	a) L b) L	a) 4.5-5.0 b) 5.5-6.0	a) L b) L
53. Oc : O Lum Chiak	M	a) H b) M	a) H b) H	a) H b) L	a) H b) L	a) 4.5-6.5 b) 4.5-5.0	a) H b) M
54. Ho : Huai Yot	M	a) M b) M	a) H b) M	a) L b) L	a) H b) H	a) 5.5-6.0 b) 6.0-7.0	a) M b) M
55. Tw : Thap Kwang	H	a) H b) M	a) H b) H	a) L b) M	a) H b) H	a) 6.5-7.5 b) 5.0-6.0	a) H b) H

TABLE B-39 MAJOR CHEMICAL CHARACTERISTICS (FERTILITY LEVEL)

OF SOILS IN PROJECT AREA (Con't)

Soil Series	OM	BS	CEC	P	K	PH	Fertility
	0-30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	a) 0-30 cm b) > 30 cm	Level a) 0-30 cm b) 30 cm
56. Ml : Muak Lek	L	a) M b) M	a) M b) M	a) L b) L	a) M b) L	a) 6.0-6.5 b) 6.0-6.5	a) M b) L
57. Ty : Tha Yang	L	a) M b) L	a) L b) M	a) L b) L	a) M b) M-H	a) 5.0-5.5 b) 5.0-5.5	a) L b) M
58. Ly : Lat Ya	L	a) M b) L	a) L b) M	a) L b) L	a) M b) M	a) 5.0-5.5 b) 5.0-5.5	a) L b) M

Source Department of Land Development

O.M. Organic Matter

B.S Base Saturation

CEC Cation Exchange Capacity

P Available Phosphorus

K Available Potassium

L Low

M Medium

H High

TABLE B-40 SOIL SUITABILITY CLASSIFICATION

Soil Series	Paddy (P)	Non-flooded Annual Crop (N)	Fruit Tree (F)	Suitable Land Use According to Soil Condition
1. Tc : Tha Chin	P-Vx	N-Vfx	F-Vfx	} mangrove forest, fish and shrimp ponds
2. Bpg : Bang Pakong	P-Vx	N-Vfx	F-Vfx	
3. Sm : Samut Prakarn	P-I	N-Vf	F-Vf	} paddy
4. Bk : Bangkok	P-I	N-Vf	F-Vf	
5. Ptg : Phan Thong	P-IIIs	N-Vf	F-Vf	
6. Ca : Cha-am	P-IVj	N-Vf	F-Vf	paddy required marl application to reduce soil acidity
7. Bp : Bang Nam Pried	P-I	N-Vf	F-Vf	} paddy
8. Cc : Chachoengsao	P-I	N-Vf	F-Vf	
9. Ma : Mahaphot	P-IIIj	N-Vf	F-Vf	} paddy required marl application to reduce soil acidity
10. Rs : Rangsit	P-IIIj	N-Vf	F-Vf	
11. Rs-a : Rangsit-very acid	P-IVj	N-Vf	F-Vf	
12. Ok : Ongkharak	P-IVj	N-Vf	F-Vf	
13. Dm : Don Muang	P-IIIj	N-Vf	F-Vf	} fruit orchard
14. NBC : Undifferen- tiated ridged acid soils	P-Vt	N-I	F-I	
15. AC-pd : Alluvial Complex-poorly drained	P-I	N-Vf	F-Vf	} paddy
16. AC-wd : Alluvial Complex-well drained	P-IIIs	N-Vf	F-Vf	
17. Cm : Chiang Mai	P-Vt	N-IIIn	F-IIIn	} fruit orchard
18. Pr : Pran Buri	P-Vt	N-IIIn	F-IIIn	

TABLE B-41 SOIL SUITABILITY CLASSIFICATION (Con't)

Soil Series	Paddy (P)	Non-flooded Annual Crop (N)	Fruit Tree (F)	Suitable Land Use According to Soil Condition
19. Rb : Ratchaburi	P-I	N-Vf	F-Vf	paddy
20. Bin : Bang Pa-in	P-I	N-Vf	F-Vf	
21. Cb : Chon Buri	P-IIIIs	N-Vf	F-Vf	
22. Kl : Klaeng	P-I	N-Vf	F-Vf	
23. Lgu : La-ngu	P-I	N-Vf	F-Vf	
24. Hk : Hin Kong	P-I	N-Vf	F-Vf	
25. Re : Roi Et	P-IIIIs	N-Vf	F-Vf	
26. Mak : Makham	P-IIIIs	N-Vf	F-Vf	
27. Pn : Phen	P-IIIg	N-Vf	F-Vf	fruit orchard
28. Kkn : Ko Khanun	P-IIIw	N-IIIId	F-IIIId	
29. Pp : Phon Phisai	P-Vt	N-IVg	F-IVg	upland crops, tree crop or reforestation.
30. Bka : Bang Khla	P-Vt	N-IVg	F-IVg	
31. Dr : Don Rai	P-Vt	N-IIIIs	F-IIIn	fruit orchard or upland crop
32. Kt : Khorat	P-Vt	N-IIIIs	F-IIIn	
33. Rn : Renu	P-IIIIs	N-IIIIsd	F-IIIn	
34. Suk : Satuk	P-Vt	N-IIIIs	F-IIIn	
35. Wn : Warin	P-Vt	N-IIIIs	F-IIIn	
36. Yt : Yasothorn	P-Vt	N-IIIIs	F-IIIn	upland crops
37. Ng : Nam Phong	P-Vt	N-IVs	F-IVs	
38. Pg : Pang Rai	P-Vt	N-IVg	F-IVg	upland crop, tree crop or reforestation
39. Nkk : Nong Khok	P-Vt	N-IVg	F-IIIg	
40. Mr : Mae Rim	P-Vt	N-IVg	F-IVg	

TABLE B-42 SOIL SUITABILITY CLASSIFICATION (Con't)

Soil Series	Paddy (P)	Non-flooded Annual Crop (N)	Fruit Tree (F)	Suitable Land Use According to Soil Condition
41. Bbg : Ban Bung	P-Vt	N-IVs	F-IVs	upland crop or tree crop
42. Hg : Hup Kapong	P-Vt	N-IIIs	F-IIIs	
43. Sh : Sattahip	P-Vt	N-IVs	F-IVs	
44. Mb : Map Bon	P-Vt	N-IIIs	F-IIIn	
45. Nm : Nong Mot	P-Vt	N-IIIs	F-IIIn	fruit orchard or upland crop
46. Lb : Lop Buri	P-Vt	N-I	F-I	
47. Bng : Bung Chanung	P-Vt	N-IIIs	F-IVc	upland crop or tree crop
48. Tk : Takhli	P-Vt	N-I	F-IIIg	
49. Tpk : Thap Phrik	P-Vt	N-IIIn	F-IIIn	fruit orchard or upland crop
50. Kb : Kabin Buri	P-Vt	N-IVg	F-IVg	upland crop, tree crop or reforestation
51. Ch : Chiang Khan	P-Vt	N-IVg	F-IVg	
52. Ws : Wang Saphung	P-Vt	N-IIIn	F-IIIg	
53. Oc : O Luk Chaik	P-Vt	N-I	F-IIIg	
54. Ho : Huai Yot	P-Vt	N-IVg	F-IVg	fruit orchard or upland crop
55. Tw : Thap Kwang	P-Vt	N-I	F-I	
56. Ml : Muak Lek	P-Vt	N-IVgt	F-IVg	upland crop, tree crop or reforestation
57. Ty : Tha Yang	P-Vt	N-IVgt	F-IVg	
58. Ly : Lat Ya	P-Vt	N-IVgt	F-IVg	
59. SC : Slope Complex	P-Vt	N-Vt	F-Vt	forest

Notes

Soil Suitability Classes

Class	I	Soils very well suited
Class	II	Soils well suited
Class	III	Soils moderately suited
Class	IV	Soils poorly suited
Class	V	Soils not suited

Limitations

f	-	flooding
x	-	salinity
s	-	unfavorable soil texture
j	-	jarosite (acid soil)
n	-	low nutrient status
g	-	gravels
w	-	risk of water shortage
d	-	soil drainage
t	-	topography or slope
c	-	consolidated layer

TABLE B-43 POTENTIAL AND ACTUAL ACID SULFATE SOILS

area : ha

Acid Sulfate Soils	Soil units*	CB	CC	PB	NN	Total
1. Potential acid sulfate soils	Bpg, Tc-Bpg	3,563	2,574	-	-	6,137
2. Actual acid sulfate soils		16,064	51,667	51,767	85,308	204,806
2.1) Normal	Ma, Rs, Dm, NBC	13,939	47,841	44,267	61,883	167,930
2.2) Very Strongly	Ca, Rs-a, Ok	2,125	3,826	7,500	23,425	36,876

Note * See Table

CB : Chon Buri

CC : Chachoengsao

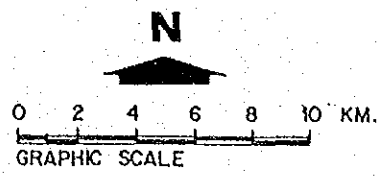
PB : Prachin Buri

NN : Nakhon Nayok

TABLE B-44 TABLE SOIL SUITABILITY FOR CROP CULTIVATION

Soil Suitability	Irrigation Suitability	Area Coverage (ha)				
		CB	CC	PB	NN	total
1. Soils suited for paddy	well suited	50,770	111,136	190,747	123,060	475,713
2. Soils suited for upland crops	not suited due to too permeable soil type	-	-	8,251	-	8,251
3. Soils suited for upland crops, tree crops or reforestation	not suited due to shallow soils	22,129	160,096	197,848	501	380,574
4. Soils suited for upland crops or tree crops	not suited due to too permeable soils	72,227	39,358	5,813	-	117,398
5. Soils suited for orchard	Suited but with particular upland irrigation method	-	38,690	5,750	3,313	47,753
6. Soils suited for orchard or upland crops	suited but with particular upland irrigation method	43,061	71,321	207,451	1,794	323,627
7. Forest land	not suited due to mountainous area	14,770	21,315	230,340	20,922	287,347
8. Mangrove forest or adapted for shrimp pond	not suited due to tidal area.	3,563	2,574	-	-	6,137
Total		206,520	444,490	846,200	149,590	1,646,800

Note CB : Chon Buri, CC : Chachoengsao, PB : Prachin Buri, NN : Nakhon Nayok



Symbol	Soil series	Subgroup
To-Bpg	The Chin-Bang Pakong Complex	Typic Hydraquent and Typic Sulfaquent
Sa	Samut Prakack series	Typic Tropaquent
Bk	Bangkok series	Typic Tropaquent
Ptg	Phan Thong series	Typic Tropaquent
Ca	Cha-am series	Sulfic Tropaquent
Ha	Mahaphot series	Sulfic Tropaquent
Rs	Rangsit series	Sulfic Tropaquent
Ok	Ongkharak series	Sulfic Tropaquent
Dm	Don Huang series	Sulfic Tropaquent
Cb	Chon Buri series	Typic Tropaquent
Kl	Klaeng series	Typic Plinthaquult
Lgu	Langu series	Typic Tropaquent
Pp	Phon Phisai series	Typic Plinthustult
Dr	Don Rai series	Oxic Paleustult
Kt	Khorat series	Oxic Paleustult
Suk	Satuk series	Oxic Paleustult
Suk/Bbg	Satuk/Ban Bung association	Oxic Paleustult
Mr	Mae Rim series	Vadic(Aquic) Quartzipsamment
Bbg	Ban Bung series	Ustoxic Dystrypept
Hg	Hup Kapong series	Typic Quartzipsamment
Sh	Sattahlp series	Oxic Paleustult
Hb	Hap Bon series	Oxic Paleustult
Nm	Nong Hot series	Oxic Paleustult
Kb	Kabin Buri series	Typic Paleustult
Ch	Chiang Khan series	Oxic Paleustult
Ws	Wang Saphung series	Ultic Haplustalf
Ty/Ly	Tha Yang/Lat Ya association	Oxic/Typic Haplustult
SC	Slope Complex	

