

タイ国

首都圈周辺市街地区水道拡張計画調查

METROPOLITAN
WATER WORKS
AUTHORITY

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1977年3月

国際協力事業団



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第1章 序 言

1-1 まえがき

バンコク首都倒周辺水道についての多角的な考察は、1973年3月に日本の調査団によって行なわれていた。これはSeparate System と称せられる地区、9 Amphoes のうち 5 Amphoes (Nong Khaem, Bang Bua Thong, Sai Noi かよび Lat Krabang) を対象とした Feasibility Study であった。

今回の調査は、前回の調査に引続いて行なわれたもので、前回と同様、 国際協力事業団によって行なわれた。

本調査は、1977年1月23日にバンコク入りしてより、1977年3月26日に至る現地滞在期間63日間、12名の調査員がこれにあたった。

今回の調査の目的および内容はつぎのとおりである。

前回調査の 5 Amphoes の見直しを含めて、首都樹周辺地区全域の 9
 Amphoes に拡げて Feasibility 調査をすること。

即ち、9 Amphoes とは

(I) Chao Phraya River 右岸地域

北 3 地区: Sai Noi, Bang Bua Thong, Bang Yai,
Nong Khaem 地区

O 4 Amphoes

(2) Chao Phraya River 左岸地域

東3地区:Nong Chok, Min Buri, Lat Krabang

的2地区: Bang Phli, Bang Bo

Ø 5 Amphoes

である。

- 2) 前個調査以後にタイ国にかいて計画されつよある。関連地区の開発を 考慮した調査
- 3) 水源調査として地下水及びKhlong 並びに河川よりの利用可能調査

即ち、9 Amphoes の水道計画に当って、Separate System としての最大の問題点は水源対策であった。

現在、首都圏における地下水の汲み上げは、既存のもので水道用約350,000m³/日、民間用約400,000m³/日といわれ、またCentral Systemにおいても更に新設の深井戸が予定されている。

一方、無規制な地下水の汲み上げによる地盤沈下、塩害化は益々拡大するであろうし、このまゝ放置すれば首都樹金域に何らかの障害が起るである。 ある。既に一部にはそれが散見せられている所である。

また Separate Systemの水源としては、表流水を考慮したとき、まず Chao Phraya River と Nakorn Chai Si River 等の大河川がその対象となるわけであるが、 Separate Systemの規模、位置からして、今直もにこの 大河川にすべての水源を求めることは経済的に成り立たず、実施可能な案とは考えられない。

しかし、Central Systemの将来計画との関連においてSeparate Systemを論ずるならば、Chao Phraya River のみに水源を依存する現有のCentral System計画は見直されて、Chao Phraya River以外の大河川も含めた複水源とすべきことも大切である。

即ち、Separate Systemを含めた広域水道として Bangkok の土水道全体を考えた更に長期的な構想も必要となるであろう。

しかし今回のSeparate Systemの取水方法については、地下水を出来るたけ求めたいものであるが、その水量には限界があるので、これと表流水

との複合的な組合せも考えられた。特に今回は作業途中において、工業団 地計画と大規模住宅団地および新空港計画案などが提言せられてからは、 経済的観点も含めて Feasible な案の決定は相当な配慮を要することとなった。

現在時点で計画される2000年の9 Amphoes のみの上水道需要量は総計77,750m[®]/日で、これ以外の工業団地、住宅団地、新空港のそれは171,750m[®]/日と大きく見込まれたのである。

よって地下水の利用は、基本的には名 Amphoes の住民用飲料水のみに 当てることは大方可能であるうが、たいし既に Bangkok 市内およびその周 辺で地盤沈下が生じているなかで、本計画のために更に地下水を揚水する ということは、中心部への地下水の補給を減少せしめることとなるう。そ とで今後は、Bangkok 中心部における無制限な井戸の掘削は問題になるう し、また本計画に見込まれる井戸は適正な配置と管理が望まれるものであ る。

1 - 2 - Central System と Separate System との関連について

さきに述べた如く、各団地計画の給水が本計画の中へ入れられるように 提言されてからは、特にSeparate Systemを独立して考えるよりは、 Central Systemとの関連により位置づけすることも得策であろうと考え られた。

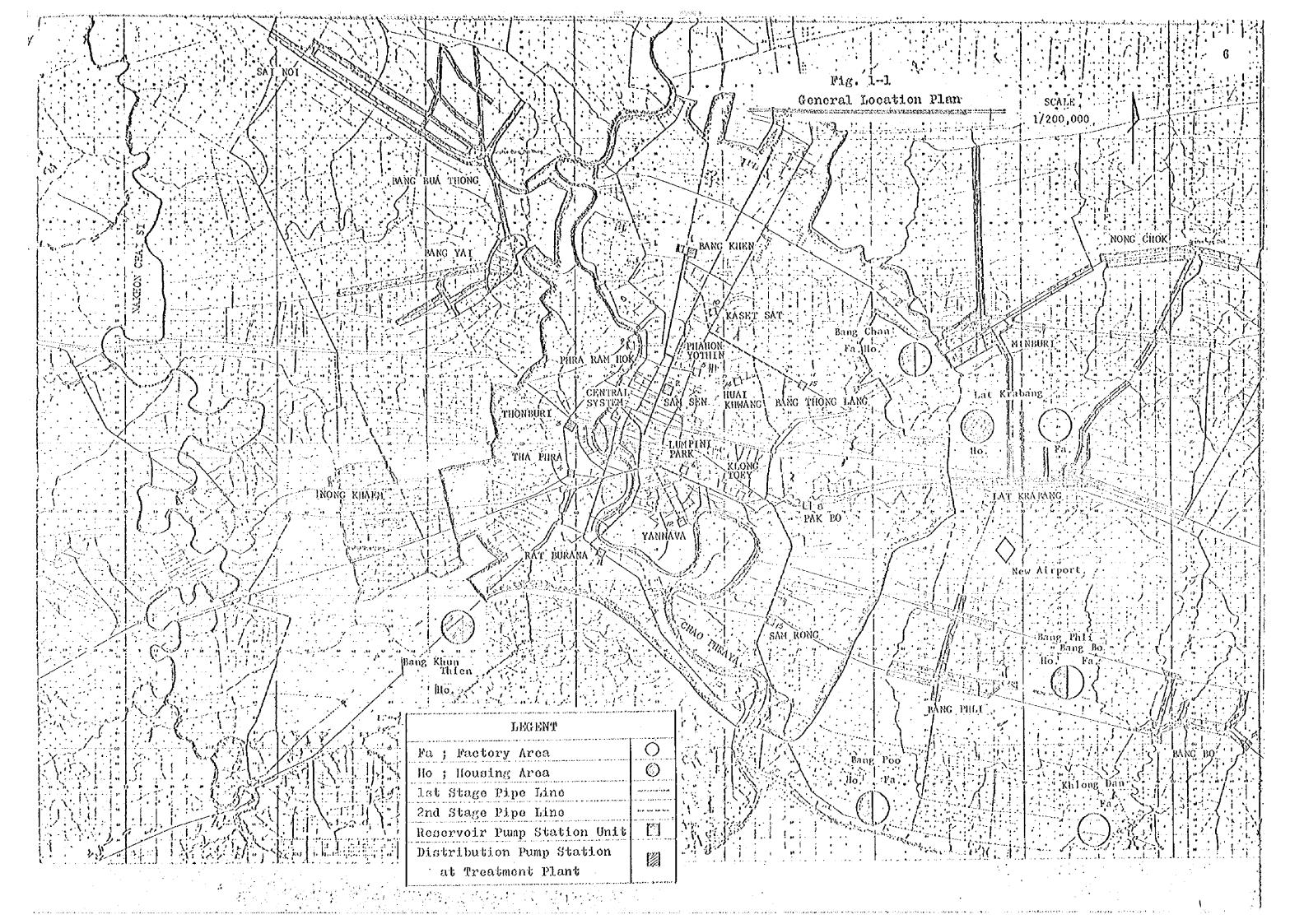
それでこれの検討も加えることとし、Contral System の近接配水池より、直接 Separate System の需要区域へ送水することも考えた。

今, この場合 Central Systemにもし設計上の余裕が認められたならば, この案は Feasible なものとして当然浮び上るであろう。 しかし、現在は Central Systemの First Stage 工事の First Phase が着工済であり、 Second Fhase の実施設計も完了しているので、 First Stage の設計内容 にまで立入って Central System の見直しをすることは困難である。

したがって、Separate SystemのFeasibility Study を行うにあたっての Central Systemの見直しは、Second Stage 以降の内容に限定される。 これらの作業の中で Second Stage の内容に相当の影響がでる時は、これらの問題も含めて別途の対タイ技術協力にゆだねなければならない。

現在の時点で、Second Stage の送水管をそのまり利用するとした時は一部送水管に不適当と思われる部分が生じこの部分は送水管の口径を変更するか、又はSeparate Systemの区域への単独送水管を別個に設けなければならない。

各給水地区の位置は図1一1に示すとおりである。



1-3 緊急工事の考え方

各 Amphoe の計画を樹立するに当っては、基本的にまず 2000年の水需要を予測し、これに対応する水道計画を作成した。工事は需要に合わせて 2 期から4 期に分けて施工するように考慮したが、とりあえず現状を回復するに必要なものを緊急工事として第1 期工事とみなした。

第1期工事としてはAmphoe Town を中心とした人口稠密な区域化のみ限定し、順次配水管の延長を図りつく、他の施設の拡張を段階的に行うよう配慮した。

METROPOLITAN WAIER SUPELY WORKS		Ministry of Health & Welfere (Vice-chairman of the Mission)	Newanthon Engineering Consultants Go., Ich. (General Thanning)	Nekenihon Engineering Consultants Co., Itt. (Water Supply Planning Economics)	Facific Consultants International (Ground Water)	Recific Consultants International (Ground Water)	Facific Consultants International (Intake & Ireatment)	Pacific Consultants International (Ofty Flanning)	Nakanihon Ingineering Oo., Itt. (Intake & Treatment)	Recific Consultants International (Water Supply Planning)	Weltenfilon Engineering Co., Itt. (Distribution System)	Facilia Consultants International
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JAPANUSE SURVEY TEAM FOR THE	or S. Neito	Nr. K. Okazawa	M. K. Shiozewa	in I keremure	Mr. N. Muto	ಗಿದ್ದ 7 ರಿಕ್ಷಚಿತ	Mr. S. Kometen	Mr. I. Kenedete	M. T. Nakamura	M. K. Wiyekure	Xx. ₹. EsShizi	्रेस. म. च्रह्मकाठका

Mr. Nate Sheiwka

ORGANIZATION CHART OF SEPARATE NATER SUPPLY SYSTEM IN MAWA

1 -- 5 現地調査における行程の経過

調査開始に当り本 Team をつぎのような Party に組み、作業の進行に合わせて適宜組合せを流動させつ 5 行った。

Party I. Electrical Prospecting

Party 2. Data Collection on Water Resources

Party 3. Planning of Water Supply Systems

Party 4. Economic Analysis & Financial Program

これらのTeamの行程経過をまとめて整理したものがつぎの表である。

月日	限日	行程	調査内容
1. 23	Ы	羽田→バンコクLH便	内藤,嗣沢,他 2 名渡タイ
1. 24	月		大便館 J I CA. MWWA を表敬訪問
1. 25	火		MWWAと打合せ(S.Wについても)
1. 26	水	羽田→バンコク JAL717便	調査団員 8 名渡タイ S. Wについての打合せ
1. 27	木		作業の下準備と全体会議
1. 28	ŵ		・MWWAと打合せ 左岸地区 Bang Phli, Bang Bo地区 視察(既設水道施設及び水源)
1. 29	. da		資料の整理、地図の複製
1. 30	Н		阿 1:
1. 31	Л		左岸地区 Min. Burl, Nong Chok, Lat Krabang 地区視察 (斑散水道施設及び水源)
2. 1	火		右岸地区 Nong Khaem, 地区視察 (既設水道施設及び水源)
2. 2	水		右岸地区 Bang Yai, Bang Bva Thong, Sai Noi地区視察 (既設水道施設及び水源)
2. 3	木		作業計画書の作成 全体会議(作業進行計画について)