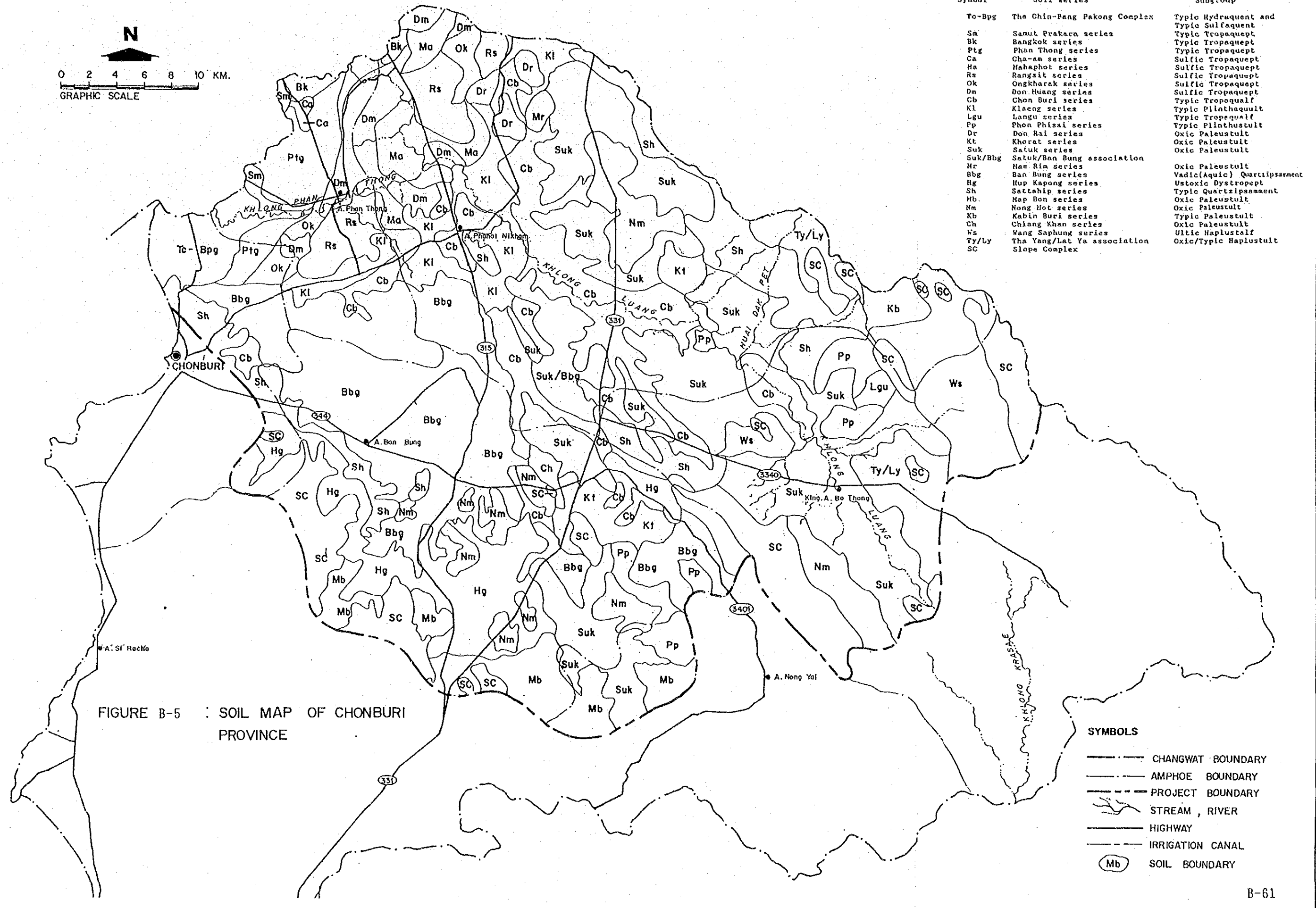


FIGURE B-5 : SOIL MAP OF CHONBURI PROVINCE

SYMBOLS

	CHANGWAT BOUNDARY
	AMPHOE BOUNDARY
	PROJECT BOUNDARY
	STREAM, RIVER
	HIGHWAY
	IRRIGATION CANAL
	SOIL BOUNDARY

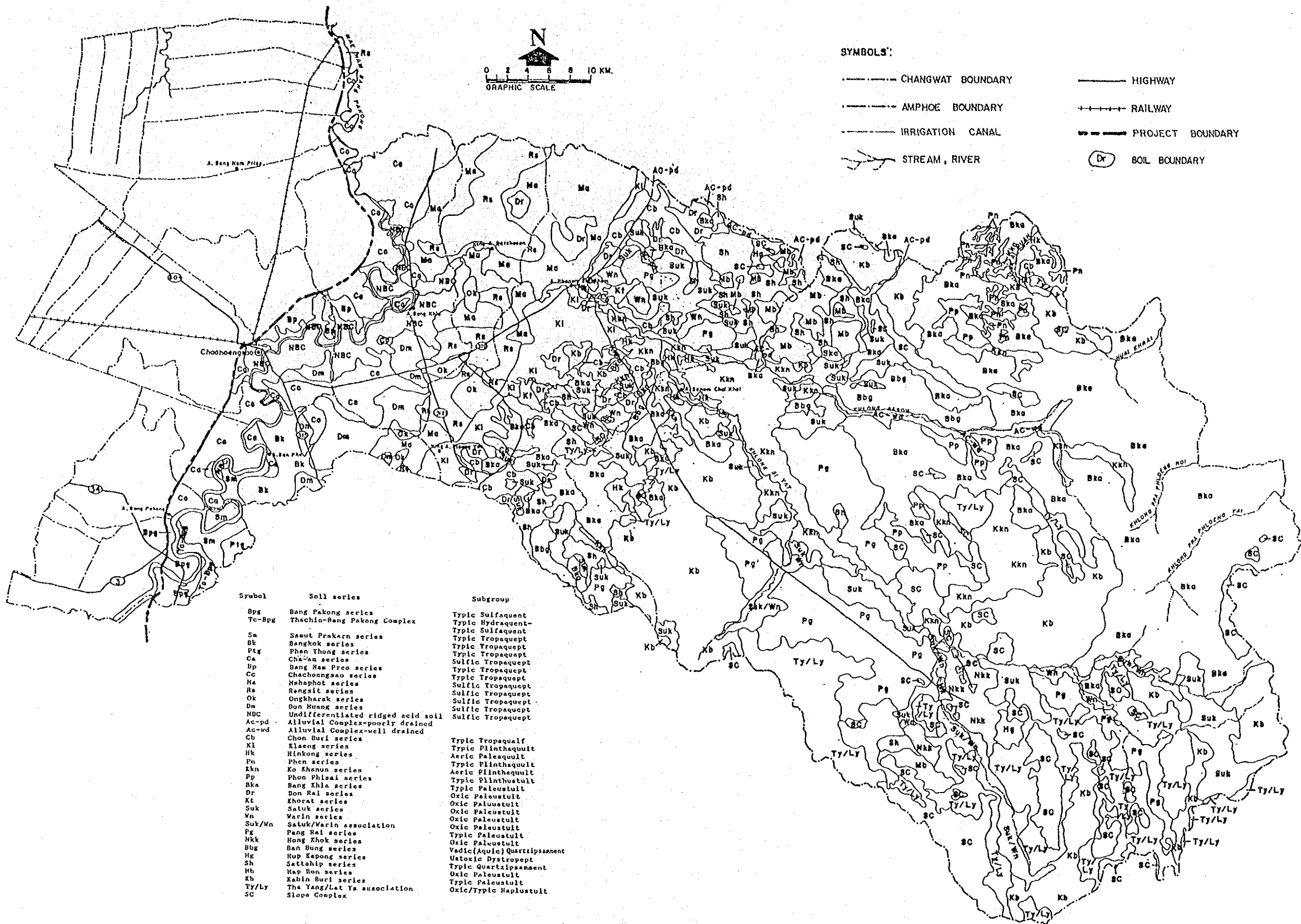
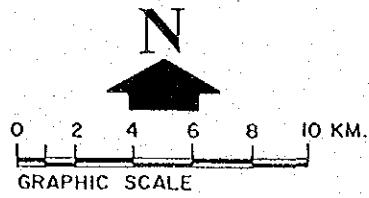
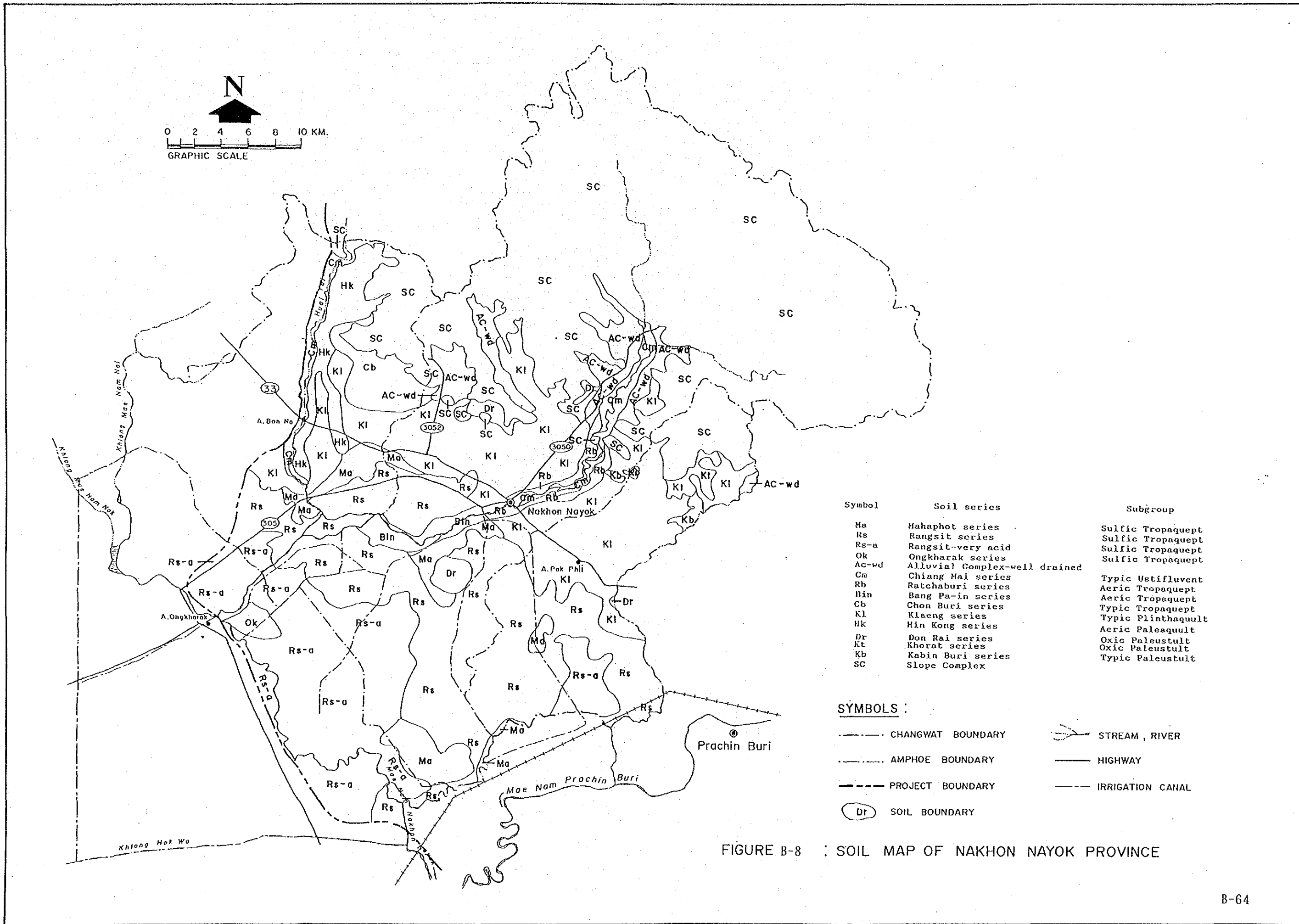


FIGURE B-6 : SOIL MAP OF CHACHOENGSAO PROVINCE



Symbol	Soil series	Subgroup
Ma	Mahaphot series	Sulfic Tropaquept
Rs	Rangsit series	Sulfic Tropaquept
Rs-a	Rangsit-very acid	Sulfic Tropaquept
Ok	Ongkharak series	Sulfic Tropaquept
Ac-wd	Alluvial Complex-well drained	Sulfic Tropaquept
Cm	Chiang Mai series	Typic Ustifluvent
Rb	Ratchaburi series	Aeric Tropaquept
Bln	Bang Pa-in series	Aeric Tropaquept
Cb	Chon Buri series	Typic Tropaquept
Kl	Klaeng series	Typic Plinthaquult
Hk	Hin Kong series	Aeric Paleaquult
Dr	Don Rai series	Oxic Paleustult
Kt	Khorat series	Oxic Paleustult
Kb	Kabin Buri series	Oxic Paleustult
SC	Slope Complex	Typic Paleustult

- SYMBOLS :**
- CHANGWAT BOUNDARY
 - AMPHOE BOUNDARY
 - PROJECT BOUNDARY
 - SOIL BOUNDARY
 - STREAM, RIVER
 - HIGHWAY
 - IRRIGATION CANAL

FIGURE B-8 : SOIL MAP OF NAKHON NAYOK PROVINCE

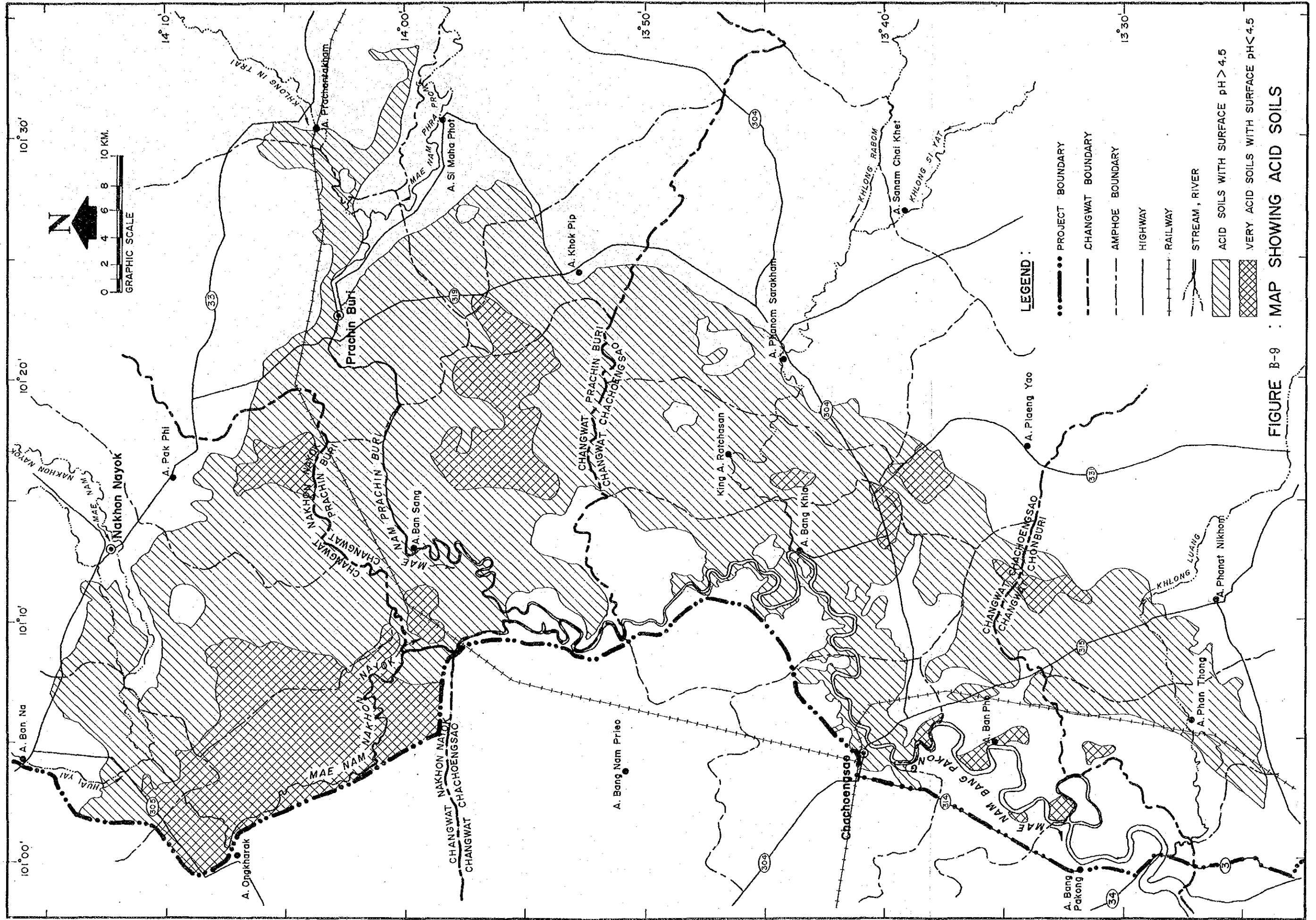


FIGURE B-9 : MAP SHOWING ACID SOILS

B-3 DETAILED SOIL SURVEY FOR FEASIBILITY STUDY AREA

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7. Soil Suitability Classification	B-107
8. Problem Soil	B-109

1. INTRODUCTION

Soil data as well as agricultural information is very necessary for feasibility study especially on agricultural water resources development project including land development and land use planning in particular. Physical and chemical features of soils and their suitability classification with major limitations when use are very useful for designation of appropriate farming system and effective improvement of soil productivity.

Soils in this area have been studied by the Department of Land Development. Detailed reconnaissance soil map was made. Additional field survey was, however, done by study team to confirm soil boundaries and with particular emphasis on some soil characteristics and problem soils. For on-farm planning phase, the more detailed survey should be executed.

2. Landform and Parent Material

Major landforms of the study area are distinguished into three groups as follows:

- former tidal flats
- low terrace and
- lower part of granitic erosional surface

Former tidal flat occupies the flat areas up away from tidal flat. It was originally flooded by sea water. Soils on this landform are derived from three different parent materials including:

- marine deposits
- brackish water deposits over marine deposits
- brackish water deposits

Low terrace area is the flat land somewhat higher than former tidal flat. It covers the soils originated from two parent material namely:

- semi-recent alluvium
- old-alluvium

Lower part of granitic erosional surface is nearly level area consisting of coarse loamy-textured soils that develop from residuum and alluvium from granitic rock.

3. Soil Types and Their characteristics

Soils in the study area are largely very deep, clayey and poorly drained that formed in marine and brackish water deposits on former tidal flat. Those occurring on low terrace and granitic erosional surface are found only in a small extent.

The marine sediments are very deep clayey soils having poor to very poor drainage, brownish gray, olive gray or greenish gray matrix with brownish and greenish mottles. Bluish unripe marine clay occurs in deep horizon. Soil reaction is slightly acid to neutral with pH 6.5 - 7.0 in surface increasing to alkaline, pH 8.0 with depth.

The brackish water deposits are also very deep clay. Straw yellow jarosite mottles which cause strong acid are found in some soil series. Dark gray clay horizon occurs very deep normally below 150 cm.

The semi-recent and old alluvium on low terrace are found far away from the Bang Pakong river close to highland outside the study area. The soils are very deep brownish gray clay loam to clay. They are more matured than those of former tidal flat area. Clay illuviation has brought about the formation of an argillic horizon in most soils.

In the Tha Lat expansion area, the sandy soils of Ban Bung series are found but in a very small extent. These soils are derived from granitic elluvium.

4. Soil Mapping Unit Description

Soil series is the mapping unit used in this study. Fifteen series were mapped as shown in soil map in Figure ①. Soil series names with their classification and landforms and parent materials are tabulated in Table ①. Major characteristics of these series were tabulated in Table ②. Area coverages of each series were shown in Table ③ and detailed as following.

(1) Sm : Smut Prakarn Series

Smut Prakarn series are found only in existing Bang Pakong irrigation area of about 810 ha or 1.34% of the whole study area.

The soils are formed from marine sediments on the slightly higher parts of the tidal flat area close to the mouth of the Bang Pakong river which are never, or only rarely flooded by sea water. Drainage is poor to very poor with slow permeability and very slow surface run off.

They are slightly to moderately saline, heavy clay soils with little or no potential acidity. The A-horizons which are 15 to 20 cm deep consist of a dark gray or brownish gray or olive gray clay with brown or strong brown mottles. Soil reaction is slightly acid with pH 6.0 - 6.5. The subsoils below 20 cm are gray or olive gray clay with strong brown and greenish gray mottles. Soil reaction is neutral with strong brown and greenish gray mottles. Soil reaction is neutral to moderately alkaline with pH 7.0 - 8.5.

These soils are highly fertile but rather poor physical property due to heavy clayey-textured and poorly drained.

They are mostly used for paddy producing not high production due to salinity problem and may be flooded by seawater intrusion during very high tide. This should be prevented by construction of dike and drainage improvement. Green manure or other compose fertilizers are needed to improve physical properties.

(2) Bk : Bangkok Series

Bangkok soils are found 4,150 ha or 6.85% of the whole study area distributed in existing Tha Lat, existing Bang Pakong and expansion Bang Pakong for 470 ha, 3,600 ha and 80 ha respectively.

The soils are formed on former tidal flat and developed in marine and brackish water sediments which are slightly away from Bang Pakong river and free from tidal flooding. They are very deep soils with poor drainage, slow permeability and slow surface runoff.

They are non-saline soils characterized by a very dark gray or dark brownish gray clay or silty clay A-horizon having mottles of strong brown or reddish yellow underlain by a gray or olive gray clay or silty clay with yellowish brown or olive light brown mottles. Soil reaction is slightly acid to neutral (pH 6.0 - 7.0) on surface becoming neutral to mildly alkaline (pH 7.0 - 8.5) in the lower part. Below about 130 cm, colours become reduced dark greenish gray. Gypsum crystals are present in the profile.

These soils are somewhat highly fertile but poor physical properties due to heavy clay and poorly drained.

They are used for paddy giving rather high production. With adequate water, dry season rice, legume crops, maize and other vegetables can be grown in dry season.

(3) Ptg : Phan Thong Series

Phan Thong series are found only in existing Bang Pakong Irrigation Project about 2,400 ha or 3.96% of the whole study area.

The soils are formed from sandy marine and brackish water deposits in former tidal flat away from the Bang Pakong river bank. They are very deep soils with poorly drained and moderate permeability.

They are characterized by a very dark gray, black or light gray to gray sandy clay loam to clay loam surface horizon overlies light gray, greenish gray sandy clay loam to clay subsoils. Strong brown, yellowish red and light olive brown mottles occur throughout. Soil reaction is neutral to alkaline with pH 7.0 - 8.0. Below about 120 - 160 cm colours become reduced dark greenish gray.

Fertility of these soils is medium. They are used for paddy growing giving medium production due to rather high alkalinity. Compose and chemical fertilizers are needed to raise crop production. With good irrigation water management, other crops such as legumes, maize and vegetables can be grown well.

(4) Ce : Chachoengsas Series

Chachoengsas series are recognized 4,930 ha or 8.14% of the whole study area. They are distributed in existing Tha Lat, existing Bang Pakong and expansion Bang Pakong for 1,550 ha, 3,300 ha and 80 ha respectively.

The soils are formed in former tidal flat from deposits of brackish water sediments, up to 100 cm deep, overlying marine sediments. They are very deep with poorly drained, slow permeability and slow surface runoff.

Chachoengsas series are acid heavy clay soils with no acid catclay present and a reduced greenish gray clay, with a low sulphur content in deeper part of subsoils. Top soil is very dark gray with brownish or yellowish red mottles overlying a brownish gray to gray with red and brownish yellow mottles and few straw yellow jarosite which is normally found deeper than 100 cm. Greenish gray reduced clay is found in deep soil. Soil reaction is strongly acid with pH 4.5 to 5.5 in the surface horizons rising to slightly acid to alkaline pH 6.5 to 8 in the deeper part of the subsoil. No gypsum crystals are present.

Soil fertility is medium and physical property is poor because of heavy clay.

These soils are used for paddy. With adequate water other crops such as soybean, mungbean, water melon etc, can be grown in dry season.

(5) Ca : Cha-am Series

Cha-am series are found only in the existing Bang Pakong area. The extent is only 470 ha or 0.78% of the whole study area. They occur very close to the Bang Pakong river bank.

The soils are developed in brackish water deposit on former fidal flat area. They are very deep, poorly drained and slow permeability.

They are both saline and acid with straw yellow mottles at shallow depth. Profiles are characterized by a dark gray, black, grayish brown clay A-horizon overlying a grayish brown or olive gray clay with pale yellow or yellow and reddish mottles. Soil reaction is very strongly acid with pH below 4.5

Soil fertility is moderately high and physical property is poor due to heavy texture and poor drainage.

These soils are normally not used for growing crops due to too strong acidity. With appropriate reclamation, rice can be grown. Due to too high sulphur content in subsoil it should be submerged with water and growing wetland rice continuously to prevent oxidation which makes the soils more acidity.

(6) Ok : Ongkharak Series

Ongkharak series are found 3,340 ha or 5.50% of the total study area. A greater extent of 3,210 ha are in existing Tha Lat project and the rest of 130 ha are in existing Bang Pakong.

The soils are formed from brackish water sediments in former tidal flat. they are acid strongly gleyed heavy clay soils with acid catclay starting at a depth from 10 to 40 cm from the surface. Profiles show a very dark gray to black with brown and clay yellowish red mottles surface overlying a brown or grayish brown with yellow mottles (jarosite) subsoil. Dark gray colour occurs in the deeper subsoil. Soil reaction is very strongly acid to extremely with pH below 4.5

These soils are relatively low to moderate nutrient status. Physical property is rather poor because of clayey textured and poorly drained.

They are mainly under rice cultivation but the yield is very low due to strong acidity. Application with marl and appropriate chemical fertilizers is necessary to raise rice yield.

(7) Ma : Mahaphot Series

Mahaphot series cover 6,760 ha or 11.15% of the whole study area. Only existing Tha Lat and existing Bang Pakong have these soils approximately 6,330 and 430 ha respectively.

These soils are formed from brackish water and fresh water deposits on very flat topography with slope less than 1%. They are very deep soil having poor drainage and slow permeability.

Top soil consists of dark gray, black clay with brownish and yellowish red mottles and pH 4.5 to 5.5. Subsoil has grayish brown, light grayish brown or brown clay with red mottles and yellow or brownish yellow catclay at very deep subsoil. This makes pH very low about 4.0 to 4.5. Dark gray reduced clay occurs in very deep horizon.

The soils have moderate nutrient status and poor physical property due to clayey textured and poorly drained.

They are under rice cultivation with moderate productin. Application with marl and fertilizers will help increase rice yield.

(8) Rs : Rangsit Series

Rangsit series are found 8,620 ha or 14.22% of the study area. They are distributed in existing Tha Lat 8,060 ha and in existing Bang Pakong only 560 ha.

The soils are formed from brackish water alluvium which is high in sulphides and low in lime and occur on former tidal flat. They are very deep clayey, poorly drained and slow permeability.

Rangsit series are heavy clay soils with "straw" yellow mottles, typical of acid sulphate soils, starting at between 40 and 100 cm from the surface. The A horizons are very dark brown to black in colour with distinct yellowish brown, strong brown and yellowish red mottles along root channels. The B horizons are brown, grayish brown or dark grayish brown with red, yellowish brown and "straw" yellow mottles which are about 140 - 150 cm from the surface, is a dark gray nearly unripe heavy clay with only few yellowish brown mottles. Soil reaction is strongly acid with pH about 4.5 at the surface and lower in the catclay B horizons.

Cracks occur at the surface when the soils dry out and slickenside and pressure faces are present in the B horizon. No gypsum crystals occur.

These soils are moderate fertile with poor physical property due to heavy clay and poor drainage.

They are used for growing paddy but the yield is not high because of acidity. To reduce acidic problem and to raise rice yield, lime application with appropriate rate of suitable fertilizers is essential.

(9) Dm : Don Muang Series

Don Muang series are found most extent in the study area about 10,590 ha or 17.48%. They are widespreadly distributed in existing Tha Lat for 6,690 ha, existing Bang Pakong 3,800 ha and only small area of about 100 ha in expansion Bang Pakong.

The soils are developed from brackish water sediments on somewhat higher former tidal flat having nearly level topography with 1 to 2 percent slopes. They are very deep, poorly drained, slow permeability.

Top soil of about 30 cm deep is clay loam to clay with very dark gray to dark brownish gray and with common mottles of dark brown and yellowish red. Soil reaction is strongly acid with pH of 5.0 to 5.5. Subsoil is loam or clay loam having the matrix colours of grayish brown with common mottles of red and straw yellow of catclay and having pH of 4.0 to 4.5.

These soils have relatively low nutrient status and used for growing rice and ridged for vegetables and fruit orchards.

(10) NBC : Undifferentiated Ridged Acid Soils

This unit is found 4,740 ha or 7.82% distributed only in existing and expansion Bang Pakong projects in the areas of about 1,900 ha and 2,840 ha respectively.

The soils are complexes of many series such as Rangsit, Chachongsas and Don Muang. They are ridged for vegetables, fruit trees and coconut. Due to applicatin of livestock manures every year top soils have slightly acid with pH of 6.0 to 6.5 while subsoil pH is still more acid.

(11) Hk : Hinkong Series

Hinkong series are found only in expansion Tha Lat area about 1,650 ha or 2.72% of total study area.

The soils are derived from silty semi-recent alluvium on low terrace with flat surface. They are deep, somewhat poor to poor with slow permeability and slightly surface runoff.

Hinkong series are characterized by a top soil of silt loam of loam having dark yellowish brown, brown or dark brown matrix with yellowish red or dark brown mottles. Subsoil consists of silty clay loam or silty clay

having colours of gray, light gray, pinkish gray or reddish gray. Manganese concretion may be found at deep subsoil. Soil reaction is strongly acid with pH ranging from 5.0 to 5.5.

Fertility level of these soils is somewhat low. They are used for paddy. If irrigation water is available various upland crops such as maize, soybean and other vegetables can be well grown.

(12) Cb : Chon Buri Series

Chon Buri soils are found only 340 ha or about 0.56% of total study area and existed only in expansion area of Tha Lat project.

The soils are old alluvium occurring on flat area having slope gradient less than 1%, they are very deep soils, poor drainage with moderate permeability and slow surface runoff.

Soil profiles are characterized by dark grayish brown to dark brown sandy loam to loam top soil with common dark yellowish brown to strong brown mottles overlying grayish brown, gray or pinkish gray sandy clay loam to sandy clay with yellowish brown dark brown, yellowish red to red mottles. Soil reaction is strongly acid with pH ranging from 5.0 to 5.5 on the surface soil becoming medium acid to neutral having pH of 5.5 to 7.0.

Those soils are low in nutrient status and mostly used for paddy. They need application of green and animal manures together with chemical fertilizers to improve soil productivity. With adequate irrigation water and good water management, the dry season cropping can be practiced.

(13) Kl : Klaeng Series

Klaeng series are found only in Tha Lat both existing and expansion about 4,590 ha and 620 ha respectively making up 5,210 ha or 8.60% of total study area.

Klaeng series are formed from old alluvium and occur on the lower part of low alluvial terrace. They are very deep, poor drainage, slow permeability and non surface runoff.

Soil profiles are characterized by a top soil of loam or silt loam having dark brown, brown or gray matrix colours together with common mottles of yellowish brown or brown overlying subsoil of clay loam to clay plus silty clay in some place having light gray to pinkish gray matrix with many red mottles. Soil reaction is strongly with pH ranging from 5.0 to 5.5.

Soil fertility is relatively low. They are used for paddy rice and have high potential for irrigation development and crop diversification practice.

(14) Kkn : Ko Khanun Series

Ko Khanun series are found only in the expansion area of Tha Lat project in the area coverage about 6,500 ha or 10.73% of the whole study area.

They are developed in old alluvium on higher part of low terrace having nearly level topography with slopes less than 2%. The soils are very deep, somewhat poorly to poorly drained with moderate to slow permeability and slightly surface runoff.

Top soils are loam to silt loam having grayish brown to brown with dark yellowish brown, strong brown mottles. Subsoils are loam to clay loam or silty clay loam having grayish brown, light gray or pinkish gray with some mottles of brownish colours. Soil reaction is strongly acid to medium acid having pH ranging from 5.0 to 6.0.

Soil fertility is low. This mapping unit may have other soil series as inclusion namely Hinkong soils. Existing land uses are paddy in lowlands and maize, cassava and fruit trees on high grounds. Some areas are left idle as grass land and shrubs. This mapping unit is oftenly subject to flash flood by rainwater in rainy season. With irrigation project, high grounds can be ridged for orchards whereas lowland would be irrigated paddy and dry season upland croppings.

(15) Bbg : Ban Bung Series

This series occupies very small extent of 60 ha or 0.10% of total area in expansion area of Tha Lat project.