Л	FI	瞬日	行 得	調 查 内 容
2.	4	ŵ.		MWWAと打合せ (作業進行計画と目程について)
2.	5	1:		現場調査の資料整理
2.	6	B	内藤、岡沢、塩沢、帰国	ii li
2.	7	Ŋ		追加 5 地区について協議 Sai No 1 地区現場調査 電探現場作業準備
2.	8	火		MWWAと追加5地区について協議 Lat Krabang地区電探調査
2	9	水		水質調査の準備 Bang Bua Thong地区現場調査 電探調査及び地下水資料収集
2.	10	水		Industrial Estate Authority & National Housing Authority と打合せ Bang Khun Thian 地区現場調査 石岸地区の内業 電探調査及び地下水資料収集
2.	11	氽		Khlong Thawi Watthana の採水 Bang Khun Thian 地区現場調査 右岸地区の内業 電探調査及び地下水資料収集
2.	1.2	d		作業日程打合せ及び資料の整理
2.	13	H		資料整理

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月日	隔口	ί̈τ	程	. 調 在 内 容
2. 14	Л			Air Port Officeを訪問,打合せ Bang Phli,Bang Bo地区現場調査 右岸地区の内業 電探調査及び地下水解析
2. 15	火			Bang Phli, Bang Bo地区水源調査 右岸地区の内業 電探調査及び地下水解析
2. 16	水			National Housing Authority と打合せ Industrial Estate Authority よ りのデーター整理 電探調査及び地下水解析 (左岸地区電探調査完了)
2. 17	水			水質調査工程表作成 Min Buri Nong Chok 地区水源調査 左岸地区の内業 電探調査の資料整理及び地下水解を
2. 18	ŵ			Lat Krabang地区水源調査 左岸地区の内業 電探調査の資料整理及び地下水解を
2. 19	1:			下図の作成及び単価表の作成
2. 20	(1			[6]l.;
2. 21	月			9 地区及び追加 5 地区の内業 電探調査結果の整理及び地下水解も

JIII	器日	行 程	調查內容
2 22	火		地下水について協議 MWWAと打合せ 資料解析及び計画観略案の検討
2. 23	水		資料の整理,解析,水理計画 北3地区の電探調査準備
2. 24	木		資 料 整 理 北3地区の電探調査及び地下水資料収集
2 25	♠	•	MWWAと打合せ 北 3 地区の電探調査 (右岸地区電探調査完了)
2 26	_: !:		登料の分析, 計画案下図の作成, 単 価表作成
2 27	П	地下水調查員2名帰国	而上
2. 28	11		計画家の検討、採水業務の準備
3. 1	火		計画案の検討 採水,分析についてサムセン浄水場 担当者と打合せ
3. 2	水		計画案作成 Nakhon Chai Si Riverの採水
3. 3	木		計画条作成 Khlong Mae Nam Om及び非戸の採水
3. 4	金		計画 案 作 成

	ЛП	曜日	行 程	調査内容
:	3. 5	-1:		水質試料、その他資料整理及び打合せ
7	3, 6	Π		fij <u>1</u> :
	3. 7	月		計画案の作成
	3. 8	火		計画 案 の 作 成 ChaoPhraya Riverの採水
	3. 9	水		Nakhon Chai Si Riverの採水 Progress Reportの作成
	3. 10	木		現 況 道 路 調 査 東3地区のKhlong及び井戸の採水 Progress Reportの作成
	3. 11	企		現 況 道 路 調 査 南2地区のKhlong及び井戸の採水 Progress Reportの作成
	3. 12			図面作成及び資料整理
	3. 13		羽田→パンコク 内藤, 岡沢, 塩沢, 渡タイ	[ii] <u>l</u> t.
	3. 14	月		JICA及びMWWA訪問 Progress Report の作成
	3. 15	火		P.W.D. 及びDTEC訪問 Progress Report の作成
	3. 16	水		Progress Reportのまとめ 英文 翻訳

ЛП	曜日	fi A	. 調 查 內 容
3. 17	木		Rrogress Report のまとめ 英文 翻 訳
3. 18	兪		英文タイプ作業 挿入図・同表の作図
3. 19	J:		(i) 1:
3. 20	11		図 面 作 成
3. 21	Я		英文タイプ作業 Progress Reportのまとめと照査
3. 22	火		MWWAと概略説明会議 Progress Reportの原稿整理と原
3. 23	水		Progress Reportのコピー、製本MWWAに対する説明図面作成
3. 24	木	and the second s	MWWAと最終討議及び説明会議 (総裁以下関係者全員出席)
3. 25	金		帰国挨拶(大使館 . J I C A . MWW A
3. 26	:A:	パンコク→東京 JAL466便 化で帰国	

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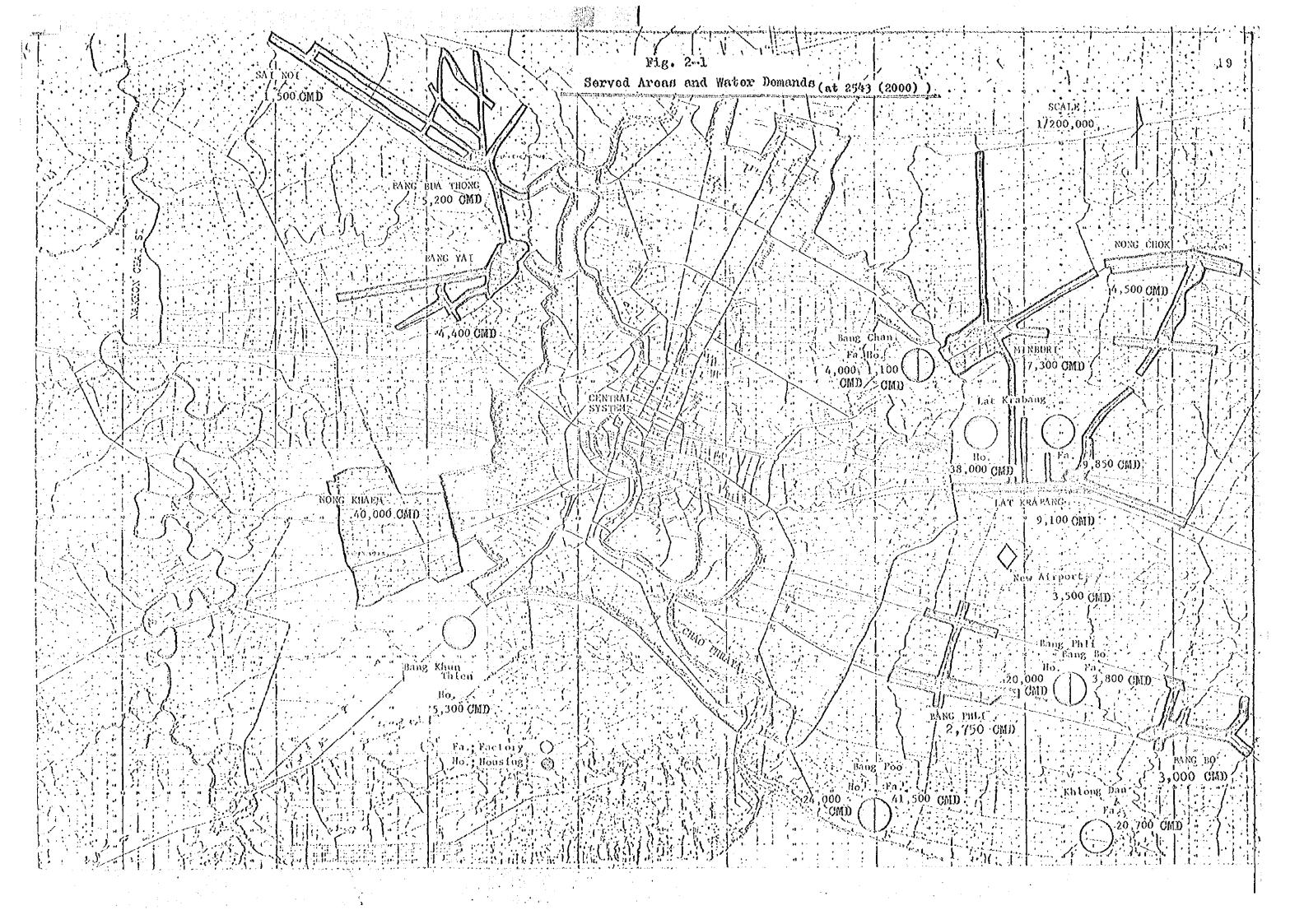
第 2 章 水需要の調査と解析

第 2 章 水需要の調査を解析

本調査の目的である Separate Systemを構成する首都圏 周辺地区全域の 9 Amphoes の水需要と、今回新たに首都圏水道公社より提言せられた工業団 地、住宅団地および新空港等の追加地区の水需要の調査を行ったものである。

各地区の水需要量は、現地調査および資料収集を行ってSeparate System 全体の2000年における需要量を想定し、水源を含めた広域的水道計画立案 の方策となる資料の作成を行った。

各給水地区の位置は図2-1に示すとおりである。



2-1 各 Amphoe の水需要量

各 Amphoe の需要量は、前回調査(1973年)で9 Amphoes について算出されていたが、今回再度、全地区の現地踏査を行い、前回の資料を基本として給水区域、給水人口、給水量の見直しを行って、各 Amphoe の基本数値を立てた。

1) 給水区域の設定

給水区域の設定に当り、まず考えられることは、各 Amphoe の中に大小、緩横に走る Khlong があり、この Khlong を中心として 人家が集中しているが、その範囲の決定はなかなか難しい。

給水区域の規模は、可能な限り広い地域を対象とするのであるが経済的な限界もあるので、前回の設定範囲を基として、現地踏査による現在の民家のはりつき状態と、各 Amphoe Town を通過している既設主要道路網の整備状況等による社会経済発展の可能性を想定して、将来の人口集中範囲を選定し給水区域を決定した。

各地区の給水区域は、図 2-1 に示してあるが、その面積は表 2-1 のように定める。

Table 2-1. Water Surved Area of 9 Amphoes

	Amphoe	Water Surved Area (Km?)	Remarks
	Sai Noi	6	
Alght Bank	Bang Bua Thong	18	
다 연	Bang Yai	16	
i. January and Constitution of the	Nong Khaem	55.2	and the second state of the second
	Nong Chok	18	
8	Min Bori	55	
प्रकट उड्ड	Lat Krabang	22	Adjacent of New Air Port
	Bong Phli	11	
	Bang Bo	7	

2)人口密度

前回の調査(1973年)より今回の調査までに4ヶ年間を経過しており、資料収集によるその間の各Amphoeにおける総人口の推移と、前回の将来人口推定値と対比すると、Bang Phli 以外は大差がない。

- 又,現地踏査より各 Amphoe Town に集中している人口も前回調査時 とほとんど変りがないものと見うけられた。

人口が増加したと思われるところは、多分 Amphoc Town の外側に広く散在している khlong 際であると想像せられる。

従って各Amphoo Town の2000年における人口密度は、前回の数値を変更することなく使用するのが適当と考えられた。よってこの値を採用して2000年における予想人口を算定した。

人口密度および2,000年の人口は、表2-2亿示す。

Table 2-2
The Density of Population and Population in the Area
(at 2,000 AD)

	Amphos	Water Served Area (Km²)	Density of Population (por/km ²)	Population in the Area (person)	
	Sal Not	6	1,500	9,000	
Nue Sue Sue	Bang Bua Thong	18	1,750	31,500	
હ હ જ જ	Bang Yai	16	1,650	26,500	
	Nong Khaem	55.2	2,500	138,000	
	Nong Choic	18	1,500	27,000	
설	Min Buri	52	2,000	44,000	
Lost Benk	Lat Krahang	22	2,500	55,000	
, ă	Bang Phli	11	1,500	16,500	
	Bang Bo	17	1,500	10,500	

3) 9 Amphoes.の給水区域内入口推移

2.000年に至るまでの年次毎の人口推移は、前回のReport と同じく、 2000年における予想人口より1980年の人口を対比し逆算して推定 することとした。

その人口は表2-3亿示す。

4) 水道普及率および1日最大使用水量

普及率の推定値および1日最大使用水量は、前回の採用値が妥当な値 と考えられるので、同じ値を使用することとし、各年次の普及率および 1日最大使用水量を表 2 - 4 , 2 - 5 のように定めた。

Presumption of Population around Water Supply Area for nine (9) Amphos Table 2-3

ī	ang arawayan karan da Resings	-	reconstruction of	وأرمضه بنيا ينتي يا عدد	nasar sagan saga j	······································	· · · · · · · · · · · · · · · · · · ·		· · · · · · · · · · · · · · · · · · ·	- We to 1 - 1 - 1 - 2	2
	Remarks						Angeles of the second s				
	30-02	000° 6	.32,500	26,500	238,000	\$7,000	೦೦೦ ಕ್ಷತ	000,55	\$6,500	005 for	
	\$395	309°2	27,574	22,387	205,000	23,000	992,85	845°24	009-45	0000	
	2990	202*9	23,609	18,274	29,000	000-61	33,400	952*07	12,700	8,500	J
	1985	4,811	49,664	\$95° 35°	900°65	45,000	28,200	32,944	1. ,800	2,500	
***************************************	1989	2,40	45.75	870*05	44,000	32,000	23,600	25,592	006°8	6,500	
	5252	350°2	55.073	5,935	22,000	2,000	17,800	18,242	2,000	5,500	
	ತಿಂಸ್ತ್ರ <u>ದ</u> ್ಯ	Saž Nož	Seng dae Mong	**************************************	Nong Ansem	Youg Chok	Min Buri	Lat Kradang	इंट्यूट डियडट	୦୫ ଥିଲେ ଓ	
) yung	44 ⁹ 711				nasa 47	9 1		

Table 2-4 Presumption of House Connection (percent)

Year	1975	1980	1985	1990	1995	2000
House Connection (per cent)	62.5	65.0	67.5	70.0	72.5	75.0

Table 2-5 Daily Maximum Quantity Consumed (Mcd.)

Yoar	Less than 50,000 Persons	50,000 100,000 Persons	More than 100,000 Persons
1,975	182.5	190	225
1980	190	210	240
1.990	205	230	270
2000	220	250	300

5) 各 Amphoe Town の年次別給水量

以上今までに算定したところの数値より、各 Amphoe Town の年次別給水量を算出したが、Nong Khaom地区では、その東北部に位置する一部に区域外給水が含まれていることと、Bang Bo 地区では、南へ約7km離れたところのKh Jong Dan地区への区域外給水が現在行なわれていることを考慮して給水量を決定した。

以下各 Amphoe Town の水道基本数値をまとめたものが 表 2 - 6 ~ 2 - 15 である。

	Amphoe		1980	1985	0 6 6	2661	5000	Remarks	
/. Conserv		δ <u>τ</u>	2,219	3,247	4,345	5,513	6,750		
y = .4	Sat Not	Da	200	0	ဇ္	.4	1,0		
*, *			10,217	ď	16,526-	Q.	ΔŽ.	The state of the s	
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Bang Bua Inong	٤.	. •	2,70	3,40	ď	5,2		
k (1778)			6,53	33		16,231	63		
 []]	Bang Ver	314		8	2,1	ഷ	7 7	A MARIE A CAMBAR AND COMPANY AND A THE COMPANY AND COM	
เชา			•	. ^	ဗို	-q1,	103,500	and Laborator in transmission of the second	1
 FX	Nong Khaem	<u>.</u>	8,000	4,00	\circ	O.	် (၁	- The second of the second	
			47,567	406,59	88,963	117,846	153,750		
-12 6 -14 m	Sub-Total	E ,	11,800	6	O	37,000	rd G		
*		Carbon Ventorial	7.150	10,125	ူဂ	16,675	20,250	1	
	Nong Chok	1:	1,400	2,00		3,600	S		
₩ are as		-	14,950	19,035	ွင့်	28,058	S		*, :
	Min Buri	<u>.</u>	2,900	3,800	မ္မ	8	7,30		
- 			· vo	22,237	220	54	,23	and the control of the second	
ગુવ	Let Krabang	: :	3.200	007,4	ά	7,40	9,40	TO THE REPORT OF THE PROPERTY	1
v {{			1,0	7,290	8		3.37		
33	Sang Frit	<u> </u>	1,100	1,450	· 60	2,25	,		1
อน		:	Ω,	5,063	5,950	6,888	7,875	والمراجعة والمتعادية والمتعارض والمتعارض والمتعادية وال	1
	5228 50		1,500	1,700	14	55,	3,000		į
3	1		48,745	63,750	79,727	96,751	114,750		
<u></u> إ	Sco-Total		10,100	13,350	17,350	21,800	26,550	e de la companya del la companya de) : [1
		ν. Or	96,312	129,627	168,690	214,597	268,500		1
Teres	A	!		() () () () () () () () () ()	(i	C C	7.4		

Note: Po, Population to be Served (person)

De, Deily Maximum Water Demand (OMD)

Fable 2-7
Basic Flam -SAI NOI-

t ,			; 		<u>}</u>		
	1975	cg65	3985	2590	1995	ಕಿಂದಿ	
Population in Water Supply Ares(person)	2,018	3,424	238,4	6,207	7,604	.000,6	
Horse Connection (%)	62.5	65.0	5:29	0.07	10 82 82	. 0-52	
Population to be Surved (person)	1,251	2,219	3,247	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	5,513	6,750	
Beily Meniaus (\$ /0.00.)	182.5	190.0	197.5	205.0	5.25.5	230.0	
Boily Maximum (CWD)	300	0 0	002	O,	1,200	1,500	i.
						,	,,

rable 2-8 Basic Plan -BANG BUA EE

	3325	6 6 6 6 7	1985	2992	. 1995	2000	
Population in Water Supply Arestperson)	22,773	15,719	19,664	23,609	27,55%	31,500	
Zoase Connection (%)	62.5	65-8	5-29	70.0	72-5	75.0	and the second state of the second
Population to be Surved (person)	7,358	10,217	13,273	16,526	72,977	23,625	apri gum k vija ak akg ak a ži
Doily Maximum (1/0.d.)	100 80 80 80 80 80 80 80 80 80 80 80 80 8	190-0	. 5-262	205.0	212.5	0.022	Laura propagation and
Peily Maximum (CED)	867° 1	. 000° ಪ	2,700	3,400	4,300	000 8* 16	b second second complete and
							,

rable 2-9 Basic Flam --Bang yai

	1975	1980	1987	1990	1995	ಶಂಚಿತ
Fopulation in Hoter Supply Arca(person)	5,235	870°05	292675	422,81	286,85	56,500
Ecase Compection (%)	62.5	0*59	5-29	9-02	72.5	75.0
Population to be Surmed (person)	3,709	6,531	9,559	12,792	16,231	19,875
Daily Maximm (ℓ /c.d.)	182.5	0.065	2.792	205.0	27. 27. 10.	220.0
Daily Maximum (CMD)	200	1,300	0061	002*8	605*€	00 2 4

Resic Plan -NONG XEAEM

	:					
	1975	2980	5005	0563	2993	ತಿದಿತಿ
Population in Water Supply Area(person)	32,000	000***	000,65	000*62	105,000	138,000
House Connection (%)	62.5	0°59	<i>5-2</i> 9	0.07	72.5	25.0
Population to be Surred (person)	000°0Z	28,600	39,825	55,300	76,125	103,500
Poily Maximum (4/0.d)	0 10 20 20	0*072	255.0	270.0	285.0	0-00£
Daily Maximum (CED)	4,500	798'9	10,155	12,931	21,695	.31,050
Out of Nang Kasam Area (CMD)	500	13,136	3,845	690°5	6,305	8,950
70\$03	, K	8,000	14,000	20,000	0 0 8 8	00°0 07

Table 2-11 Basic Plan -NonG CHOM

	2261	6858	3985	1590	2995	2000
Population in Water Supply Area(person)	7,000	000,55	15,000	19,000	23,000	27,000
E0430 C02502502 (%)	, 2, 5 , 5 , 5	65.0	67.5	70.0	72.5	0.55
Population to be Surmed (person)	4,375	057.2	10,125	13,300	529,91	20,250
Daily Kanimum (1/0.å.)	182.5	190.0	5-261	205.0	212.5	220.0
Gaily Maxiaum (CWD)	800	2,400	2,000	2,800	3,600	ن. <u>څ</u> هه

Besic Plan -MIN BUR

•	5262	1980	1985	1590	596₹	2004
Population in Water Suppit Area(person)	17,800	23,000	28,200	33,400	38,700	٥٥٥ ^{- چ} ېچې
Zorse Connection (%)	62.5	65.0	67.5	20.0	72.5	75.0
Population to be Surved (person)	12,125	14,950	19,035	23,380	28,058	33,000
Daily Maximum (1/0.0.)	182.5	190.0	3:261	205.0	212.5	220.0
Daily Mexicum (CED)	. 2,100	2,900	3,800	7,800	000-9	7,300
						,

Rable 2-13 Rasic Plan - TAT XR

				•		
	2975	2980	1985	2996	5000	2000
Population in Water Supply Area(person)	23,242	. 25,592	32,944	\$62,04	879°27	55,000
Eorse Correction (%)	62.5	65.0	67.5	20.0	72.5	0*52
Population to be Surred (person)	107,11	16,635	22,237	28,207	34,545	42.,250
Doily Maximum (1/0.6.)	182.5	0.062	. 5-25:	205.0	91 91 1V	S-0-02-8
Daily Maximum (CMD)	2,100	3,260	007*7	5,800	2,400	00 5 6

2251e 2-14

Sasic Plan -BANG PET

gar about from	3975	1980	1985	2990	1995	2000
Population in Woter Supply Area(person)	90962	006°8 ·	008-01	12,700	14,600	16,500
House Connection (%)	55.5	0.59	10	0-02	72.5	0-57
Population to be Surved (person)	4,375	5,785	7,290	6,890	10,585	12,375
$\frac{1}{(\lambda \cdot c_{-\delta})}$	182.5	\$30.0	197.5	205.0	212.5	520.0
(cm) manyer Aired	008	1,200	5-450	4 000000000000000000000000000000000000	2,250	2,750
		, .		_{se} ,		2

Table 2-15 Basic Plan -BANG

•						•	
	\$4 \$7 \$7	29,80	1985	1990	1995	0003	porture start
Population in Kator Supply Area(person)	5,500	005-9	2,500	8,500	005*6	10,500	
House Cornection (%)	10 61 10	6.59	57.5	0-02	5-22	75.0	and the second or more of
Population to be Surmed (person)	3,438	4,225	5,063	026*5	6,888	7,875	7.3. ALM MAIN EN
Daily Maximum $(\ell/c.d.)$	182.5	190.0	197.5	205.0	232.5	220.0	
Deily Maximum (CED)	000	850	00065	1,250	1,500	44 .	i Paramananan kanada
Out of Beng Bo Ares (CBD)	200	. 650	002	850	1,050	1,250	province and and
Totol	7,200	4,500	.002.5	002.8	2,550	3,000	
							1

2 -- 2 -- 首都樹周辺開発地区の水需要量

Soparate Systemに関する開発計画としては5ヶ所の工場団地と、5ヶ所の住宅公団ならびに新空港が1ケ所計画されている。

これらの計画需要量は、Industrial Estate AuthorityとNational Housing Authorityよりの年次別計画資料によった。

各開発ケ所の水需要量は表2-16に示すとおりである。

Table 2-16 Water Demand for Additional Area (CMD)

	Location		1980	1985	1990	1995	8000
Bank	Bang Khum Thie	Fa		54)	Bys	to the control of the	E-0
	mang natai 2000	110	5,300	5,300	5,300	5,300	5,300
4) 30 10 10 10 10 10 10 10 10 10 10 10 10 10	Total		5,300	5,300	5,300	5,300	5,300
.,	D	la	4,000	4,000	4,000	4,000	4,000
	Bang Chan	80	1,100	1,100	1,100	1,100	1,100
		Fa	5,200	5,200	9,850	9,850	9,850
	Lat Krabang	но	2,700	13,300	26,000	38,000	38,000
अंतरुद्व	New Airport		1,500	2,000	2,500	3,000	3,500
	Bang Phil	Fa	1,100	3,800	3,800	3,800	3,800
\$4.05 \$4.05 \$4.05	Bung Bo	110	4,000	12,000	20,000	20,000	20,000
14 (i)	Bang Poo	ra,	10,400	10,400	20,700	31,200	41,500
		lio	5,040	17,760	24,000	84,000	24,000
	White Dan	Fa	5,200	12,450	20,700	20,700	20,700
	Khlong Dan	110	6.4	**	40	eu.	£.n
	Total	- Princesor e	40,240	82,010	132,650	155,650	166,45

Fat Factory Area

Ho: Housing Area

2-3 水需要量総括表

1) 水器要量

以上今まで算出した Separate System 全体の水器要量は, 2000年で 249,500m/日となった。

この内Chao Phraya River の右提で 5 6,4 0 0 m⁸/日、左提で193,100 m⁸/日である。

この水量に対して Separate System は、水源の確保および送配水計画を、 Central System よりの送水の可能性も含めて立案する。

全体の需要量は、表2-17~2-19に示す。

Table 2-17 Summary of Water Demand (2000 AU)

٠,	***************************************		Right Bank	heft Bank	Tota1
Popu	lation to be serve	d(person)	153,750	114,750	268,500 (9 Amphoes)
ಕ್ಷ್ಮ ಕ್ಷ್ಮ	Amphoe	(CMD)	51,100	26,650	77,750
Water)emand	Additional Area	(CMD)	5,300	166,450	171,750
<u></u> "A	Total	(CHD)	56,400	193,100	249,500