The soils are hydromorphic sandy-textured derived from granitic rock colluvium forming on flat lowland area. They are very deep, moderately well drained, moderate to rapid permeability.

Soil profiles are characterized by grayish brown, brown or dark brown loamy sand or sandy loam with mottles of dark brown or yellowish brown overlying pinkish gray, light brown or light reddish brown sandy loam with dark brown or yellowish brown mottles. Soil reaction is generally slightly acid to mildly alkaline with pH ranging from 6.0 to 8.0.

They are very low in nutrient status with relatively poor physical property. Normally this soil is used for upland crops such as cassava, maize, sugarcane. Green manures and other compose fertilizers and chemical fertilizers application including soil mulching and appropriate crop rotation practices is necessary for increasing crop production.

5. SOIL PROFILE DESCRIPTION

Sm1 Samut Prakan Seies

Profile Code No. : S 13
Soil Name : Samut Prakan series : Sm
Classification : a) National : Hydromorphic Alluvial Soils
b) U.S.D.A : Typic Tropaquepts
Described by :
Date :

I. INFORMATION OF THE SITE

Location : Amphoe Amphawa, Samut song Khram Province
Elevation : 1 - 15 m.
Relief and slope : flat, slope 1 % or less
Physiography : former tidal flat
Natural Vegetatin or Land Use : transplanted rice
Climate :
- Climate type : Tropical Savanna and Tropical Monsoon
- Annual rainfall : 1,400 mm.
- Mean temperature : 27.9°C

II. GENERAL INFORMATION ON THE SOIL

a. Parent material : brackish water sediment
b. Drainage : poorly drained
c. Permeability : slow
d. Run off : slow
e. Ground water depth : fall below 1 m. during the peak of dry season
f. Other

III. PROFILE DESCRIPTION

Horizon	Depth (cm)	Description
Apg	0-12	Olive grey (5Y 4/2) clay with common fine dark brown mottles; weak to moderate subangular

		blocky; sticky and plastic (wet), very firm (moist); many very fine interstitial and common very fine tubular pores; many very fine roots; gradual smooth boundary.
A3g	12-28	Dark grey (5Y 4/1) and olive grey (5Y 5/2) clay with few fine dark brown mottles; moderate medium subangular blocky breaking to small blocks; sticky and plastic (wet), firm (moist); common very fine interstitial and tubular pores; many very fine roots; clear, wavy boundary.
B2g	28-84	Olive (5Y 5/3) and grey (5Y 6/1) silty clay with few fine brown mottles; weak to moderate coarse subangular blocky; sticky and plastic (wet), firm (moist); few large brown reduction coatings in fresh pores and on ped faces; many very fine tubular pores; few small soft manganese nodules; few small worm casts; many very fine and few fine roots; gradual, smooth boundary.
B3g	84-115	Greenish grey (5G 5/1) and olive grey (5Y 5/2) silty clay with few very fine brown mottles; weak to moderate prismatic, breaking into medium blocks with greenish grey reduction colors on ped faces; sticky and plastic; many very fine tubular pores; green color in fresh pores; few fine soft manganese nodules; few shell fragments; many very fine roots.
	Remark	Below 115 cm. a green and olive grey, reduced, half ripe clay was observed in borings.

Bk : Bangkok Series

Profile Code No. : S 13/1
Soil Name : Bangkok series : Bk
Classification : a) National : Hydromorphic Alluvial Soils
b) U.S.D.A : Typic Tropaquepts
Described by : Kevie
Date : 27 June 1968

I. INFORMATION OF THE SITE

Location : Amphoe Muang, Samut Prakan Province
Elevation : 1 m.
Relief and slope : flat
Physiography : old tidal flat
Natural Vegetatin or Land Use : transplanted rice with few bushes
Climate :
- Climate type : Tropical Savanna and Tropical Monsoon
- Annual rainfall : 1,400 mm.
- Mean temperature : 27.9°C

II. GENERAL INFORMATION ON THE SOIL

a. Parent material : alluvial marine clay
b. Drainage : poorly
c. Permeability : slow
d. Run off : slow
e. Ground water depth : below 1 m. in the peak of dry season
f. Other

III. PROFILE DESCRIPTION

Horizon	Depth (cm)	Description
Apg	0-12	Dark grey (10YR 4/1) clay with many fine strong brown and reddish brown mottles as coating in root channels and ped faces; few fine tubular

A12g	12-25	<p>pores on structure faces; many fine and very fine roots; gradual, irregular boundary; pH 6.0 Dark grey (10YR 4/1) clay with many fine and medium reddish brown mottles as coatings in pores and on ped faces; weak coarse subangular blocky breaking to weak fine subangular blocky; firm (moist); few very fine and fine tubular pores; gradual, wavy boundary; pH 6.5</p>
ABg	25-50	<p>Grey (5Y 5/1) and dark grey (N 4/0) clay with many medium yellowish brown and brown mottles; weak coarse angular blocky; common slickensides; few fine and very fine pores; few round iron nodules; common fine roots; gradual, smooth boundary; pH 7.5</p>
B21g	50-100	<p>Grey (5Y 5/1) clay with many medium and coarse yellowish brown and light olive brown mottles, often along root channels; moderate angular blocky; firm (moist); common pressure faces and few slickensides ; few black manganese mottles; few fine roots; gradual, smooth boundary; pH 7.5</p>
B22g	100-130	<p>Dark grey (5Y 4/1) clay with many medium yellowish brown soft iron pipes along root channels ; moderate coarse prismatic with smooth faces breaking to weak coarse subangular blocky; sticky and plastic; clay cutans on vertical prism faces; many very fine and few fine tubular pores; many soft iron pipes; very few roots; gradual, smooth boundary; pH 7.5</p>
C1g	130-160	<p>Dark greenish grey (5GY 4/1) clay with common coarse green mottles along root channels; sticky and plastic; half ripe; gradual, smooth boundary; pH 8.0</p>
C2g	160-200	<p>Dark greenish grey (5GY 4/1) clay; sticky and plastic; half ripe to nearly unripe; root channels surrounded by nearly ripe clay; pH 8.0</p>

Ptg : Phan Thong Series

Profile Code No. : SE 15/15
Soil Name : Phan Thong series : Ptg
Classification : a) National : Hydromorphic Alluvial
b) U.S.D.A : Typic Tropaquepts
Described by : Kevie
Date : 4 March 1970

I. INFORMATION OF THE SITE

Location : Amphoe Phan Thong, Chon Buri
Elevation : 2 - 3 m. above sea level
Relief and slope : flat
Physiography : old tidal flat
Natural Vegetatin or Land Use : Rice
Climate :
- Climate type : Tropical Savanna
- Annual rainfall : 1,700 mm.
- Mean temperature : 27°C

II. GENERAL INFORMATION ON THE SOIL

- a. Parent material : marine deposit
- b. Drainage : poorly drained
- c. Permeability : moderate
- d. Run off : slow
- e. Ground water depth : fall below 1.5 m during the peak of the dry season
- f. Other

III. PROFILE DESCRIPTION

Horizon	Depth (cm)	Description
Apg	0-10	Very dark grey (10YR 3/1) silty clay loam with common, fine strong brown and reddish yellow mottles in very fine root channels ; moderate coarse subangular blocky; firm (moist) hard (dry) few very fine tubular pores; many fine

		and very fine roots; clear, smooth boundary; pH 6.5
A12g	10-20	Black (10YR 2/1) silty clay loam with common, fine strong brown and reddish yellow mottles in very fine root channels; massive to weak coarse subangular blocky; firm (moist), hard (dry), common very fine tubular pores; common very fine roots; abrupt, slightly wavy boundary; pH 7.0
A2g	20-34	Light grey to grey (10YR 6/1) silt loam with very few, fine, diffuse light olive brown mottles mainly in upper 2 cm. of the horizon; weak prismatic; very friable (moist); few thick dark grey and black humus clay coatings on vertical ped faces ; many very fine and few fine mainly vertical tubular pores ; few very fine roots, gradual, wavy boundary ; pH 7.5
B21g	34-70	Light grey to grey (5YR 6/1) silt loam with many coarse yellowish brown, strong brown and light olive brown mottles weak prismatic breaking to coarse subangular blocky; slightly sticky, friable (moist); thick black humus clay coating in vertical pores and on few vertical ped faces; many fine vertical and very fine tubular, common very fine inter-stitial pores; few manganese nodules; few very fine roots; gradual, smooth boundary; pH 7.5
B22g	70-140	Light grey to grey (5YR 6/1) silt loam with common, medium diffuse light olive brown mottles few green and olive brown mottles; weak prismatic breaking to subangular blocky; slightly sticky, friable (moist), black humus clay coatings in pores; many fine vertical and very fine tubular pores; very few soft manganese nodules; pH 7.5
II BCg	140-180	Greenish grey (5GY 5/1), few, green and olive mottles, some of which are slightly hard; light clay; half ripe; pH 8.0

II Cg 180-250+ Dark greenish grey (5 GY 4/1), very few green mottles; silt loam; many shell fragments; pH 8.0

Cc : Chachoengsao Series

Profile Code No. : 14/1
Soil Name : Chachoengsao series : Cc
Classification : a) National : Hydromorphic Alluvial Soils
b) U.S.D.A : Typic Tropaquepts
Described by : Pons/van der Kevie
Date : 5 June 1968

I. INFORMATION OF THE SITE

Location : Ban Nam Doeng, Amphoe Muang, Chachoengsao Province
Elevation : 2 m.
Relief and slope : flat, no slope
Physiography : old tidal flat
Natural Vegetatin or Land Use : transplanted rice
Climate :
- Climate type : Tropical Savanna
- Annual rainfall : 1,400 mm.
- Mean temperature : 27.9°C

II. GENERAL INFORMATION ON THE SOIL

a. Parent material : alluvial breackish water
b. Drainage : poorly drained
c. Permeability : slow
d. Run off : slow
e. Ground water depth : fall below 1.5 m during the peak of the dry season
f. Other

III. PROFILE DESCRIPTION

Horizon	Depth (cm)	Description
Apg	0-15	Very dark grey (10YR 3/1), clay with few brown mottles mainly in pores; weak coarse subangular blocky; many roots; partly decomposed; clear, smooth boundary; pH 5.5

A11g	15-23	Very dark greyish brown (10YR 3/2) clay with black spots; few brown mottles and yellowish brown mottles; medium very coarse angular blocky, arranged in weak coarse prisms with curved faces (shell chaped); firm; few very fine tubular pores; common roots; gradual, wavy boundary; pH 5.5
B1g	23-70	Grey (2.5YR 6/1) clay with many coarse red mottles mainly in the upper part of the horizon common coarse prominent brownish yellow mottles; moderate coarse prisms with sharp angular breaking to weakly developed angular blocky, faces of prisms are smooth; friable (moist); some dark coating; few very fine, fine any medium tubular pores; few roots; gradual, smooth boundary; pH 6.5
B2g	70-125	Grey (5Y 6/1a) clay with many coarse prominent brownish yellow and yellowish brown mottles in lower part, mainly along root holes moderate coarse prismatic, breaking to small prisms with very sharp edges; sticky and plastic; humus clay coating in pores; common very fine tubular pores on ped faces and fine and medium vertical tubular pores; few soft and hard iron concretions; common very fine roots; gradual smooth boundary; pH 8.0
BCg	125-155	Grey (10YR 5/1) and 5Y 5/1) clay with few dark spots; very few brown, few green mottles along pores; moderate coarse prismatic breaking to medium angular blocky; sticky and plastic; nearly ripe; few slightly hard iron concretions; few very fine, fine and medium tubular pores; few partly decomposed roots; pH 8.0
C1g	155-240	Dark grey (5Y 4/1) clay; nearly ripe; few pieces of tissue
C2g	240-300	Greenish grey (5GY 5/1) clay; calcareous; nearly ripe.

Ca : Cha-am Series

Profile Code No. : SE 14/4
Soil Name : Cha-am series : Ca
Classification : a) National : Hydromorphic Alluvial Soils
b) U.S.D.A : Typic Tropaquepts
Described by : Kevie & Chalio
Date :

I. INFORMATION OF THE SITE

Location : Amphoe Bang Pakong, Chachoengsao Province
Elevation : 1 m.
Relief and slope : flat, slope 1 % or less
Physiography : former tidal flat
Natural Vegetatin or Land Use : transplanted and broadcast rice
Climate :
- Climate type : Tropical Savanna
- Annual rainfall : 1,000 - 1,400 mm.
- Mean temperature : 27.9°C

II. GENERAL INFORMATION ON THE SOIL

a. Parent material : brackish over marine sediments
b. Drainage : poorly drained
c. Permeability : slow
d. Run off : slow
e. Ground water depth : fall below 1.5 m during the peak of the dry season
f. Other

III. PROFILE DESCRIPTION

Horizon	Depth (cm)	Description
Apg	0-19	Dark greyish brown (10YR 4/2) clay with few fine distinct strong brown mottles, mainly along root channels; weak medium prismatic, breaking to coarse subangular blocky; firm (moist), sticky and plastic (wet); ripe: common

		fine and many very fine tubular pores; many very fine and few medium roots; clear, slightly wavy boundary; pH 4.5
B1g	19-46	Greyish brown (10YR 5/2) clay with many fine and medium prominent yellowish red mottles, mainly as coatings in pores and on ped faces; moderately weak, medium and coarse subangular blocky; firm (moist), sticky and plastic (wet); cracks of 4 mm wide extend in horizon down to 40 cm; common fine and very fine tubular pores; gradual smooth boundary; pH 4.5
B2g	46-90	Greyish brown to brown (10YR 5/2 - 7.5YR 5/2) clay with many medium and few coarse distinct pale yellow (jarosite) mottles, mainly as fillings in coarse root channels and on ped faces; moderately weak angular and subangular blocky; slightly firm (moist), sticky and plastic (wet); common very fine tubular pores; no roots; gradual, smooth boundary; pH 4.5
B3g	90-120	Dark grey to grey (5Y 4/1 - 5/1) clay with many coarse prominent very dark grey and reddish brown mottles as coatings on vertical ped faces; few medium and coarse prominent pale yellow (jarosite) mottles as very thin coatings on vertical ped faces; moderate coarse angular blocky; few fine and medium vertical pores; gradual, smooth boundary; pH 5.0
C1g	120-150	Dark grey (5Y 4/1) clay with few dark reddish brown mottles as coatings in medium pores; few dark reddish brown, slightly hard iron oxide coatings on vertical ped faces; sticky; plastic (wet); nearly ripe; diffuse, smooth boundary; pH 8.0
C2g	150-200	Dark greenish grey (5GY 4/1) clay with thin greenish grey silty clay layers of 3 cm. thickness; firm (moist), sticky and plastic (wet); half ripe; pH 8.0

Ok : Ongkharak Series

Profile Code No. : C 8/8 : C 8/8
Soil Name : Ongkharak series : Ok
Classification : a) National : Hydromorphic Alluvial Soils
 : b) U.S.D.A : Sulfic Tropaquepts
Described by : Kevie/Phichai
Date : 28 May 1970