. Water Demand of the . right tank of Chao Fursya River (CND) Table 2-18

A CONTRACT OF THE PROPERTY OF	Remember 3					•			
	2000	1,500	5, 200	007,4	000 11	000,02	5,300	005,30	56,400
	1995	1,200	7,300	3,500	೦೦೦ ಕ	28,000	5,300	33,300	006,54
	0661	000	3,400	2,700	7,000	000°	5,300	25,300	32,300
	5661	700	2,700	2,900	5,300	000,77	5,300	300,91	27,,600
	C 80 60 F	500	3,000	COE - E	008,6	0000	5,300	ಂಚ್ಕ	001,71
	Year	Ser Nor	ತಿಜ್ಯಾ ಶಿಜ್ಯಾ ಗೊಂಬಣ	Ser Sust	Sub Totel	Nong Knaem	Seng Khun Taken	8ಚರಿ 7ರಕ್ಕೆ	Total
	Location		ಕಿಂಭ್ರಹ್		\$ CDS	ಕಂಥಮೆಕ	Development Program	Sus	Right Bank Total
1			ध्य छद्रज्यपृष्ठ	भव ६ ५१	дор	doiade	dd meml	Rong 1	·* • • • • • • • • • • • • • • • • • • •

Table 2-19 Water Demand of the left bank of Chao Phraya Ziver (CHU)

. ۵۰ سه. د.	Loc	ation		1980	1985	1990	1995	2000	Bonarka
		Kong Chek		1,400	2,000	2,800	3,600	4,500	
. !	Amption	Nto Bur t		2,900	3,800	4,800	6,000	7,300	
ł		Lat Kraba	ng	3,200	4,400	5,800	7,400	9,100	
	Sub	Total		7,500	10,200	13,400	17,000	20,900	
		Bang Chan	Pa	4,000	4,000	4,000	4,000	4,000	
3 Dissertes		paug Chan	Ho	1,1000	1,100	1,100	1,100	1,100	
	Bevelop::⊕n∜	***************************************	ya	5,200	5,200.	9,850	9,850	9,850	
Dagt.	Program	Lat Krabang	Bo	2,700	13,300	26,00Ú	38,000	000,80	
		Now Mir Por	e	1,500	2,000	2,500),000	3,500	
	Sub	Total		14,500	25,600	43,450	55.950	56,450	
		Bang Phli		1,100	1 ,450	1,850	2,250	2,750	
	Amphoo	Dang Bo		1,500	1,700	2,100	2,550	3,000	
	Sub	Total		2,600	3,150	3,959	4,800	5,750	
			Pa	1,100	3,800	3,800	3,800	3,800	
ಕ್ಷಾತ್ರವಾಧವಾಧ್ಯವ	•	-Bang Bo	Ito	4,000	12,000	20,000	20,000	80 000	
କଟିଆ ଅନ	Covolopment Program	Down See	Pa	10,400	10,400	20,700	31,200	41,500	
South		Bang Poo	ilo	5,040	17,760	24,000	24,000	24,000	
		Khlong Dan	ra	5,200	12,450	20,700	89,700°	20,700	
	Տսի	Total		25,740	56,410	89,200	99,700	110,000	
	Laft Da	ok Total		50,340	95,360	159,000	177,450	193,100	

Pa i factory histo

llo i llousing Aron

第 3 章 既存給水施設の検討と将来計画に対する提案

第 3 章 既存給水施設の検討と将来計画に対する提案

バンコク首都圏周辺水道計画に包含されている 9 Amphoes の 水道計画を行うに際し、既存施設の有効な利用をはかるために約 1 ヶ月にわたり現場調査を行なった。

以下、その現況を述べるとともに、既存施設の検討と提案を行なう。

3-1 既存施設の能力

- 1) The Right Bank of Chao Phraya River
- (1) Sai Noi ……… 約10年前に井戸を廃止した。その原因は塩害とも、又鉄分が多くなったとも言われているが真相は不明である。 現在、飲料水は雨水、他の生活用水はKhiong水を利用していて、 水道施設は皆無である。
- (2) Bang Bua Thong ……… 1963年に浄水場を建設し現在にいたっているが、Khlong Phra Phimonの水質が年々悪化の傾向にあるので将来地下水に関する再調査を行なう計画がある。
 - (i) 浄水場の能力 浄水方式;薬品沈でん+急速ろ過 浄水能力; 2,000 m³/日 平均原水濁度;約1,000 度 薬 注 率(平均)

バン士: 132ppm

消石灰; 250 每/月

cl ; 2 ppm

ろ過速度; 100 m/日

洗 浄;逆洗のみ(1日1回)

(II) 高架水槽 50 m⁶×1槽, 有効高 約20 m

⑪ 配 水 管 主配管 A.C.P. ∮100 mm

(V) 問 題 点 逆洗圧が一定でないため、近床の砂利が露出し、 プレークスルーがはなはだしいため、浄水も濁 度が認められる。

- (3) Bang Yai ……… 当初使用していた井戸は砂の温入が著しいため、 1976年,約500 m離れた地点に新しい井戸を設け、現在にいたっている。
 - (I) 非戸の能力 1,200 m³/日(水中タービンポンプ)
 - (ii) 高架水槽 60 m⁸ × 1 槽, 有効高 約20 m
 - (iii) 配 水 管 主配管 A.C.P. Ø 100 mm
- (4) Nong Khaem ……… 1973年にFeasibility Plan が提案されたが、以後計画は着手されず、現在にいたっている。

現在、井戸が1ヶ所あるがその水質は悪く、塩素イオン濃度は200 ppmをはるかに超えているので、将来の水源とし利用するのは不可能である。

- 2) The Left Bank of Chao Phraya River
 - (1) Nong Chok …… 現在, 井戸は2ヶ所あるがその楊水量は極めて 少なく, 雑用水として使用するために Khiong 水を大型タンク車で選ん で治水井に井戸水と観合して投入しており、完全な水道施設としての 目的を果していない。
 - (1) 井戸の能力 不明
 - (ff) 高架水槽 60 m8×1槽, 有効高 約20 m
 - ⑪) 配 水 管 主配管 A.C.P. Ø 100 mm
 - (2) Min Buri …… 現在, 2ヶ所の井戸より揚水し給水を行っている。建設年次は比較的古く2井共約15年前であり、設備の老朽化が 日立つ。
 - (i) 井戸の能力 2,800 m³/日1,900 m³/日

- (II) 高 架 水 槽 50 m⁸ × 1 槽, 有 効高 約 2 0 m7 0 m⁸ × 1 槽, "
- 配 水 管 主配水管 A.C.P. Ø 2 0 0 mm
- (3) Lat Krabang …… 地下水の汲上げにより地盤沈下が激しく, 8年間に約10cmの沈下が生じている。原因は既存の井戸が近くに集 中しているためと思われる。揚水不能になる前に対策をたてる必要が ある。
 - (i) 非戸の能力 1,000 m⁸/日×3井
 - (ff) 高 架 水 槽 5 0 m⁸ × 1 槽 6 0 m⁸ × 1 槽
 - ← 配管 水管 主配管 A.C.P. Ø 100 mm
- (4) Bang Ph Ii ……… 非戸揚水量は非常に少なく、殆んどの雑用水 を Khlong 水に依存している。
 - (i) 非戸の能力 720 m[®]/日
 - (ii) 高 架 水 槽 100 m⁸ × 1 槽, 有効高 約23 m
 - ⑪ 配 水 管 主配管 A.C.P. ダ100 nm
- (5) Bang Bo …… 現在, Khlong Dan へ区域外給水が行なわれて おり、将来も行なう予定で計画を作成する必要がある。
 - (1) 井戸の能力 1,200 m*/日

500 #

- (II) 高架水槽 100 m⁸ × 1 槽, 有効高 約18 m 120 m⁸ × 1 槽, "約23 m
- 側 配 水 管 Bang Bo A.C.P. Ø 150 mm Khlong Dan A.C.P. Ø 200 mm

(V) そ の 他 MWWA にて 200 m 10 月戸を掘削中 120 m の高架水槽を築造中 配水管を布設中

竣工は1977年9月予定

3-2 検討と提案

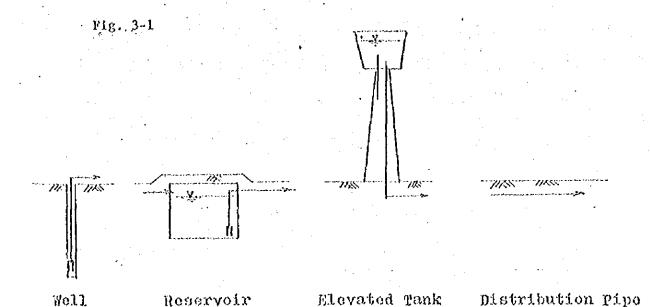
第2章で算用した2000年における総需要水量249,500㎡/日を全部 地下水でまかなうととは、地下水調査により、事実上不可能と判断された。 その結果、水源を表流水あるいはContral Systemに求めるにせよ、将来 の水道システムは広域水道システムをとらざるを得ないと思われる。

一方、緊急に水道施設の整備が望まれている各Amphoe に対して、広域 水道システムがその機能を発揮する時期を早期に求めることは困難と思われる。

以上のことから、各 Amphoe の現況改善に対しては地下水を利用する水 道計画が暫定的にせよ必要と思われるので、この観点から以下の提案を行 なう。

1) 配水システムの基本フロー

各 Amphoe の配水システムは図 3 - 1 を基本とする。



2) 既存施設に対する提案

(1) We 1 1

現在使用されている井戸は5~10年前に建設されたものであり、 管理に必要な設備(流量計,水位計等)が備わっていないので、これ ら設備を新たに設ける。

(2) 高架水槽

各 Amphoe 共、Town の中心部に高架水槽が設置してあり、将来の配水システムからも望ましい位置なので、これらは将来共利用する。

(3) 配水管

各 Amphoe 共、配水主管は将来の水量に対して余裕がないので、将 来水量に見合った配水管を布設する。

3) 計画に対する提案

(1) 配水池の建設

現在、各Amphoe共、高架水槽の容量が小さく、揚水量と給水量の 調節がなされていない。そのため、井戸の運転が不規則となり井戸の 寿命を短かくしていると共に給水が非常に不安定な状態にある。

これを解決するに1日最大給水量の6hr分の配水池を建設する。 表3-1に各Amphoeの容量を示す。

(2) 観測井の設置

Amphoe Bang Phli および Bang Bo は塩水の進入が予想されるので、新規井戸を建設した段階で観測井の設置が望まれる。

(3) 機器の設置

- 主)塩素注入設備 (配水池流入部)
- 非)流 量 計 (名井戸の導水管部)

Table-3-1

Capacity of Service Reservoir in each Amphoe

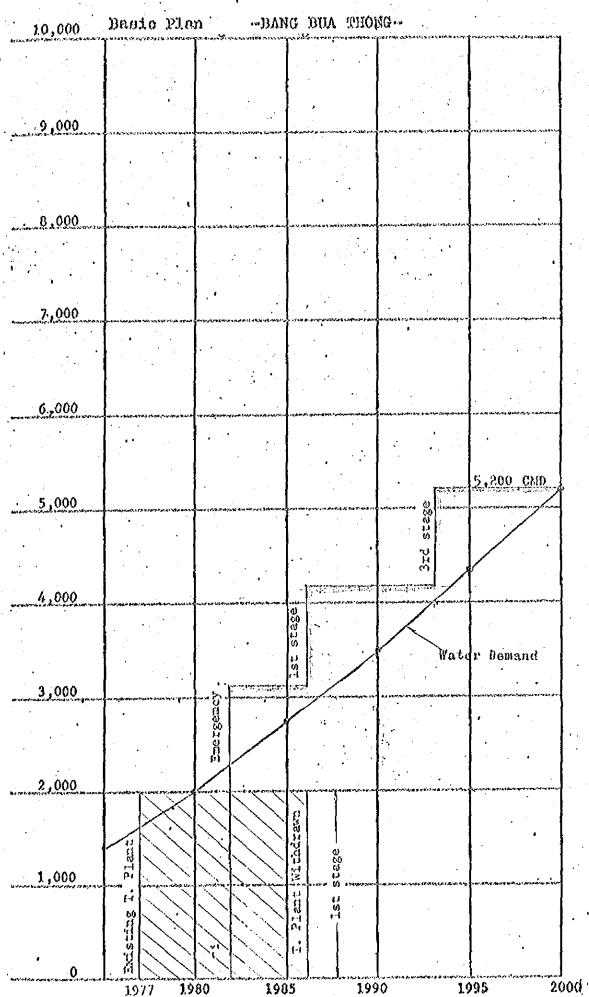
Amphoe	Capacity of Service Reservoir (CM)	Daily Maximum Water Demand (CMD)
Sai Noi	400	1,500
Bang Bua Thong	1,300	5,200
Bang Yai	1,100	4,400
Nong Khaem	10,000	40,000
Min Buri	1,800	7,300
Nong Chok	1,100	4,500
Lat Krabang	2,300	9,100
Bang Phli	700	2,750
Bang Bo	450	1,750
Klong Dan	300	1,250