I. INFORMATION OF THE SITE

Location : Amphoe Nong Sua, Prathum thani Province
Elevation : 2 m.
Relief and slope : flat
Physiography : old tidal flat
Natural Vegetatin or Land Use : rice
Climate :
- Climate type : Tropical Savanna
- Annual rainfall : 1,400 mm.
- Mean temperature : 27°C

II. GENERAL INFORMATION ON THE SOIL

a. Parent material : brackish water deposits
b. Drainage : poorly drained
c. Permeability : slow
d. Run off : slow
e. Ground water depth : fall below 1.0 m during the peak of the dry season
f. Other

III. PROFILE DESCRIPTION

Horizon	Depth (cm)	Description
Apg	0-13	Black (10YR 2/1) silty clay with few fine distinct strong brown mottles in pores; weak to moderate medium angular blocky, breaking to fine blocky; firm (moist), sticky and plastic (wet); many very fine intstitial and common

		very fine tubular pores; many very fine roots; gradual, wavy boundary; pH 4.5
ABg	13-28	Black (10YR 2/1) and light brownish grey (10YR 6/2) clay; many medium and coarse red, many fine and medium yellowish brown mottles; moderate fine angular blocky;; friable (moist), sticky and plastic (wet); many very fine interstitial and few very fine tubular pores; few very fine roots; gradual, wavy boundary; pH 4.5
B1g	28-37	Brown (7.5YR 5/2) clay; many medium and coarse red and yellowish brown, many fine and medium yellow (jarosite) mottles; moderate coarse angular blocky; breaking to fine blocky; firm (moist), sticky and plastic (wet); black humus clay coatings in pores; many very fine interstitial and common very fine and fine, mainly vertical tubular pores; few very fine root; gradual, wavy boundary; pH 4.5
B2g	37-140	Brown to greyish brown (7.5 YR 5/2 - 10YR 5/2) clay; many medium and coarse prominent yellow (jarosite) and few medium prominent brownish yellow mottles, mainly in vertical streaks; moderate coarse angular blocky, breaking to medium and fine blocky; firm (moist), sticky and plastic (wet); many pressure faces; common very fine and few medium vertical tubular pores; few very fine roots; pH 4.5
B3g	140-160	Brown (7.5YR 5/2) clay with few medium distinct yellowish brown mottles; half ripe
Cg	160-200	Dark grey (5Y 4/1) clay; half ripe.

Ma : Maha Phot Series

Profile Code No. : SE 12/7
Soil Name : Maha Phot series : Ma
Classification : a) National : Hydromorphic Alluvial Soils
b) U.S.D.A : Sulfic Tropaquepts
Described by : W. Van der Kevie
Date : 1969

I. INFORMATION OF THE SITE

Location : Amphoe Si Mahaphot, Prachin Buri Province
Elevation : 2 - 4 m. above sea level
Relief and slope : flat, slope less than 1 %
Physiography : river basin
Natural Vegetatin or Land Use : Broadcast rice
Climate :
- Climate type : Tropical Savanna
- Annual rainfall : 1,000 - 1,400 mm.
- Mean temperature : 27°C

II. GENERAL INFORMATION ON THE SOIL

a. Parent material : river alluvial over brackish sediments
b. Drainage : poorly drained
c. Permeability : slow
d. Run off : slow
e. Ground water depth : fall below 1.5 m. during the peak of the dry season
f. Other

III. PROFILE DESCRIPTION

Horizon	Depth (cm)	Description
Apg	0-12	Black (10YR 2/1) clay with common, fine strong brown mottles along root channels; moderate crumb structure; sticky and plastic; friable (moist); many very fine roots; clear, slightly wavy boundary, pH 5.0

A12g	12-32/35	Black (10YR 2/1) clay with common fine strong brown mottles; weak coarse angular blocky; sticky and plastic, firm (moist); common pressure faces; common very fine and few fine tubular pores; common very fine roots; clear, wavy boundary, pH 5.0
B1g	32/35-51/59	Dark greyish brown (10YR 4/2) clay with some inclusions of dark material; many, fine and medium brown and many, fine and medium dark reddish brown mottles along root channels; moderate medium angular blocky; sticky and plastic; firm (moist); many very fine and common fine vertical tubular pores; few very fine roots; gradual, wavy boundary, pH 4.5
B2g	51/59-140	Greyish brown (10YR 5/2) clay with many, medium red, few, fine dark red and common, medium brownish yellow mottles; moderate medium angular blocky, breaking into fine blocky and arranged in prisms; sticky and plastic; (wet), firm (moist); few slickensides; many very fine and fine vertical tubular pores and few medium vertical tubular pores; few very fine roots, pH 4.5
C1g	140-170	Greyish brown (10YR 5/2) clay with few to common yellow and brownish yellow mottles; half ripe, pH 6.5
C2g	170-200+	Greyish brown (10YR 5/2) clay; pH 6.5

Rs : Rangsit Series

Profile Code No. : C 8/7
Soil Name : Rangsit series : Rs
Classification : a) National : Hydromorphic Alluvial Soils
b) U.S.D.A : Sulfic Tropaquepts
Described by : Kevie/Phichai
Date : 28 May 1970

I. INFORMATION OF THE SITE

Location : Amphoe Nong Sua, Prathum Thani
Elevation : 2 m.
Relief and slope : flat
Physiography : old tidal flat
Natural Vegetatin or Land Use : rice
Climate :
- Climate type : Tropical Savanna
- Annual rainfall : 1,400 mm.
- Mean temperature : 27°C

II. GENERAL INFORMATION ON THE SOIL

a. Parent material : brackish water deposits
b. Drainage : poorly drained
c. Permeability : slow
d. Run off : slow
e. Ground water depth : fall below 1 m during the peak of the dry season
f. Other

III. PROFILE DESCRIPTION

Horizon	Depth (cm)	Description
Apg	0-15	Very dark grey to black (10YR 3/1 - 2/1) clay with common fine distinct yellowish brown mottles, mainly in pores; moderate coarse subangular blocky, breaking to medium and fine blocky, firm (moist); sticky and plastic (wet);

		few very fine interstitial and tubular pores; many fine roots; gradual slightly wavy boundary; pH 5.0
A12g	15-30	Very dark grey to black (10YR 3/1 - 2/1) clay with many fine and medium yellowish brown and few fine red mottles; weak to moderate medium angular blocky breaking to fine blocky; firm (moist), sticky and plastic (wet); few slickensides; common very fine interstitial and few very fine tubular pores; few very fine roots; gradual, wavy boundary; pH 4.5
B1g	30-49	Greyish brown (10YR 5/2) and very dark greyish brown (10YR 3/2) clay with many medium and coarse red and dark red, many fine and medium yellowish brown mottles; moderate medium and fine angular blocky; firm (moist), sticky and plastic (wet); common slickensides and pressure faces; many very fine interstitial and few very fine tubular pores; few very fine roots; gradual, smooth boundary; pH 4.5
B21g	49-59	Brown (7.5YR 4/2) with few small inclusions of very dark grey clay; many medium and coarse red and dark red, many fine pale yellow (jarosite) and few fine yellowish brown mottles; moderate medium and fine angular blocky; firm (moist), sticky and plastic (wet); common pressure faces and slickensides; many very fine interstitial, few fine tubular pores; few very fine roots; clear, wavy boundary; pH 4.5
B22g	59-110	Brown (7.5YR 5/2) clay; many medium and coarse yellow (jarosite) and few and yellowish brown mottles, mainly as vertical streaks (fillings of coarse tubular pores and cracks); moderate coarse prismatic, breaking to angular blocky; firm (moist), sticky and plastic (wet); few slickensides; few very fine tubular and few fine and medium vertical tubular pores; pH 4.5

B23g	110-160	Brown (7.5YR 5/2) clay; common medium and coarse yellowish brown, few medium yellow (jarosite) mottles; half ripe; pH 6.0
BCg	160-190+	Dark grey to dark greenish grey (5Y 4/1 - 5GY 4/1) clay; half ripe; pH 6.0

Dm ; Don Muang Series

Profile Code No. : C 10/6
Soil Name : Don Muang series : Dm
Classification : a) National : Hydromorphic Alluvial Soils
b) U.S.D.A : Sulfic Tropaquepts
Described by : Kevie/Sanan/Preecha
Date : 8 april 1970

I. INFORMATION OF THE SITE

Location : Amphoe Bang Khen, Bangkok
Elevation : 2 m.
Relief and slope : flat
Physiography : old tidal flat
Natural Vegetatin or Land Use : Transplanted rice
Climate :
- Climate type : Tropical Savanna
- Annual rainfall : 1,000 - 1,400 mm.
- Mean temperature : 27°C

II. GENERAL INFORMATION ON THE SOIL

a. Parent material : sandy brackish water deposits
b. Drainage : poorly drained
c. Permeability : slow
d. Run off : slow
e. Ground water depth : fall below 1.5 m during the peak of the dry season
f. Other

III. PROFILE DESCRIPTION

Horizon	Depth (cm)	Description
Ap1g	0-10	Very dark grey to very dark greyish brown (10YR 3/1 - 3/2) clay loam with common very fine yellowish red mottles along root channels; weak coarse and medium subangular blocky; slightly sticky and slightly plastic (wet), firm

		(moist); few fine and very fine tubular pores; common very fine roots; abrupt slightly, wavy boundary; pH 5.5
Ap2g	10-18	Very dark grey (10YR 3/1) clay loam with common fine yellowish red mottles; few very fine tubular pores; common very fine roots; abrupt, slightly wavy boundary; pH 5.5
A2g	18-27	Greyish brown (10YR 5/2) clay loam with few very fine strong brown mottles, mainly along root channels; weak medium subangular blocky; slightly firm (moist); common very fine vertical tubular pores; few very fine roots; gradual, wavy boundary; pH 5.5
B1g	27-71	Dark greyish brown (10YR 4/2) loam; few coarse slightly hard red, and few coarse slightly hard strong brown mottles; weak coarse sub-angular blocky; firm (moist); humus clay coatings in fine tubular pores; common very fine roots; clear; wavy boundary; pH 5.5
B2g	71-90	Light brownish gray (10YR 6/2) loam; many coarse weak red, coarse yellowish brown and brownish yellow and few fine yellow (jarosite) mottles; moderate fine subangular blocky; slightly sticky and plastic, friable (moist); few thin humus coating on ped faces and in pores and some hard iron pipes; many very fine and common fine tubular pores; pH 4.5
II B2g	90-170	Light brownish grey (10YR 6/2) clay with many coarse brownish yellow and common medium yellow (jarosite) mottles; nearly ripe; pH 4.5
II BCg	170-210	Greyish brown (10YR 5/2) clay with few medium brownish mottles along vertical root channels; some iron pipes; pH 5.5
II C1g	210-220	Grey (5Y 5/1) clay half ripe pH 6.0
II C2g	220-260+	Dark grey (5YR 4.1) clay; half ripe; pH 6.0

Hk : Hin Khong Series

Profile Code No. : SE 14/21
Soil Name : Hin Khong series : Hk
Classification : a) National : Low Humic Gley Soils
b) U.S.D.A : Aeric Paleaquults?
Described by : Pisoot Vijansorn
Date : 4 May 1975

I. INFORMATION OF THE SITE

Location : Amphoe Sanamchai Khet, Changwat Chachoengsao
Elevation : 10 m.
Relief and slope : flat, slope 1 %
Physiography : low terrace
Natural Vegetation or Land Use : paddy field
Climate :
- Climate type : Tropical Savanna
- Annual rainfall : 1,378.6 mm.
- Mean temperature : 27.9°C

II. GENERAL INFORMATION ON THE SOIL

a. Parent material : semi-recent alluvium
b. Drainage : poorly drained
c. Permeability : slow
d. Run off : slow
e. Ground water depth : 2 m.
f. Other

III. PROFILE DESCRIPTION

Horizon	Depth (cm)	Description
Ap	0-17	Brown (10YR 5/3) silty loam; common fine distinct yellowish brown mottles; weak fine subangular blocky structure; soft, slightly sticky, slightly plastic; abundant very fine

		and fine roots; strongly acid abrupt smooth boundary; pH 5.5
B1	17-34	Pale brown (10YR 6/3) silty loam; common fine and medium distinct strong brown mottles; weak to medium subangular blocky structure; hard, slightly sticky and plastic; many silt coating along vertical ped faces ; few/very fine roots; strongly acid gradual smooth boundary; pH 5.0
B21tg	34-55	Light brownish gray (10YR 6/2) heavy silt loam; many medium distinct strong brown mottles; moderately medium and coarse sub-angular blocky structure; very hard, sticky and plastic; common moderately thick along and silt coating on ped faces; very strongly acid (pH 4.5)
B22tg	55-125	Grayish brown (7.5YR 5/2) silty clay loam; many medium and coarse strong brown mottles; other characteristic indentical to above horizon more thick coating on ped faces

Cb : Chon Buri Series

Profile Code No. : SE 14/44
Soil Name : Chon Buri series : Cb
Classification : a) National : Low Humic Gley Soils
 : b) U.S.D.A : Paleaqualfs
Described by : Pradit & Vibul
Date : 27 April 1977

I. INFORMATION OF THE SITE

Location : Ban Thung Sadao, Amphoe Bang Khla, Chachoengsao
 Province
Elevation : 20 m.
Relief and slope : flat
Physiography : terrace deposit
Natural Vegetatin or Land Use : paddy field
Climate :
 - Climate type : Tropical Savanna
 - Annual rainfall :
 - Mean temperature :

II. GENERAL INFORMATION ON THE SOIL

a. Parent material : old alluvium
b. Drainage : somewhat poorly drained
c. Permeability : slow
d. Run off : slow
e. Ground water depth : more than 150 cm
f. Other

III. PROFILE DESCRIPTION

Horizon	Depth (cm)	Description
Ap	0-14/21	Grayish brown (10YR 5/2) and light yellowish brown (7.5YR 6/4); many fine and medium faint brown (7.5YR 4/4) mottles, sandy loam, moderate medium and coarse subangular blocky structure;

		friable, slightly sticky, slightly plastic; few fine roots; clear and wavy boundary; pH 6.5.
B1	14/21-30	Pale brown (10YR 6.3), common fine distinct yellowish brown (10YR 5/6) mottles, mainly along root channels, light sandy clay loam; moderate medium and coarse subangular blocky structure ; friable, slightly sticky and plastic; few fine roots; clear and wavy boundary; pH 6.5.
B21t	30-60	Light brownish gray (10YR 6/2), common fine and medium distinct strong brown (7.5YR 5/6) mottles, sandy clay loam; moderate medium and coarse subangular blocky structure; friable, slightly sticky and plastic; patchy thin clay coating on ped faces and continuous thick in pores; few fine roots; gradual smooth boundary; pH 6.0.
B22t	60-80	Light yellowish brown (10YR 6/4), common fine and medium distinct strong brown (7.5YR 5/8) mottles; sandy clay loam; weak fine and medium subangular blocky structure; friable, sticky and plastic; broken moderately thick clay coating on ped faces and continuous thick clay coating in pores; few fine roots; clear smooth boundary; pH 5.5.
B23t	80-110	Light yellowish brown (10YR 6/4) and very pale brown (10YR 7/3), common medium distinct strong brown (7.5YR 5/8) common medium distinct yellowish brown (10YR 5/8) and few medium prominent yellowish red (5YR 5/8) mottles; sandy clay loam; weak fine and medium subangular blocky structure; friable sticky and plastic; broken moderately thick on ped faces and continuous thick clay coating in pores; few fine roots; pH 5.0