(4) 将来建設計画

別紙のような建設計画を提案する。

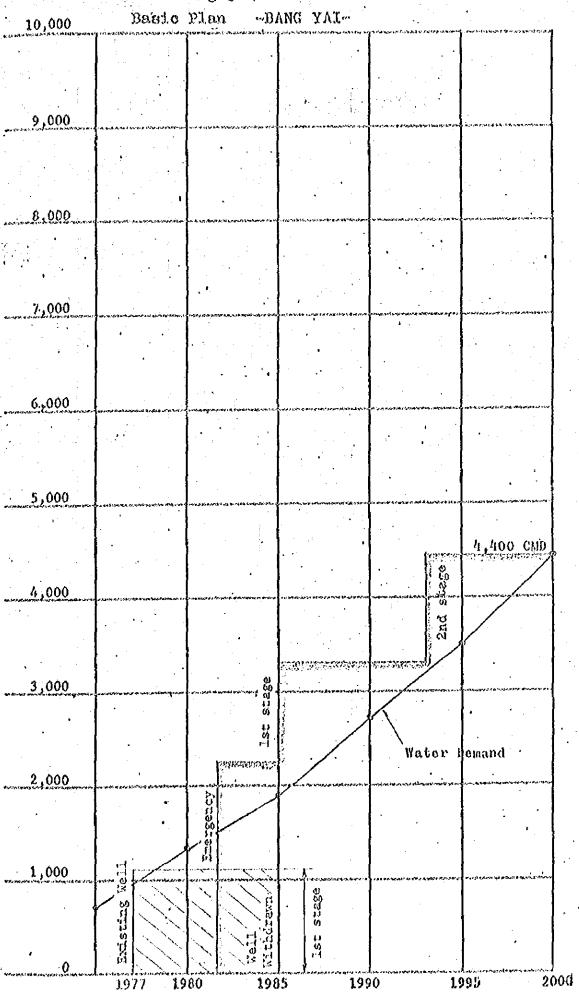
(図3-2~図3-10)

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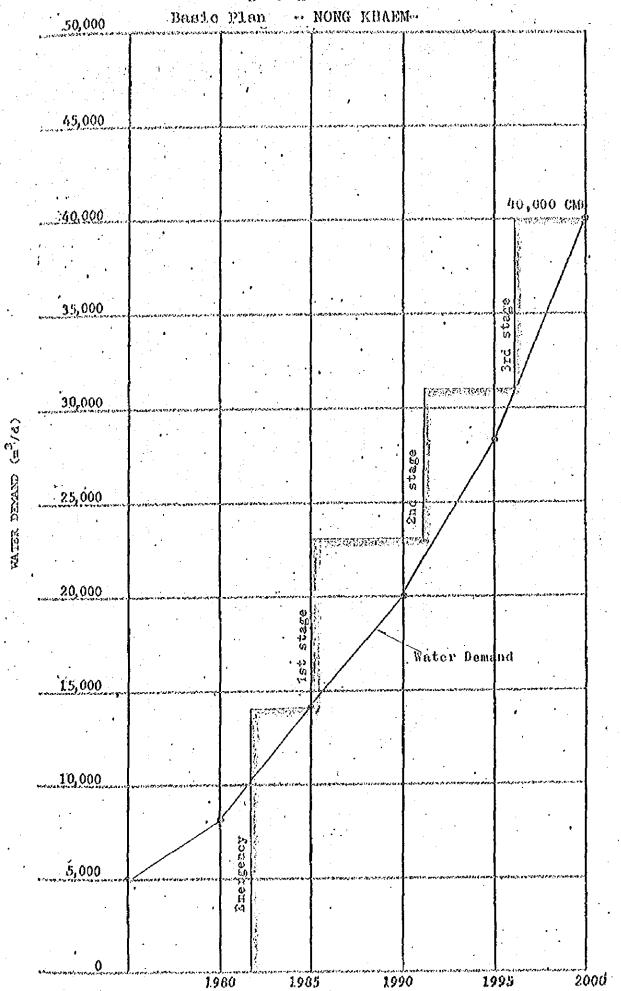


WATER DEPAND (=3/c)

Pig. 3-4.



WATER DEMAND (=3/4)



F1g. 3-6

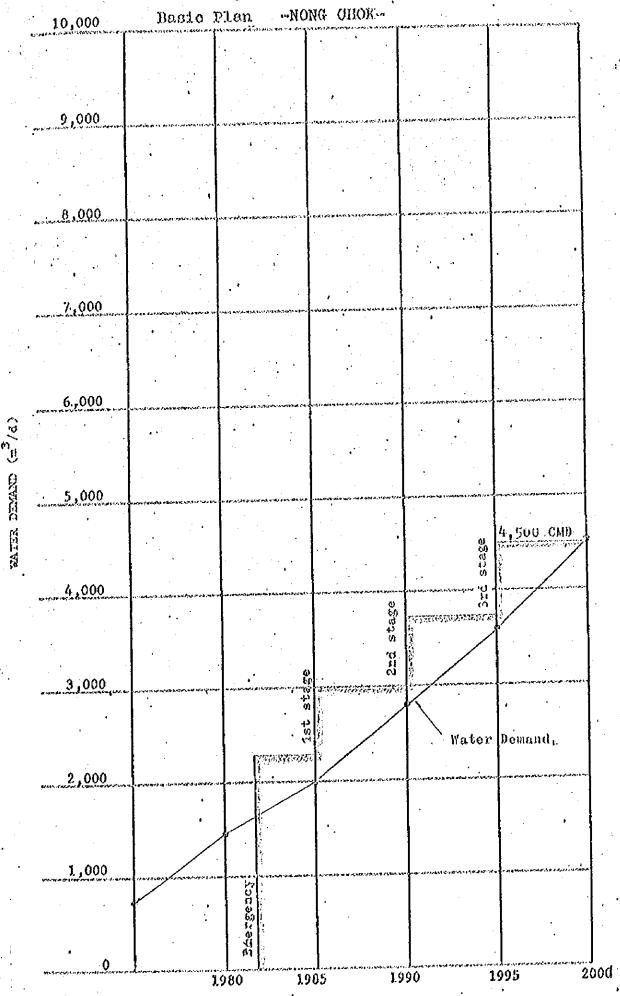
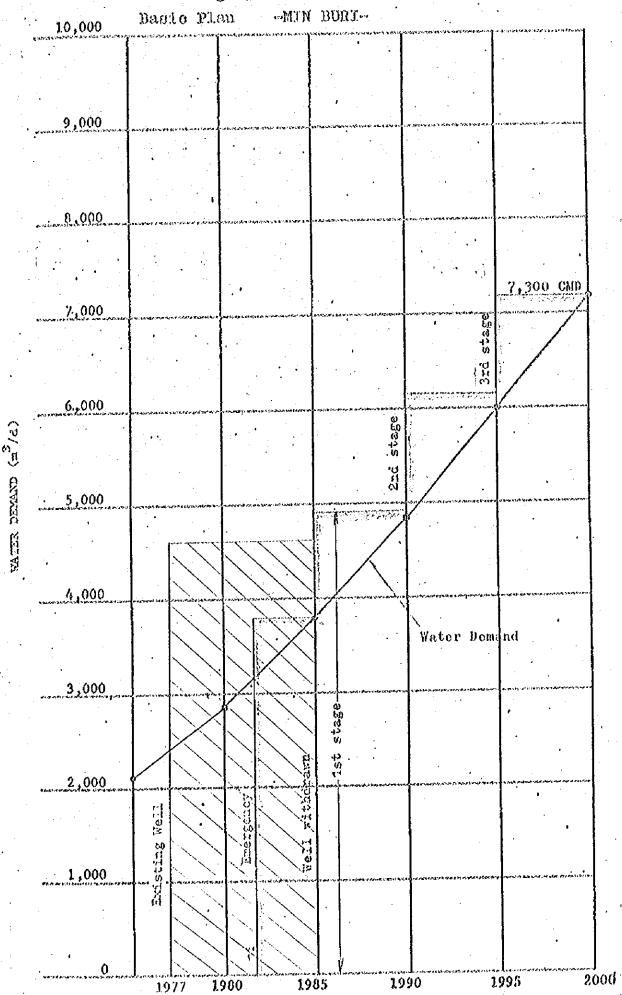
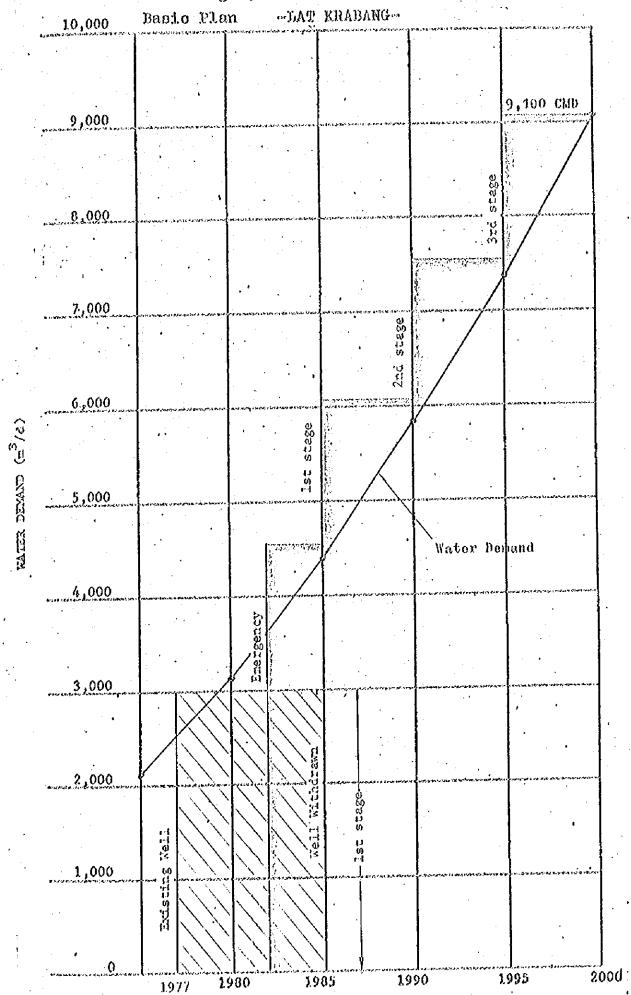
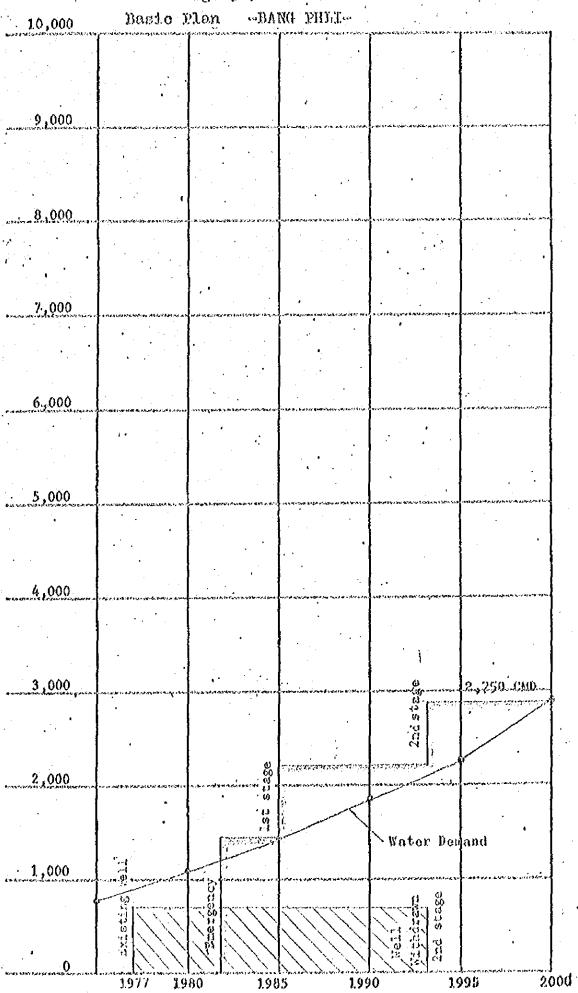