K1 : Klaeng Series

Profile Code No. : SE 14/3
Soil Name : Klaeng series : K1
Classification : a) National : Low Humic Gley Soils
 : b) U.S.D.A : Oxic Plinthaquults
Described by : Kevie, chalieo
Date : 23 April 1969

I. INFORMATION OF THE SITE

Location : Changwat Chachoengsao
Elevation : 10 - 20 m.
Relief and slope : low terrace, flat
Physiography : level terrain of the lower portion of low terraces
Natural Vegetatin or Land Use : transplanted rice (20 tang/rai)
Climate :
- Climate type : Tropical Savanna
- Annual rainfall : 1,387.6 mm.
- Mean temperature : 27.9°C

II. GENERAL INFORMATION ON THE SOIL

a. Parent material : old alluvium
b. Drainage : somewhat poorly drained
c. Permeability : estimated to be slow
d. Run off : slow
e. Ground water depth : below 1 m. during the peak of the dry season
f. Other

III. PROFILE DESCRIPTION

Horizon	Depth (cm)	Description
Ap	0-12	Clay (10YR 4/2-3); fine faint yellowish brown (10YR 5/8) and few moderate prominent (10R 4/8) mottles; with fine and medium subangular blocky; firm; slightly sticky, slightly plastic few very fine tubular pores and common fine and

		very fine interstitial pores; few very fine roots; clear smooth boundary
B1t	12-24	Clay with coarse sand fragment; (10YR 5/1-6/2) common fine and medium subangular blocky (7.5YR 5/8) and common medium (10r 4/6) mottles; moderate fine and medium subangular blocky; friable; slightly sticky and slightly plastic; common very fine tubular and many fine and very fine interstitial pores; few fine hard Fe-Mn concretion; thin patchy clay coatings on ped faces and pores; gradual & smooth boundary
B21t	24-48	Clay with coarse sand fragment; (10YR 6/2) common fine and medium brownish yellow (10YR 4/8) and common medium red (10R 4/6) mottles; some inclusions of sandy clay with (10Yr 4/1) color; moderate weak medium subangular blocky; slightly friable; slightly sticky; slightly plastic; moderate thick broken clay coating on ped faces and in pores; many very fine interstitial pores; no roots; clear smooth boundary
Bg2t	48-70/85	Clay with coarse sand fragment (10YR 6/2 and 10YR 5/2) coatings; many red (10R 4/6) mottles; moderate medium subangular blocky; friable, slightly sticky and slightly plastic, moderate thick continuous clay coatings on ped faces and in pores; common very fine tubular and many very fine interstitial pores; no root clear wavy boundary
B23t	70/85-120	Clay with coarse sand fragment; (10YR 6/1 and 10YR 5/2) for coatings; very few medium strong brown (7.5YR 5/6) and few fine red (10R 4/6) mottles; moderate weak medium subangular blocky, friable, slightly sticky and slightly plastic; thin broken clay coatings on ped faces and in pores; common very fine tubular and few fine tubular pores; common fine and very fine interstitial pores; few very fine roots;

Kkn : Ko Khanun Series

Profile Code No. : CC-II
Soil Name : Ko Khanun series : Kkn
Classification : a) National : Low Humic Clay Soils
b) U.S.D.A : Aeric Oxic Plinthaquults?
Described by : Pisoot Vijansorn
Date : 4 May 1975

I. INFORMATION OF THE SITE

Location : 2.5 km. east of Amphoe Sanam chai Khet, Tambon Bang Mafuang, Amphoe Sanam Chai Khet, Changwat Chachoengsao
Elevation : 15 m.
Relief and slope : nearly flat, slope 1 %
Physiography : middle terrace
Natural Vegetatin or Land Use : mixed deciduous forest
Climate :
- Climate type : Tropical Savanna
- Annual rainfall : 1,378.6 mm.
- Mean temperature : 27.9°C

II. GENERAL INFORMATION ON THE SOIL

a. Parent material : relatively old alluvium
b. Drainage : somewhat poorly drained
c. Permeability : moderate
d. Run off : slow
e. Ground water depth : 3.5 m.
f. Other

III. PROFILE DESCRIPTION

Horizon	Depth (cm)	Description
A1	0-7	Dark grayish brown (10YR 4/2-4/3) loam; few fine faint dark grayish brown mottles; weak fine and medium subangular blocky structure;

		friable, slightly sticky slightly plastic; few fine roots; medium acid clear smooth boundary; pH 6.0
A2	7-22	Pinkish gray (5YR 6/2-6/3); fine sandy loam to loam; weak medium subangular blocky structure; friable, slightly sticky slightly plastic; few fine medium roots; strongly acid clear smooth boundary; pH 5.5
B1	22-48	Light reddish brown (5YR 6/4); fine sandy loam to loam; many medium distinct yellowish red mottles; weak medium subangular blocky structure; friable, slightly sticky and plastic; few fine and medium root; very strongly acid gradual smooth boundary; pH 5.0
B21t	48-73	Light pinkish gray (5YR 6/2); clay loam; many medium prominent yellowish red; moderately medium to coarse subangular blocky structure; friable, sticky and plastic; few fine clay coating; plinthited of red color forming continuous compose of 5-10 % by volume; common fine and medium roots; very strongly acid gradual smooth boundary; pH 5.0
B22t1	73-100	Pinkish gray (5YR 7/2); clay loam; common medium distinct strong brown and dark red mottles; moderately medium subangular blocky structure; friable, sticky and plastic; common fine clay coating; on ped faces plinthites forming as continuous faces; very strongly acid gradual smooth boundary; pH 5.0
B23t	100-125	Light gray (5YR 7/1); clay loam; common medium prominent yellowish red mottles; other features almost identical to above horizon except more plinthite.

Bbg : Ban Bung Series

Profile Code No. : SE 15/21
Soil Name : Ban Bung : Bbg
Classification : a) National : Hydromorphic Regosolic Gray Podzolic
Soil
b) U.S.D.A : Aquic Arinic Eutrochrepts
Described by : Chalileo-Mitri
Date : 7 August 1973

I. INFORMATION OF THE SITE

Location : Amphoe Ban Bung, Chon Buri Province
Elevation : 60 m.
Relief and slope : nearly flat, 1 %
Physiography :
Natural Vegetatin or Land Use : cassava, sugar cane
Climate :
- Climate type : Tropical Savanna
- Annual rainfall : 1,379.4 mm.
- Mean temperature : 27.9°C

II. GENERAL INFORMATION ON THE SOIL

a. Parent material : old sandy alluvium
b. Drainage : somewhat poorly to moderately well drained
c. Permeability : rapid
d. Run off : slow
e. Ground water depth : > 1.5 m almost the year
f. Other

III. PROFILE DESCRIPTION

Horizon	Depth (cm)	Description
Ap	0-20	Grayish brown (10YR 5/2) sandy loam; weak coarse subangular blocky structure; friable, non sticky, non plastic; many fine interstitial, few fine and medium tubular

		pores; common fine roots; clear smooth boundary to A21 ; pH 8.0
A21	20-42	Very pale brown (10YR 7/3) loamy sand with common coarse dark brown (7.5YR 3/2, 7.5YR 4/4) mottles; massive; slightly firm, non sticky, non plastic; many fine interstitial, few fine and medium tubular pores; more compact than above horison; few fine roots; gradual smooth boundary to A22; pH 8
A22	42-95	Very pale brown (10YR 7/3) loamy coarse sand with many coarse and medium brown and dark brown mottles ; very meak coarse subangular blocky structures breaking into single grains; friable, non sticky, non plastic; many fine and medium interstitial, common fine tubular pores; no root; gradural smooth boundary to B1; pH 8.0
B1	95-130	Light brown (7.5YR 6/4) loamy coarse sand with many medium and coarse strong brown mottles; very weak coarse subangular blocky structre; friable, non sticky, non plastic; many fine and medium interstitial, few fine tubular pores; common slightly hard, few hard iron nodules; gradual smooth boundary to B2; pH 8.0
B2	130-150+	Pinkish gray (5YR-7.5YR 7/2) sandy loam with common medium and coarse brownish yellow and few corase strong brown mottles; weak coarse subangular blocky structure; firm, slightly sticky, non plastic; many fine and medium interstitial, few fine tubular pores; common slightly hard iron nodules; pH 8.0

6. SOIL ANALYSIS DATA

Soil analysis data have been tabulated in Table 4. Major soil chemical properties and fertility level is shown in Table 5.

7. SOIL SUITABILITY CLASSIFICATION

Five classes of soil suitability are designated for paddy (P), non-flooded annual crop (N) and fruit tree (F) as followings ;

Class-I Soils very well suited having no significant limitations.

Class-II Soils well suited having slight limitations.

Class-III Soils moderately suited having moderate limitations.

Class-IV Soils poorly suited having severe limitations.

Class-V Soils not suited having very severe limitations.

At the lower level, the suitability classes are further divided into subclasses based on kinds and degree of limitation hazard.

Main limitations are namely.

f : flooding

x : salinity

s : unfavorable surface texture

j : jarosite

n : low nutrient status

w : risk of water shortage

t : unfavorable topography

Suitability subclass for paddy, non-flooded upland crop and fruit tree of each soil series are presented in Table-6.

7.1 Soil Suitability for Paddy

In total area of 60,600ha, sorts suited for paddy cover 55,770ha or 92.03%. The rests of 4,800ha and 30ha or 7.92% and 0.05% are not suited and others.

The soils suited for paddy of 55,770ha can be further classified into 3 classes namely.

1) Soils very well suited (p-III)	16,750ha	or	27.65%
2) Soils moderately suited (p-III)	32,210ha	or	58.10%
- due to unfavorable texture (p-III s)	2,740ha	or	4.52%
- due to present of jarosite (p-III j)	25,970ha	or	42.85%
- due to risk of water shortage (p-III w)	6,500ha	or	10.73%
3) Soils poorly suited due to present of jarosite at shallow depth (L40cm) from surface (P-Nj)	3,810ha	or	6.82%

Area coverages of soil suitability classes and subclasses for paddy of existing / expansion of The Lat and Bang Pakong are shown in Table-6.

7.2 Soils Suitability for Upland Crops (N) and Fruit Tree (F)

From Table-5 it indicates that most soils are suited for paddy and not suited for upland crops and fruit tree because of flooding. This is classified for cultivation period in rainy season only. But in dry season these paddy soils can be grown with upland crops having some limitations namely poor drainage of soils and jarosite TP. The NBC soils (undifferentiated ridged acid soils) can be grown well with upland crops and fruit trees. On this unit, if existing land uses are orchards, they will be not suited for upland crops.

On Ko Khanun series (Kkn) on the basis of limitations, potential to be planted with rice, upland crops and fruit trees are nearly equal. Main limitations for growing upland crops and fruit trees are poor drainage of soils which may damage crops if the soils are excessive saturated. This can be corrected by making furrows or ridges.

8. PROBLEM SOILS

The term "problem soils" refers to those having certain chemical or physical characteristics which restrict agricultural development. In study area, acid sulfate soils are dominant.

8.1 Acid Sulfate Soils

8.1.1 Their Characteristics and Effects

Acid sulfate soils are formed from brackish water sediments which have high content of sulfides, the principal one being pyrite (FeS_2). When these soils are exposed to aerobic condition, complex chemical and biological oxidation process occur, resulting in the formation of sulfates, and in the absence of sufficient neutralizing materials, free hydrogen ions associate with the sulfate.

An important mineral formed during the oxidation is a basic ferric sulfate or jarosite ($\text{KFe}_3(\text{SO}_4)_2(\text{OH})_6$). This is a pale yellow or straw yellow material which produces the characteristic mottling giving the descriptive term "catclay". It causes strongly to extremely acid reaction and occurs above the pyrites which is the dark grayish or bluish marine clay horizon. This pyrite horizon has pH of 7.0 to 8.0 and found at the deep subsoils normally below 150cm.

These acid sulfate soils are problem due to the followings :

(1) Some primary and trace elements will be changed to undissolved forms which are unavailable to plants.

(2) Iron, aluminium and manganese are excessively dissolved until reaching toxic level. In this condition nitrogen, phosphorus will be fixed and precipitated and the plants cannot utilize them.

(3) Soil micro organisms which are very useful to plants will be not active in acid soils. Decomposition of organic matters will be slow down resulting in the release of nitrogen, phosphorus and sulfur is very poor. These are why these elements are deficient in acid soils.

(4) Acid soils have poor physical properties such as too heavy texture, very poor drainage. This makes the soils not suited for growing upland crops during off-season of growing rice.

Acid sulfate soils in the study area are Cha-am series, Mahaphot series, Rangsit series, Ongkharak series, Don Muang series and undifferentiated ridged acid soils making total area of 34,520ha or 56.95%. In this amount,

24,290ha, 7,290ha and 2,940ha, are respectively present in existing Tha Lat area, existing and expansion of Bang Pakong area. They are under rice cultivation. Some parts have been changed to other uses such as orchard plantations, of tangerin, mango, coconut and bettel nut.

8.1.2 Improvement Method

(1) Hydrotechnical Method

This method is to wash out sultate form the soils by water through flooding, draining and leaching system. Sufficient good irregation water to flood the area is required. The acid compounds will be dissolved into the water and leached down and drained out through ditches and drainage ways. Ground water has to be controled to stay at appropriate level in order to leach and drain sultate efficiently. In rainy season, the sultate will decrease naturally especially when they are under paddy cultivation. Flooding the area before trasplanting is practical method.

(2) Lime Application

Limes are the oxide, hydroxide and carbonate of calcium and magnesium. These compouds are the acid soil amendment materials. They may be in the forms of ground lime, flue dust, white lime, burned and ground shell and marl. It is found by the Department of Land Developoment that marl is the most effictive acid soil amendment material. It naturally occurs in enormous amount in lime stone areas of Nakhon Sawan, Lop Bun and Saraburi. Lime station of DLD. is at Phra Bhudabhat district, Saraburi province. Recommended rates are 1-1.5 tons per rai (6.25-9.38 tons per ha) for slight acid soils and 1.5-2.0 tons per rai (9.38-12.50 tons per ha) for strong acid soils in every five year. It should be applied with 30kg / rai (187.5kg / ha) of ammonium phosphate (16-20-0). Suggested practice is flooded with water after marl application and then plowing and transplanting.

Results of Lime Application to Soils

Lime application to soils results in improving some soil properties which are favorable to crops.

(a) Improve physical properties of soils. Soil structures will become more granular and cumb which is more friable and good for plant growth.