Fig. 3-7



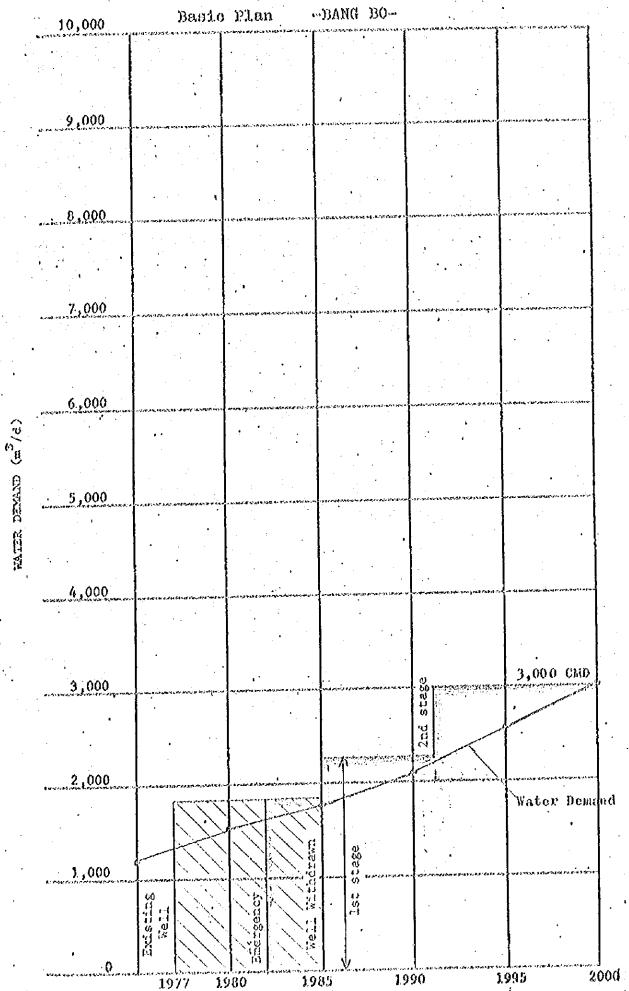




1.985

HATER DEPARTO (=3/2)

Fig. 3-10



第 4 章 水源調査の結果と提案

第 4 章 - 水源調査の結果と提案。

4-1 地 下 水

今回の調査はChao Phraya River 左岸一帯及び右岸北部 3 地区において 3 2 測点の電気探査と既設井戸の聞きこみ、及び既存資料の収集を中心に 約 1 ヶ月行われたが、その結果 Bangkok 周辺地区における地下水理地質の 概要を把握することが可能となった。かつ、本プロジェクトにおける地下水の取扱いについても、その方向性が明らかとなった。

1) 電 気 探 査

電気探査を実施するため本調査団は3機種の測定器を持参したが、結果的に大型の農資 S型機をすべての測点に使用することになった。電気探査は左岸にて24測点を実施し、右岸地区において8測点を実施した。測定は上部層の厚い粘土層に影響されて困難を極めたが、慎重に測定に努めた結果、予期以上の成果を収めるに至った。電気探査の測定結果は次のようなものである。測定位置は図4-1参照。

- (1) 一般的に層比抵値は低く、粘性土を全般的に含んでいることが解る。
- (2) 左岸において特に層比抵値の低い場所はNong Chok, Min Buri 北部と Bang Ph Li 及び Bang Bo の南部である。
- (3) 比較的帯水層の状況が良いと判断される部分は国道34号線沿いと
 Lat Krabang を通る東西方向の地域である。
- (4) 右岸地区については、Bang Yai 及びBang Bua Thong の東部が悪く、西部後ど良いという結果が得られた。

現状において標準曲線法による解析がすでに終了し、帯水層の性状については明らかになったが、既設井との地層対比によって行われる直視 法解析は現在行われつつある。この解析によって帯水層の構造を検討する予定である。

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2) 既調査資料の解析

(1) 帯水層について

帯水層は最上部層の Bangkok Aquifer (50m zone)から Pak Nam Aquifer (550m zone) 返 8 帯水層が存在するが、上部 2 層は水質的 に問題があり、300m以下の4帯水層については充分なデータがない。しかし、EGATで使用している深井戸は100m²/hrの Capacityをもつ にもかかわらず、その地下水は水温が49℃と高く、かつ、SO1イオンの Contents が高いという性質を有しており、深度的にみて Recharge が充分でないと推定される。

残る 2 帯水層の Nakhon Luang Aquifer (150m zone) と Nonth-buri Aquifer (200m zone) は水質的に飲料に適し, かつ 経済性のの高い帯水層であり、透水量係数の値からしても充分に補給涵養のある帯水層であると推定され、本 Separate System の地下水源として、両帯水層をその対象としたい。

しかしながら、両帯水屑は Bangkok 南部において塩水が浸入し塩等 を生じている状況下にある。

※ 深度500m以下の帯水層を利用する化際し 涵養量以上の取水 を行うならば容易に水質を悪化せしめ、かつ本帯水層の減圧は、 圧密層の範囲を拡大せしめることになり、地盤洗下は現状以上の 規模となることが予測されよう。

3) Bangkok 市内にかける地下永事情について

100

Bangkok 市内にかける地下水揚水量及び地下水位の状況は Charoen Piancharone and Charoen Chuamthaisong (1976)によってすでに明らかにされている。

との報告によると Bangkok 中心部にかいて 1958年~ 1959年の調 査結果ですでに30 feet ~ 40 feet に水位が低下し、1968~1969 年の調査では60 feet から70 feet に水位が低下している。又このとき は Phra Pradacg 工業地帯に新しい水位降下の中心が出現している。 さ らに1973年~1974年には水位降下の中心はさらに北上し、その水 位は100 feet になっている。北上の原因はPrivate Housing Projects に起因するものと推定される。この時点にかいて影響は Bangkok 周辺に 及びMin Buri において70 feet, Bang Phli において65 feet, Bang Bua Thong において 60 feet と水位が変化している。この水位の降下は 地下水の過剰な揚水によるものと考えられ、このため海側からの塩水の 浸入が顕著になって来ている。地下水の揚水量については,1960年に 175,000m³/日の値が得られ、1963年に33·0,000m³/日,1976 年には600,000 m³/日 (Piancharoen, 1976) あるいは700,000 m⁸/H (by Ministry of Agriculture and Cooperatives 1976) が場 水されていると言う。水位の低下状況は年々増加し1960年に 0.6 m/ 年であったものが、1968年では1.4m/年、1973年では2.3m/年と 低下し、現状では3~4m水位が低下している。地下水に対する補給は 垂直循接と水平流動による額強力があるが annual rainfall の5%~6 多がRecharge 量であるとされている。 従来のデータより概略計算を行 ってみると、全場水量のわずか30~35%が額養されているにすぎな 現状の揚水をこのまま放置しておくことは地下水の結構のみならず, 地盤洗下を生ぜしめることは明らかである。

従って早急に表流水を水源とする上水道及び工業水道を新設あるいは 増設し、限度ある資源の保全をはかるべきであるう。

尚,塩水化の速度として250 ppmの塩水クサビの浸入速度を求めると、この結果約年間500~550 mの値が得られた。

4)Separate Systemにおける地下水源について

現状において Bungkok 市内の地下水位が年々低下しつつある状況下にあって、周辺地区は重要な演奏源となっている。従って、この地域でさらに地下水を利用することは好ましくない。量の大小にかかわらず、周辺地区で地下水を揚水することはその量に近いだけの補給を停止せしめることになる。しかしながら住民の生活改善を安価な水源をもって行うとすれば地下水以外になく、地下水を Separate Systemにおいて使用することは当然 Central Systemにおいて同量の 地下水取水を停止すると言う条件下にあってはじめて可能となるものであり、 Bangkok の状況を考えるとその取水量は Recharge 量と同程度のものと考えられよう。 かつ又揚水に伴うに井戸相互間の干渉を考慮すると、地下水源は 1ヶ所に集中させることはさけ、分散させるべきであると考える。

(I) Recharge 量化ついて

Recharge 量は annual rain-fall の5%として考える。

- 义、水平方向の流動量もRecharge 量として考えるべきであるが,この場合とれを無視することとする。

annual rain fall 1400 mm/年

1400 mm/年 × 0.05 == 70 mm/年

$\frac{1}{1000} \times 70$ mm/4F $\times 1,000,000$ m⁸ = 70,000 m⁸/4F/Kd

= 1 9 1 m⁸/H/Km = 1 9 0 m⁸/H/Km

(2) 地層状況及び地下水理状況を考慮した条件(安全率)

(1) 起一幕

Min Buri 及び Nong Chok は北方に粘土層の厚い地層 をひかえていることより F.S. = 2.0 とする。

Bang Phli Bang Bo 塩水化の危険があるため F.S. = 2.0 とする。 Lat Krabang は F.S. = 1.5 として考える。

(#) 有 是

Sai Noi は粘土層を考慮し下.S. = 2.0とし、Bang Bua Thong 及びBang Yai は F.S. = 1.5とする。

Nong Khaemはすでに塩水化しているので地下水源は考慮しない。

(3) 涵養面積

各地区の必要水量(前回レポートの値)に見合う涵養面積は表 4 ー 1 のとおりである。

Table - 4-1

	Location	Recharge Area
4.1910	BANG PHLI	$3,800 \text{ CMD} \div 190 \text{ CM/day/km}^2 \times 2.0 = 40 \text{ km}^2$
1	BANG BO	$2,500 \text{ CMO} = 190 \text{ CM/day/km}^2 \times 2.0 = 26.3 \text{km}^2$
BANK	MIN BURI	$7,300 \text{ CMD} \div 190 \text{ CM/day/km}^2 \times 2.0 = 76.8 \text{ km}^2$
	NONG CHOK	$4,500 \text{ CM} \div 190 \text{ CM/day/km}^2 \times 2.0 = 47.3 \text{ km}^2$
	IAT KRABANG	$7,500 \text{ CMD} \div 190 \text{ CM/day/km}^2 \times 1.5 = 59.2 \text{ km}^2$
	SAI NOI	1,500 CMD # 190 CM/day/km ² x 2.0 = 15.8 km ²
RIGHT	BANG BUA THONG	5,000 CMD : 190 CM/day/km ² x 1.5 = 41.1 km ²
BANK	BANG YAT	4,400 CMD ; 190 CM/day/km ² x 1.5 = 34.7 km ²
TOTAL	and the second s	. 341.2 km ²

(4) 井戸からの可能揚水量化ついて

Sai Noi 及び Nong Chok については T=の m⁸/時 S=1.0×10⁻⁸ として計算し、Min Buri 及び Bang Phli、Bang Bo、Lat Krabang、 Bang Yai 及び Bang Bua Thong は T=15 m⁸/時 S=1×10⁻⁴ として計算する。

Sai Noi 及び Nong Chok

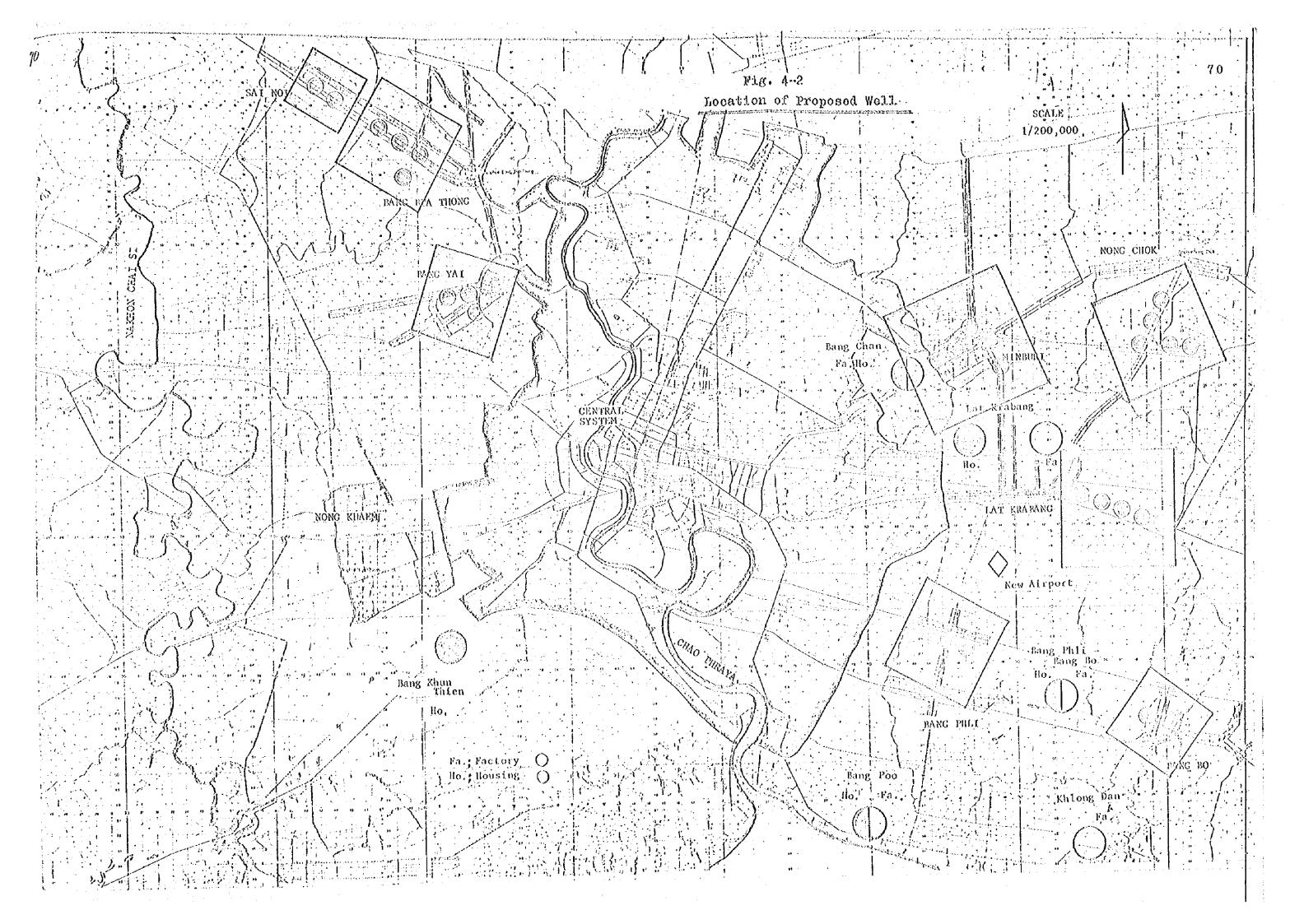
 $1.4.0 \, m^8 / \Pi / m \times 1.0 \, m \times 0.7 = 9.8.0 \, m^8 / \Pi / \text{well}$

Min Buri, Bang Phli, Bang Bo, Lat Krabang, Bang Bua Thong. Bang Yai

220 m⁸/日/m×10m×0.7=1540m⁸/日/well 以上の結果をまとめると表4-2のとおりであり、非戸配置は図4-2に示す。

Table-4-2

Location	Daily Demand CKD	Lifting Volume, CMD/well	No. of Wells	Recharge Area km ²	-do- per cach well km ²
BANG PHLI	3,800	1,540	3	40	13.3
BANG BO	2,500	1,540	2	26.3	13.1.
MIN BURI	7,300	1,540	5	76.8	15.4
номо снок	4,500	980	5	47.3	9,5
LAT KRABANG	7,500	1,540	5	59.2	111.8
SAI NOI	1,500	980	2	3.5.8	7.9
BANG BUA THONG	5,200	1,540	4	41.1	10.3
BANG YAI	4,400	1,540	3	34.7	11.6



4-2 表 流 水

表流水をSeparate Systemの水源として考えた場合、Fig. 4-3 に示す Khlong 及び River が、計画給水区域との関連において、 位置的に大きな可能性を占めている。

一方、水道水源として最も重要なFactorは、その水源の持つ水量と水質であることは言うまでもない。

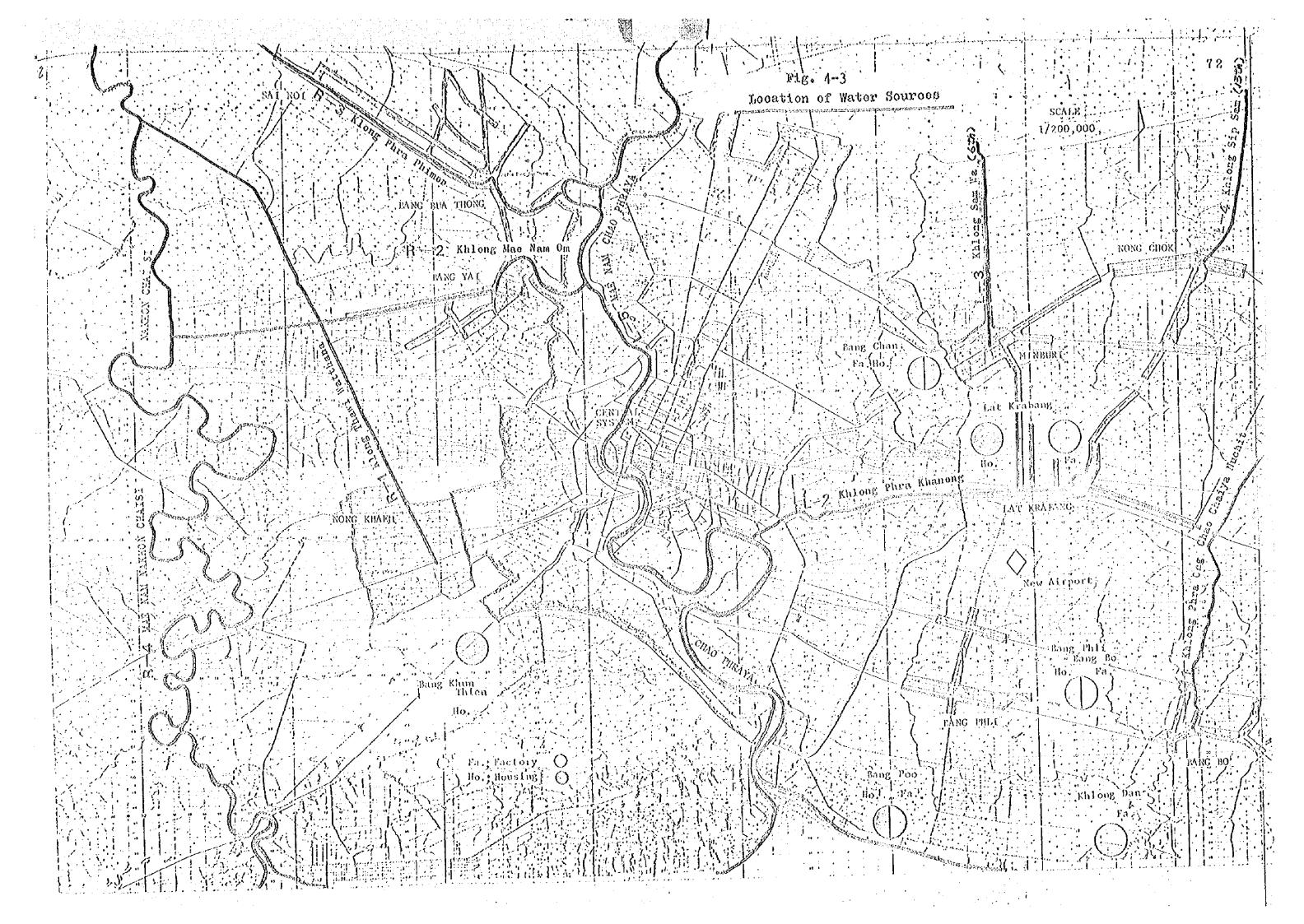
今回の現地調査で得られた Data を基に、以下対象の表流水を Khlong と River に大別して、各水源毎にその可能性の大要を述べる。

- 1) Right Bang of Chao Phraya River
 - (1) Khlong Water
 - (i) Khlong Thawi Watthana (R-1)

このKhlong は前回(1973年)のFeasibility Studyにおいて 地下水の全く可能性のない Nong Khaem 地区の水道水源として、 Recommend された。一般的にKhlong の水を水道水源として考える 場合問題となるのは、Khlong の有機的汚染の進行である。

従って、今回の路査では、水道水源としての評価をするに当り、 Khlong については、特に有機的汚染に溶眼して集中的に行なわれた。 つまり、汚濁の指標として BOD。を採用して、各対象 Khlong での水 質解析をした。

Khlong Thawi Watthana についての BODs 値は、3点について行なったがその結果は以下に示す通りである。



Item Point	00 (ppm)	BOD5 (ppm)	Remarks
Amphoe Taling Chun	1.5	4.3	Noar Railway Bridge
Amphoe Thasi Charom	2,8	5.2	In front of Wat Saladaeng
Amphoe Phasi Charoen	1.6	4.5	Near Petch Kasem Bridge

Water Quality of Khlong Thawi Watthana

上表に示すように、本Khlongを水道水源として考えた場合、BOD。は既に通常の水処理での限界値と言われる4 ppm を超えており、4年前検出されたBOD。値 1.6 ppm と比較すると約3倍の値であり、毎年約0.8 ppm づつ汚濁が進んでいることになる。

他方、本Khlongを水量的に評価した場合、第7章のRefference Na 9 に示すように Dry Season においては 殆んど流量がないため、何らかの対策をたてなければ約50,000 m³/日にも及ぶ Nong Khaem 地区の Demand には到底対応できないであろう。

以上、Khlong Thawi Watthana についての検討の結果は、水道水源として重要な2つの要求である水量及び水質のどちらも不適当であると判断された。よって、本Khlong は計画水源の枠よりはずさなければならない。

(ji) Khlong Mac Nam Om (R-2)

Khlong Mae Nam Omは、Chao Phraya River 本流より直接分岐 しており、量的にも水道水源として充分であり、ゲート等の水制が ないところから、水質的にもChao Phraya River と大差ないもの と思われる。従って、もしChao Phraya River 右岸全体の 地 域化 Chao Phraya River の水を供給するにしても、本 Khlong でその役割は充分果たせるものと思われる。

前回の調査では、本Khlong の有機的汚染についての解析は、その 外観より判断して不要として行なわれなかった。しかし、先に述べ た如く、Khlong Thawi Watthana が水道水源として不適当と判断 されるに至った現在、右岸地区の水道水源としてKhlong Mac Nam Omは、大きな Sharc を占めることとなる。 従って、その重要性を 考えて本Khlong の水質解析を行なった。

(iii) Khlong Phra Phimon (R-3)

このKhlong は、Fig. 4 - 3 に示す通り、位置的に他地区と大き く離れている Sai Noi 地区の表流水源として一応検討の対象と考え た。しかし、この Khlong の有機的汚染は非常に顕著なものであり、 先に述べた Khlong Thawi Watthana の水質と比較しても、その汚濁 は、はるかに進行している。更に水量的にも非常に大きな不安が残 る。

従って、一応位置的には評価できるが、水質的或いは水量的な評価をすれば、Khlong Phra Phimon は水道水源としての可能性は無い。

(2) River Water

(i) Nakhon Chai Si River (R-4)

今まで右岸地区のKhlong 表流水の可能性について検討した結果,結局のところ Khlong Mac Nam Omのみが、唯一のFeasible な水道水源と考えられる。

また,右岸地区に他の表流水源の可能性を求めるならば,やゝ遠

くなるが Nakhon Chai Si River が考えられる。 Nakhon Chai Si River に Separate System の右岸地区の金水量を求めた場合、その Total Demandは、2000年において 56,400 m³/目(0.65 m³/see)である。

一方, Nakhon Chai Si River の渇水期における総水量は 50m⁸/sec) であり、このうち 30m⁸/sec は塩水瀬上防止の為の 維持用水で、残りの 20m⁸/sec = 1,800,000m⁸/日が水道用水として取水可能であると伝えられている。

従って、右岸全体の Separate System の Demand は、2000年に おいても充分 Cover できることになる。

また、C.M.D. (Camp Dresser & Mckee)のReportによれば、Central Systemにおける右岸全体のWater Demandは 2000年において1,230,000m³/日といわれ、この値にSeparate Systemの2000年におけるWater Demandを上乗せしてもTotal Demandは1,286,400m³/日であり、今仮にChao phraya River 右岸全域の水器要量を、このNakhon Chai Si Riverに依存したとしても取水可能量の2/3程度である。

従って、Chao Phraya River の横断 Tunnel の工事の成否が問題となっている現在、もし、この横断工事が不可能となった場合は、Central Systemを右岸と左岸に分断して、Nakhon Chai Si Riverを水源とした変更計画を立案することが可能であろう。