(b) Improve chemical properties of soils pH will be raised and some chemical properties will be changed to better condition

- reduce H+
- reduce toxic iron, alluminum and manganese

- increase available phosphorus and molybdenum
- increase available calcium and magnesium

(c) Improve biological properties of soils. Soil organisms will become more active which will accelerate the processes of amination, ammonification and nitrification which will release many elements essential to plants such as nitrogen, phosphorus, etc..

(d) Lime will help reduce or slow down the growth of some diseases in soils. There are three different kinds of lime popularly used in Thailand

1) Raw lime : from burned limestone and shell and grinding together having 85-98% purity.

2) White lime : made by burning limestone and spraying with water when cold, having 95-96% purity.

3) Marl : from carbonate of limestone with shell having 75-99% pure. This type is the most popular.

(3) Other Methods

There are some other methods such as application of rock phosphate. This must be applied every year. Biological methods such as use of crop types / varieties that are tolerant to acid soils such as rice, water melon, pine tree, eucalyptus, tangerin, mango. However, adequate irrigation water and liming are necessary.

Table B-45 Landform, Parent Material and Classification of Soils :

Landform and Parent Material		Mapping Symbol	Soil Series	Subgroup	Family
marine deposits		Sm	Smut Prakarn	Type Tropaquept	fine clayey, mixed, non acid
	blackish water deposits over marine deposits	Bk	Bangkok	Type Tropaquept	very fine clayey, mont, non acid
		Ptg	Phan Thong	Type Tropaquept	fine silty, mixed, non acid
		Cc	Chachoengsao	Type Tropaquept	very fine clayey mont, non acid
	blackish water deposits deposits	Ca	Cha-am	Sulfie Tropaquept	very fine clayey, mont, non acid
		Ok	Ongkharak	Sulfie Tropaquept	very fine clayey mixed acid
		Ma	Mahaphot	Sulfie Tropaquept	very fine clayey mixed acid
		Rs	Rangsit	Sulfie Tropaquept	very fine clayey mixed acid
		Dm	Don Muang	Sulfie Tropaquept	very fine clayey mixed acid
		NBC	Undifferentated ridged acid soil	—	—
Hk		Hinkong	Aeric Paleaquult	fine silty, mixed	
old alluvium	Cb	Chon Buri	Typic Tropaqualf	fine loamy, mixed	
	Kl	Klaeng	Typic Plinthaquult	clayey, kaolinitic	
residuum and colluvium from grance	Kkm	Ko Knanun	Aeric Plinthaquult	fine loamy, mixed	
	Bbg	Ban Bung	Vadic (Aquic) Quartzipsamment		

Table B-46 Major Physical Characteristics of Soils in Project Area (1/5)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	a) Drainage b) Permeability
1. Sm : Smut Prakarn	0-1	very deep	a) clay b) clay	a) gray or brownish gray with brownish mottles b) gray or olive gray with dark brown and yellowish red mottles, greenish gray colour occurs at lower depth	a) poorly b) slow
2. Bk : Bangkok	0-1	very deep	a) clay b) clay with some gypsum	a) dark gray with brownish, yellowish red mottles b) gray, dark gray, dark greenish gray with yellowish brown, brownish and greenish mottles	a) poorly b) slow
3. Ptg : Phan Thong	0-1	very deep	a) sandy clay loam or clay loam b) sandy clay loam or clay loam	a) very dark gray, black or light gray to gray with strong brown, yellowish red and light olive brown mottles b) light gray, greenish gray with yellowish brown, strong brown and olive brown mottles	a) poorly b) moderate

Table B-46 Major Physical Characteristics of Soils in Project Area (2/5)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	Drainage a) Drainage b) Permeability
4. Cc : Chachoengsao	0-1	very deep	a) clay, silty clay b) clay	a) dark gray or black with brownish and yellowish red mottles b) gray with brown or red mottles over greenish gray below 100 cm.	a) poorly b) slow
5. Ca : Cha-am	0-1	very deep	a) clay b) clay	a) brown, dark grayish brown with yellowish mottles b) brownish gray, dark brown, dark gray to greenish gray and dark greenish gray with pale yellowish, straw yellow and yellowish red or strong brown mottles	a) poorly b) slow
6. Ok : Ongkharak	0-1	very deep	a) clay to silty clay b) clay	a) very dark gray to black with brown and yellowish red mottles b) brown or grayish brown with yellow mottles (jarosite) shallower than 40 cm. over dark gray below 150 cm.	a) poorly b) slow

Table B-46 Major Physical Characteristics of Soils in Project Area (3/5)

Soil Series	Slope (%)	Soil Depth	Texture a) Surface b) Subsoil	Colour a) Surface b) Subsoil	Drainage a) Permeability b) Permeability
7. Ma : Mahaphot	0-1	very deep	a) clay b) clay	a) very dark gray to black with brown mottles b) grayish brown or brown with red and yellow mottles (jarosite) at deep subsoil over greenish gray	a) poorly b) slow
8. Rs : Rangsit	0-1	very deep	a) clay b) clay	a) black or very dark gray with brown mottles b) brown or grayish brown with red and yellow mottles (jarosite) at below 40 cm. over dark gray below 150 cm.	a) poorly b) slow
9. Dm : Don Muang	0-1	very deep	a) sandy clay, clay loam or clay b) sandy clay loam or sandy clay	a) very dark gray or black with yellowish red, and strong brown mottles b) grayish brown or brown with red or pale red, brownish yellow and yellow mottles (jarosite)	a) poorly b) moderate
10. NBC : Undifferentiated ridged acid soils	-	very deep	The unit consists of alluvial complex soils which are ridged for orchards and cannot be separated as individual unit		a) well b) slow

Table B-46 Major Physical Characteristics of Soils in Project Area (4/5)

Soil Series	Slope (%)	Soil Depth	Texture		Colour		Drainage Permeability	
			a) Surface	b) Subsoil	a) Surface	b) Subsoil	a)	b)
11. Hk : Hin Kong	0-1	very deep	a) silt loam		a) pale brown or brown with brown		a) somewhat - poorly	
			b) silty clay loam over silty clay or clay		b) pale brown to pinkish gray with brown mottles over gray with brown and red mottles		b) slow	
12. Cb : Chon Buri	0-1	very deep	a) sandy loam or sandy clay loam		a) grayish brown with brown mottles		a) somewhat - poorly	
			b) sandy clay loam to sandy clay		b) light gray or pinkish gray with brown mottles		b) moderate	
13. Kl : Klaeng	0-1	very deep	a) sandy loam or clay loam		a) grayish brown with brown mottles		a) somewhat - poorly	
			b) sandy clay loam to sandy clay over clay		b) grayish brown to gray with strong brown and red mottles over light gray with red mottles below 100 cm.		b) moderate	

Table B-46 Major Physical Characteristics of Soils in Project Area (5/5)

Soil Series	Slope (%)	Soil Depth	Texture		Colour		a) Drainage b) Permeability
			a) Surface b) Subsoil	a) Surface b) Subsoil	a) Surface b) Subsoil	a) Surface b) Subsoil	
14. Kkn : Ko Khanun	0-1	very deep	a) loam	a) brown	a) moderately well	a) moderately well	
			b) loam, clay loam	b) reddish gray or pinkish gray with many red mottles	b) moderate	b) moderate	
15. Ebg : Ban Bung	0-2	deep	a) sandy loam or loamy sand	a) grayish brown, brown or strong brown	a) excessively	a) excessively	
			b) loamy sand	b) pinkish gray, light brown or light reddish brown	b) rapid	b) rapid	

Table B-47 Area of Soil Series by Irrigation Block

Mapping Symbol	Soil Series	Tha Lat.		Bang Pakong		Total	
		Existing	Expansion	Existing	Expansion	Hectare	%
1.Sm	Smut Prakarn	—	—	810	—	810	1.34
2.Bk	Bangkok	470	—	3,600	80	4,150	6.85
3.Ptg	Phan Thong	—	—	2,400	—	2,400	3.96
4.Cc	Chachoengsao	1,550	—	3,300	80	4,930	8.14
5.Ca	Cha-am	—	—	470	—	470	0.78
6.Ok	Ongkharak	3,210	—	130	—	3,340	5.50
7.Ma	Mahaphot	6,330	—	430	—	6,760	11.15
8.Rs	Rangsit	8,060	—	560	—	8,620	14.22
9.Dm	Don Muang	6,690	—	3,800	100	10,590	17.48
10.NBC	Undifferentated ridged acid soil	—	—	1,900	2,840	4,740	7.82
11.Hk	Hinkong	—	1,650	—	—	1,650	2.72
12.Cb	Chon Buri	—	340	—	—	340	0.56
13.Kl	Klaeng	4,590	620	—	—	5,210	8.60
14.Kkm	Ko Knanun	—	6,500	—	—	6,500	10.73
15.Bbg	Ban Bung	—	60	—	—	60	0.10
	Other soils	—	30	—	—	30	0.05
Total		30,900	9,200	17,400	3,100	60,600	100.00

Table B-48 Results of Soil Analysis

Soil Name and Laboratory Number	Horizon	Depth (cm)	Particle Size Analysis				pH		CaCO ₃ %	Conductivity 1:5 EC x 10 ⁶	Carbon %	Nitrogen %	Exchange Capacity And Cations (Milli-equiv/100g)							Base saturation % $\frac{B \times 100}{B+A}$	P p.p.m Bray NO.2	K p.p.m Ammon Acetate		
			Coarse frac- tion %	Sand	Silt	Clay	H ₂ O	KCl					Ca	Mg	K	Na	Sum Basis (B)	Extra Acidity (B)	Sum (B+A)				CEC Soil	CEC Clay
Semut Prakan series (Sm)	A9g	0-12	5	30	65	6.4	6.4	1.9	3,000	0.23	-	10.8	15.0	2.3	1.1	29.2	7.3	36.5	42.3	46.6	89	211	1110	
	A3g	12-18	2	35	63	7.1	7.1	3.1	1,000	0.43	-	15.2	16.8	2.6	4.8	39.4	4.8	44.2	41.1	65.8	89	243	1095	
	B2g	18-84	5	52	43	7.2	7.2	5.4	2,600	0.78	-	8.7	14.9	2.3	0.0	25.9	3.8	29.7	42.6	97.9	88	524	1140	
	C1g	84-115	3	54	43	7.3	7.3	7.8	2,000	1.60	-	10.0	14.2	1.9	6.0	32.1	3.1	35.2	36.3	84.4	91	329	1010	
	A9g	0-12	2	31	67	5.0	4.3	-	330	0.93	-	5.5	16.5	1.4	6.2	29.7	10.4	40.1	31.4	46.9	74	66	720	
Bangkok series (Bk)	A12g	12-25	1	30	69	5.9	5.2	-	300	0.33	-	6.7	17.2	1.5	11.4	36.7	8.3	45.0	31.8	46.1	81	8	520	
	P 746-951	25-100	1	34	65	6.9	6.1	1.8	400	0.17	-	6.8	18.0	1.6	13.8	40.1	5.6	45.7	33.4	51.4	88	10	610	
	B22g	100-130	2	38	60	6.5	5.9	1.6	300	0.48	-	7.7	18.7	1.6	16.6	44.6	6.9	51.5	34.8	57.9	87	16	840	
	C1g	130-160	1	39	60	7.7	7.2	4.0	500	1.66	-	17.5	21.7	2.4	21.2	62.8	3.0	65.8	33.7	56.2	95	57	1170	
	C2g	160-200	1	45	54	7.9	7.2	5.1	500	1.89	-	16.4	23.2	2.2	23.2	63.9	2.8	66.7	34.1	62.2	95	131	1080	
Phan Thong series (Prg)	A9g	0-10	9	64	27	4.9	4.5	0.1	180	0.83	0.12	6.5	5.2	0.6	1.9	14.2	5.9	20.1	14.4	53.3	71	5	226	
	A12g	10-20	8	59	33	6.3	5.6	0.9	82	0.55	0.10	7.3	6.2	0.6	2.1	16.2	4.4	20.6	17.5	53.0	79	5	259	
	A2g	20-34	5	69	26	7.0	6.1	0.1	87	0.07	0.02	4.6	4.6	0.4	1.7	11.3	1.6	12.9	11.2	43.1	88	4	190	
	B21g	34-70	26	50	24	7.0	5.9	0.7	132	0.05	0.02	6.8	7.1	0.6	2.4	16.9	2.6	19.5	15.8	65.8	87	8	235	
	B22g	70-180	28	51	21	7.8	7.1	1.3	195	0.04	0.02	12.4	6.3	0.5	3.0	22.2	1.0	23.2	14.4	68.6	96	180	217	
Chaoengtao series (Cc)	Cg	180-240	18	58	24	7.5	7.3	6.1	440	1.00	0.08	36.8	10.3	0.9	7.1	55.1	1.3	56.4	20.9	87.1	98	197	440	
	A9g	0-15	6	32	62	4.3	3.7	-	150	3.28	0.16	5.2	12.7	0.9	2.6	21.4	17.6	39.0	28.9	46.6	55	9	335	
	A11g	15-23	5	32	63	4.5	3.8	-	150	1.02	0.15	4.9	13.4	0.1	3.9	22.3	16.3	38.6	28.6	45.4	58	12	360	
	B1g	23-70	4	26	70	4.5	3.6	-	200	0.97	0.08	5.1	16.0	1.1	5.4	27.6	13.1	40.7	29.0	41.4	58	9	390	
	B2g	70-125	1	29	70	6.3	5.4	-	350	0.14	0.06	6.1	21.0	1.4	1.1	29.6	6.2	35.8	34.3	46.7	80	6	510	
C1g	BCg	125-155	4	31	65	3.7	3.3	-	400	0.95	0.10	7.6	25.9	1.6	14.7	49.8	17.8	67.6	31.3	42.7	59	30	630	
	C1g	155-240	1	31	68	3.1	3.0	-	-	2.50	-	-	-	-	-	-	-	-	-	-	-	-	-	
	C2g	240-300	1	32	67	6.4	3.6	-	-	1.94	-	-	-	-	-	-	-	-	-	-	-	-	-	

Table B-49 Major Chemical Property Level

Soil Series	OM	BS	CEC	P	K	pH	Fertility level
	0~30cm	a) 0~30cm b) >30cm	a) 0~30cm b) >30cm	a) 0~30cm b) >30cm	a) 0~30cm b) >30cm	a) 0~30cm b) >30cm	a) 0~30cm b) >30cm
1.Sm : Smut Prakarn	H	a) H b) H	a) VH b) VH	a) VH b) VH	a) VH b) VH	a) 6.0-6.5 b) 7.0-8.5	a) H b) H
2.Bk : Bangkok	mod. L	a) VH b) H	a) VH b) VH	a) mod. L b) M	a) VH b) VH	a) 6.0-7.0 b) 7.0-7.5	a) mod. H b) mod. H
3.Ptg : Phan Thong	L	a) H b) H	a) M b) M	a) L b) M	a) H b) H	a) 7.0-8.0 b) 7.0-8.0	a) M b) M
4.Cc : Chachoengsao	mod. H	a) M b) M	a) H b) H	a) L b) VL	a) VH b) VH	a) 4.5-5.0 b) 6.5	a) M b) M
5.Ca : Cha-am	mod. H	a) M b) M	a) H b) H	a) M b) M	a) VH b) VH	a) 3.0-3.5 b) 3.0-3.5	a) mod. H b) mod. H
6.Ok : Ongkharak	M	a) L b) L	a) H b) H	a) M b) VL	a) VH b) VH	a) 4.0-4.5 b) 4.0-4.5	a) L-M b) M
7.Ma : Mahaphot	VL	a) L b) L	a) H b) H	a) M b) VL	a) VH b) VH	a) 4.5-5.0 b) 4.0-4.5	a) M b) M
8.Rs : Rangsit	VL	a) L b) L	a) H b) H	a) M b) VL	a) VH b) VH	a) 4.5 b) 4.0-4.5	a) L-M b) M
9.Dm : Don Muang	M	a) M b) M	a) M b) mod. L	a) VL b) VL	a) H b) M	a) 5.0-5.5 b) 4.0-4.5	a) mod. L b) M
10.NBC : Undifferentated ridged acid soil	L	a) H b) H	a) H b) H	a) H b) H	a) H b) H	a) 5.5-6.0 b) 4.0-4.5	a) H b) H
11.Hk : Hinkong	L	a) L b) L	a) L b) mod. L	a) L b) L	a) L b) L	a) 5.0-5.5 b) 5.0-5.5	a) L b) L
12.Cb : Chon Buri	L	a) M b) M	a) VL b) VL	a) VL b) VL	a) VL b) L	a) 5.0-5.5 b) 5.5-7.0	a) L b) L
13.K1 : Klaeng	L-M	a) L b) L	a) mod. L b) M	a) L b) L	a) L b) L	a) 5.0-6.0 b) 5.0-5.5	a) L b) L
14.Kkm : Ko Knanun	mod. L	a) L b) L	a) L b) L	a) VL b) VL	a) VL b) VL	a) 4.5-7.0 b) 5.0-5.5	a) L b) L
15.Bbg : Ban Bung	L	a) M b) H	a) VL b) VL	a) H b) L	a) L b) VL	a) 6.5-8.0 b) 6.0-8.0	a) L-M b) VL

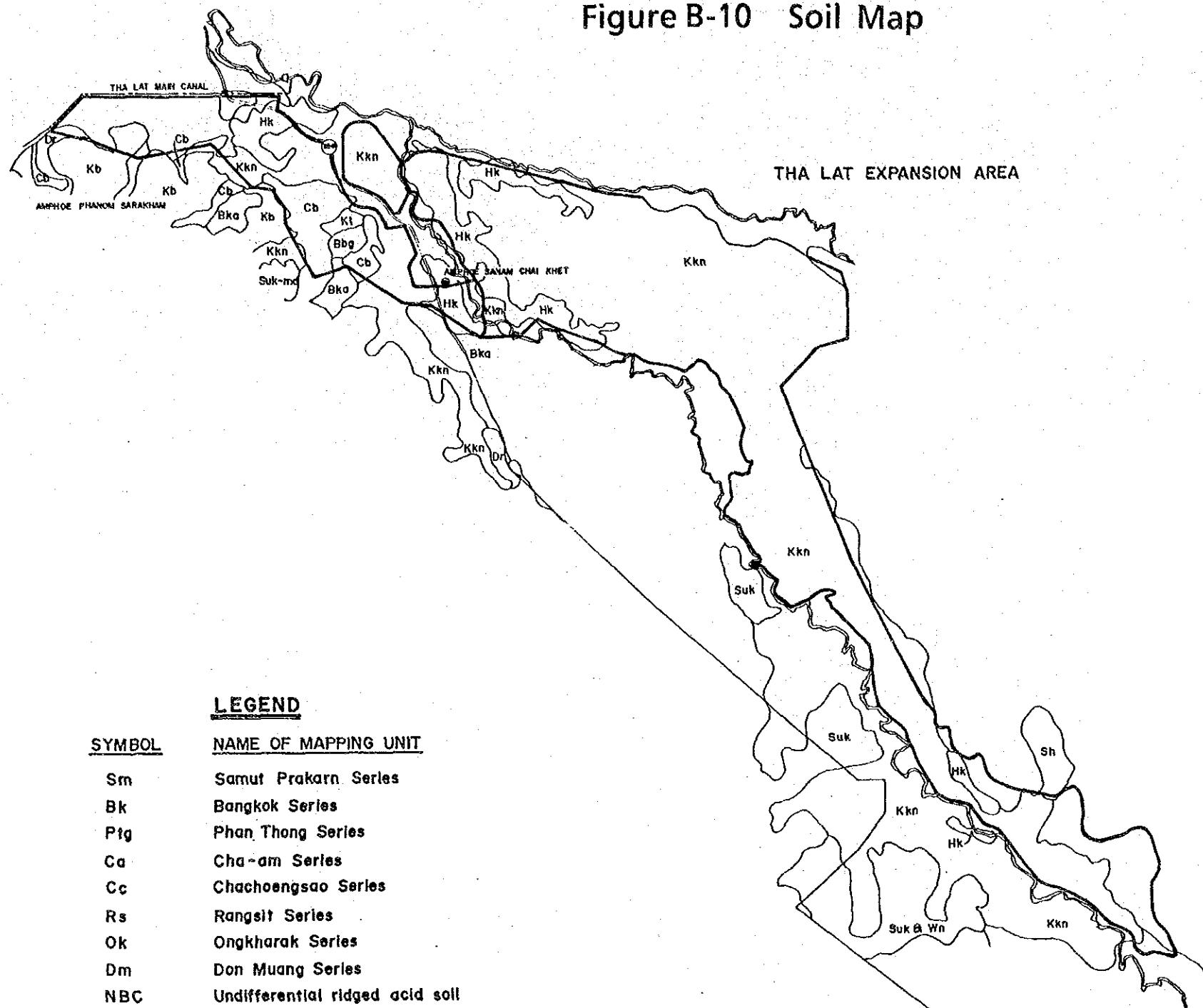
Table B-50 Soil Suitability Classification of Soil Series

Soil Series	Paddy (P)	Non-flooded Annual Crop (N)	Fruit- tree (F)	Suitable Land Use (rainy season)
1.Sm Smut Prakarn	P-I	N-Vf	F-Vf	Paddy
2.Bk Bangkok	P-I	N-Vf	F-Vf	
3.Ptg Phan Thong	P-III s	N-Vf	F-Vf	
4.Cc Chachoengsao	P-I	N-Vf	F-Vf	
5.Ca Cha-am	P-IV j	N-Vf	F-Vf	Paddy required marl to reduce soil acidity
6.Ok Ongkharak	P-IV j	N-Vf	F-Vf	
7.Ma Mahaphot	P-III j	N-Vf	F-Vf	
8.Rs Rangsit	P-III j	N-Vf	F-Vf	
9.Dm Don Muang	P-III j	N-Vf	F-Vf	
10.NBC Undifferentated ridged acid soil	P-V t	N-I	F-I	Fruit orchard
11.Hk Hinkong	P-I	N-Vf	F-Vf	Paddy
12.Cb Chon Buri	P-III s	N-Vf	F-Vf	
13.Kl Klaeng	P-I	N-Vf	F-Vf	
14.Kkm Ko Knanun	P-III w	N-III d	F-III d	Fruit orchard, Upland crop / some paddy
15.Bbg Ban Bung	P-V t	N-IV s	F-IV s	Upland crop

Table B-51 Soil Suitability for Paddy

Mapping Symbol	Soil Series	Tha Lat.		Bang Pakong		Total	
		Existing	Expansion	Existing	Expansion	hectare	%
P-I Soils very well suited	Sm, Bk, Cc Hk, Kl	6,610	2,270	7,710	160	16,750	27.65
P-III Soils moderately suited						35,210	58.10
P-III due to unfarable texture	Ptg, Cb	—	340	2,400	—	2,740	4.52
P-IIIj due to present of jarosite	Ma, Rs, Dm	21,080	—	4,790	100	25,970	42.85
P-IIIw due to risk of water shortage	Kkn	—	6,500			6,500	10.73
P-IV Soils poorly suited						3,810	6.28
P-IVj due to present of jarosite at shallow depth. (< 40cm from surface)	Ca, Ok	3,210	—	600	—	3,810	6.28
P-V Soils not suited						4,800	7.92
P-Vf due to unfavorable topography	NBC, Bbg	—	60	1,900	2,840	4,800	7.92
Othres		—	30	—	—	30	0.05
Total		30,900	9,200	17,400	3,100	60,600	100.00

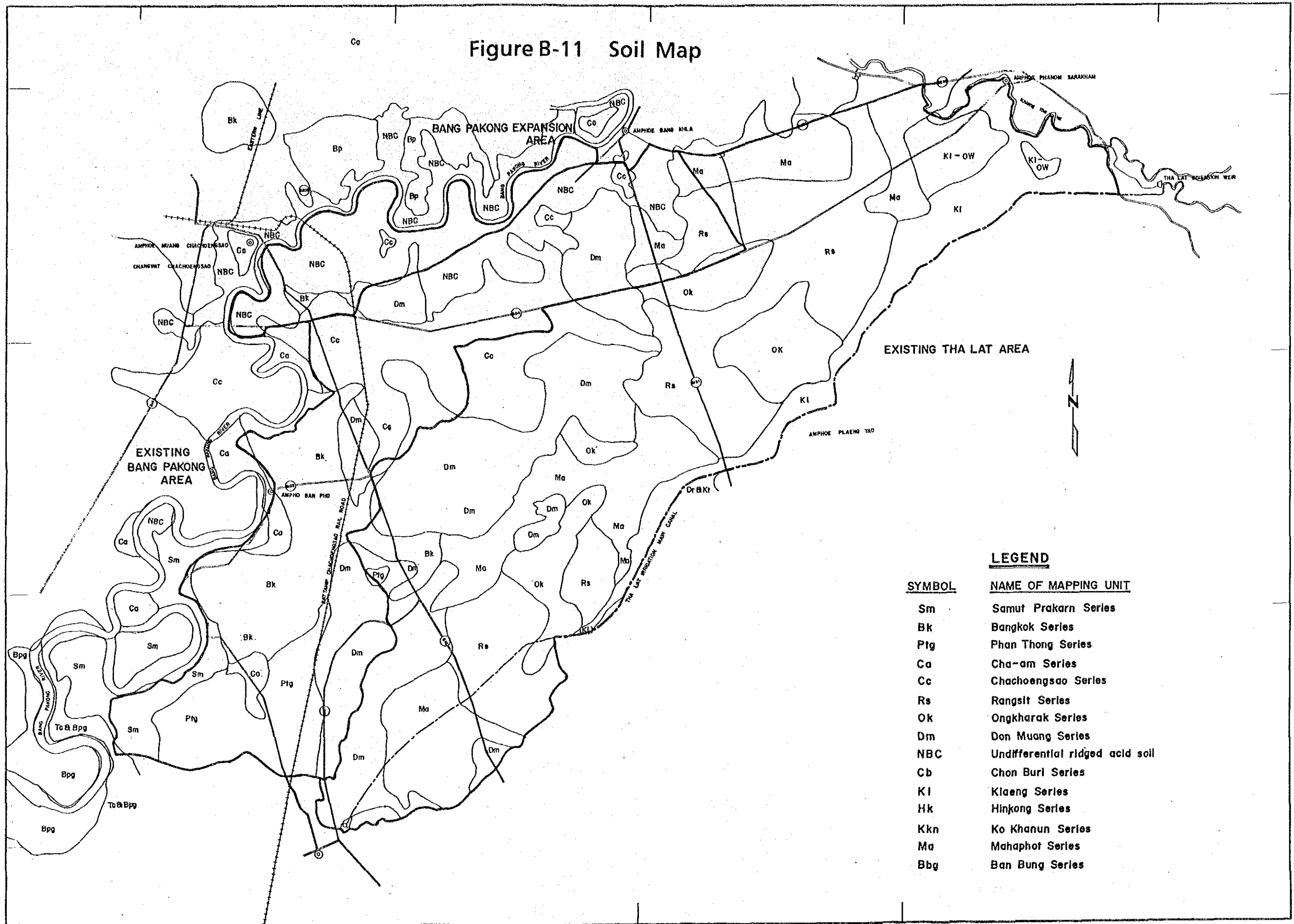
Figure B-10 Soil Map



LEGEND

SYMBOL	NAME OF MAPPING UNIT
Sm	Samut Prakarn Series
Bk	Bangkok Series
Ptg	Phan Thong Series
Ca	Cha-am Series
Cc	Chachoengsao Series
Rs	Rangsit Series
Ok	Ongkharak Series
Dm	Don Muang Series
NBC	Undifferentiated ridged acid soil
Cb	Chon Buri Series
Kl	Klaeng Series
Hk	Hinkong Series
Kkn	Ko Khanun Series
Ma	Mahaphot Series
Bbg	Ban Bung Series

Figure B-11 Soil Map



LEGEND

SYMBOL	NAME OF MAPPING UNIT
Sm	Samut Prakarn Series
Bk	Bangkok Series
Ptg	Phan Thong Series
Ca	Cha-am Series
Cc	Chachoengsao Series
Rs	Rangsit Series
Ok	Ongkharak Series
Dm	Don Muang Series
NBC	Undifferentiated ridged acid soil
Cb	Chon Buri Series
KI	Klaeng Series
Hk	Hinkong Series
Kkn	Ko Khanun Series
Ma	Mahaphot Series
Bbg	Ban Bung Series

**APPENDIX-C. GEOLOGY, FILL MATERIALS
AND SEISMICITY**

CONTENT

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C.1-1 STRATIGRAPHY OF THE STUDY AREA

GEOLOGIC AGE	NAME OF FORMATION /IGNEOUS ROCKS	LITHOLORY	ENGINEERING GEOLOGIC REMARKS
Holocene	Riverbed Deposits	clay, silt, sand, gravel and rock fragments	-Subject to cutoff for dam foudation
	Colluvial Deposits		
Pleistocene Pliocene	Terrace Deposits Plio-Pleistocene Formation	clay, silt, sand, gravel and rock fragments	-Generally beds have an enough bearing capacity for fill dam foundation -Seepage control requires for sandy and gravelly beds
Jurassic	Khorat Group		quartzose sandstone interbedded with siltstone -Quartzose sandstone shows high permeability due to coarse grained mineral composition and presence of open fractures -Grouting requires
Trias	Rhyolite	rhyolite, volcanic bercecia and dacite	-Volcanic rocks shows high permeability -Grouting requires
	Diorite and Granite	diorite and granite	-Diorite subject to weathering in flood plain -Grouting requires
	Phong Nam Ron Formation	sandstone and slate	-Chert shows cracky -Grouting requires
Permian	Ratburi Group	limestone and chert	-Limestone shows cavernous -Grouting requires
Carboniferous	Tanaosi Group	weathered sandstone siltstone and conglomerate	-Heavily weathered siltstone shows less than 20 blows of SPT -Fractured sandstone shows high permeability
Pre-Cambrian	Thung Song Group	shale, phyllite, schist and gneiss	-Thickness of heavily weathered rocks ranges 3 to 12 m -Seepage control for foundation requires by blanket