他方, このように大きな Capacity を持つ Nakhon Chai Si River には,塩水遡上という水質的に大きな問題がある。 Nakhon Chai Si River の塩水遡上に関する資料は比較的少ないが,前回(1973年)の路雀で入手した Data によると 1970年に河口より60~80

kmの間に飲料水としての限度ぎりぎりのクロールイオン 200 ppm を検出した実例や、60km地点で 16,000 ppm という異常に高いクロールイオンを検出した 1968年の実例が報告されている。

一方,前回の調査団によって行なわれた試験結果によると Sampling point の最下流点であった Khlong Phasi Charoen との交点(河口より25km)においてもクロールイオンは約20 ppmに過ぎず、海水の遡上は認められなかった。

このようにクロールイオン濃度に関する資料が少ないことや、各 資料の数値が大申に違う為、これらの相関をつかむ事は非常に困難 なことになっている。

従って、一応Nakhon Chai Si River よりの取水は、河口よりも80km以上さかのぼるならば、水道水源として先ず問題がないものと見做される。しかし、もしNakhon Chai Si River を水源と定める場合には、水源の予定地点において少なくとも1ヶ年の水質試験を継続して行なり必要があるう。

2) Loft Bank of Chao Phraya River

(I) Khlong Water

(i) Khlong Phra Ong Chao Chaiya Nuchit (L-1)

このKhlong は、Fig. 4 — 3 に示す通り、Chao Phraya River左 提及び南部地区のAmphoe Bang Bo、Bang Phli の水源として位置 的には非常に都合のよい所にある。また、水質的にも先に述べた Khlong Thawi Watthana と比較するとかなり清澄であるといえる。

しかしながら、この Khlong は、現在 Chacheong Sac Water Works (belonging to PWD) によって、4,800 m³/日 の水が、水道原水として取水されており、新たに近い将来 4,800 m³/日の水が

拡張工事として増量される予定である。

また、Amphoe Bang Boから2km北に上った位置で、Bang Pra-kong Water Works (belonging to PWD)によって、5,000㎡/日の水が水道水源として計画されている。従って、既にTotal量で約15,000㎡/日の水が、他の水道施設の水源として配分されている事実を考えた場合、本Khlong は非常に捨て難い水源であるが、このKhlong に左岸南部地区、即ち、Bang Bo、Bang Phli、Khlong Dan、Bang Pooの総量約120,000㎡/日もの大量の水を依存することは、量的に極めて困難であるので、このKhlong は水源として放棄せざるを得ないであろう。

(||) Khlong Phra Khanong (L-2)

このKhlongは、前回の調査でAmphoe Lat-Krabang 地区の水源として暫定的に選定されたが、水質的には大きな問題が残っている。前回の調査で、このKhlong については、いわゆる有機的汚染の疑いが強かったので、BODsの試験が行なわれた。この結果は2 ppmであり、同時期に実施されたKhlong Thawi WatthanaのBODs値 1.6 ppm よりも大きく、水道水源としてはや3疑わしいものであった。しかし、前回のScope of Worksの中では、Chao Phraya River 左岸地区については、対象が Amphoe Lat-Krabang地区のみに限られていたので、いたずらに遠い水源をLat-Krabang地区だけの為に求めることは経済的に Feasible な Plan だとは言えなかった。従って Khlong Phra Khanong は、水道水源として決して最適であると言えないが、本 K long に対する排水処理対策の早急な確立を前提として、一地 Amphoe Lat-Krabang地区に対する水源として Recommend された。

しかし、先に述べたようにKhlong Thawi Watthana の水質汚染 が毎年BODs値で約0.8 ppmの割合で進行している事実や、Khlong 沿いに密集する人家を考えた場合、水道水源としては不適であろう。

(iii) Khlong 6 th (L-3)及びKhlong 13 th (L-4)

この2つのKhlongは、Chao Phraya River左岸のAmphoe Min Buri Nong Chok にそれぞれ流れ込んでいる。これらのKhlong は、北部に位置する Khao Yai 山脈にはさまれた広大を流域面積を持っている。 従って、その流量は非常に豊富であり、特にKhlong 13 th においては、Flood Season で20 m³/sec, Dry Season においても5 m³/secの水が直接 Nong Chok の Amphoe Town に流れ込んでいる。

この2つのKhlong に左岸全体のWater Demand を求めた場合,そのTotal量は2000年において193,000m⁸/日であるのに対し,Khlong 13 thのDry Season の確量は、先にも示した如く5 m⁸/see = 432,000 m⁸/日である。この内,Khlong 13 thの Separate Systemに対する取水可能量を半分と考えても充分に、左岸全体のDemandを満たすことになる。

この様にこの2つのKhlong は非常に重要なKhlong であり、
Separate System内にあるKhlong の中では、水道水源として最適なものと言えよう。

又、Khlong においても,たびたび問題となる有機的汚染も、これらの2つの Khlong は例外であり、水質的な価からも、水道水源として Recommendable な Khlong である。

(2) Chao Phraya River (L-5)

Separate Systemを考える場合のChao Phraya Riverの価値は、 Separate Systemの水源として考えられている井戸、あるいはKhlong が、水量及び水質的に将来その使用に基えられなくなった場合には深 い意味を持つであろう。

R I D が最近に調査したところによると、最下流の流量は85 m⁸/sec であり、河口における塩水遡上防止流量60 m⁸/sec を差引いた 残りの25 m⁸/sec (2,160,000 m⁸/日)の範囲でCentral System の水道水源に与えられるようである。

他方 Central System の将来の必要原本量は表4~3の如くである。

Table-4-3: Demand Estimates of Raw Water for Water Supply in Bangkok Metropolitan Areas

.		Raw Wa	ater Réquired	
Year	Surface Water cu.m./day	Ground Water cu.m./day,	Total cu.m./day	Ground Water as Percentage of cu.m./day
1975	1,000,000	350,000	1,350,000	25.92
1977	1,000,000	438,000	1,438,000	30.45
1978	1,800,000	580,000	2,380,000	29.36
1980	2,800,000	330,000	3,313,000	10.54
1985	3,600,000	160,000	3,760,000	4.25
1990	4,800,000	I	4,800,000	
1995	6,000,000		6,000,000	** .
2000	6,000,000	•	6,000,000	

この表より判断されることは、近い将来 Chao Phraya River および その他の水源開発が、Central System 内の将来における水锅要を満 たす為に必要となってくるであろう。

4 - 3 Central System

さて今迄、Separate Systemの水源として、Well と Surface Water の みに限って検討を進めて来たが、ここでもう一つ、大きな可能性を占めて いる、Central System からの送水について検討を加える必要がある。

Table -4-4: Water Demand of Central System and Separate System

(unit: 1,000 CMD) Ground Separate Right Bank Left Bank Total. Tota1 System (% of Year Centra 1 Separate Central Separate Central Separate Tota1 System System System System System System Demand) 1,227 1.00 1,689 125 1,814 7.0 1985 1,462 25 4,622 250 4,872 5.0 1,064 3,558 190 2000 60

表 4 - 4 は、1985年と2000年における Central System と Separate Systemの水需要の比較表である。

Separate Systemの2000年における需要量は250,000m2/日であり、 その量はCentral Systemのそれに比較してわずかに5%にすぎない。

この事は、Separate Systemの水需要をすべてCentral Systemでまかなう事の可能性が非常に大きい事を示している。したがって今回のStudyの中に、Central Systemより、分水を受けた場合の可能性と経済性について、おおまかではあるが検討を加えた。

^{*} Excluding capacity of existing treatment plant & well:

4-4 水質調査

1) 採水位置

今回の水質調査は,

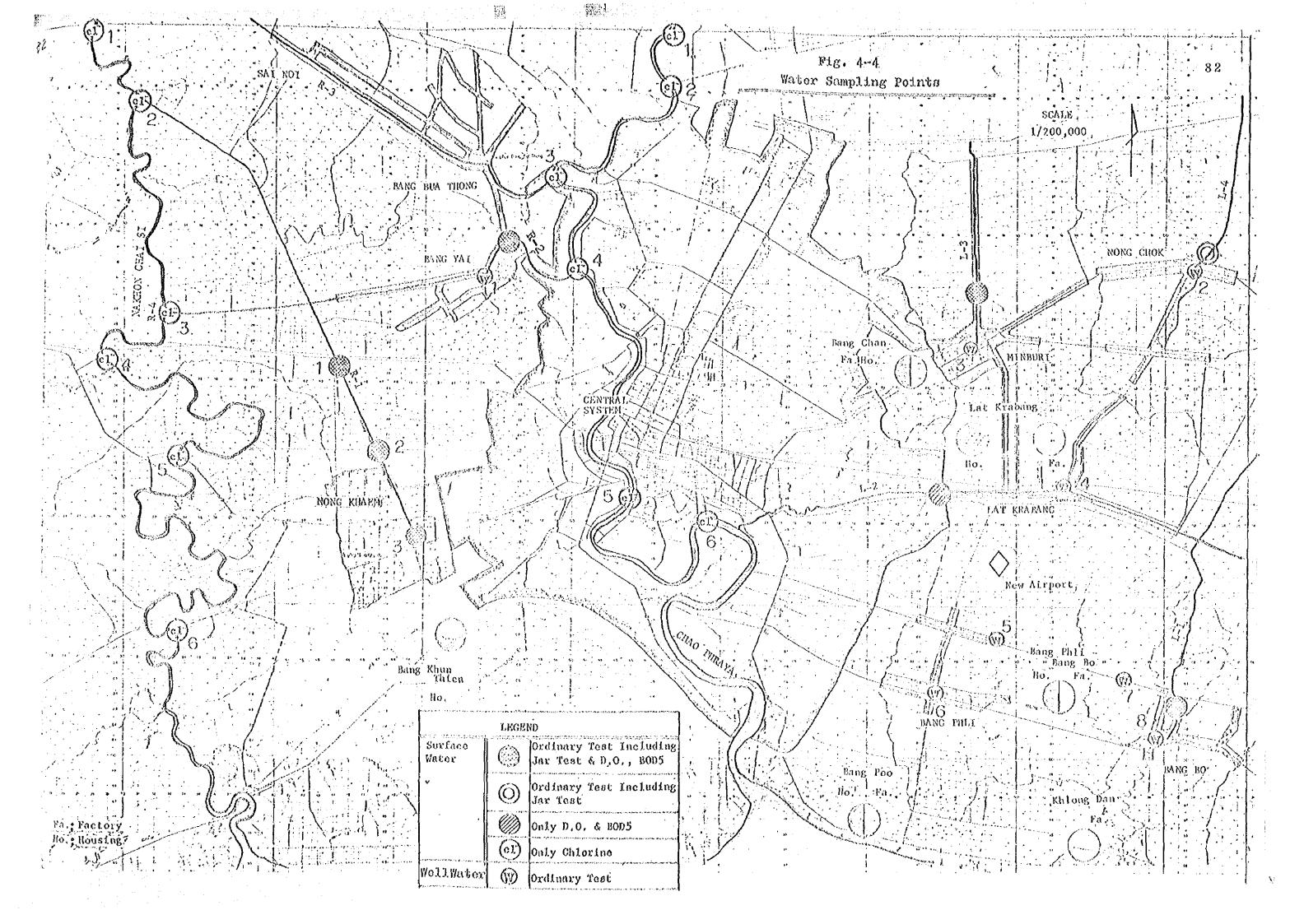
- (I) Chao Phraya, Nakhon Chai Si 両大河の塩水遡上の把握
- (2) 水源となる可能性のあるKhlong Water の調査
- (3) 既設井戸水の水質調査

以上、3点に関して調査を行ない Separate Systemの水源として良好な収水地点の選定がなされた。

各採水点の数は表4~5の如くであり、位置は図4~4亿示す。

Table 4-5

Location	Item	Number
MANA A ENPERE ESTABLE STATE ST	Ordinary Test Including Jar Test & D.O., BOD-5	6
Khlong	Ordinary Test Including Jar Test	1.
	Only D.O. & BOD.5	1
River	Only Chlorine	12
Well.	Ordinary Test	8
Total		28



2) 考 察

(1) Chao Phraya, Nakhon Chai Si 両河川については、Chao Phraya の水を既にSam Sen 浄水場で多量に使用しており、両河川共、量的に みて一般的な水質調査は必要ないものと思われるため、今回は塩水遡上の現況把握とその予測に重点を置くことにした。

なお、採水点の選定については、過去の測定Dataとの比較をはかる意味で、概ね同一場所からの採水となるよう考慮し、新しい地点を主に上流側に加えることで採水点が決定された。

まず、Nakhon Chai Si の採水は、海から約20km~90kmに亘る6 point , 各3層(上層、中層、下層、Na6の中層、下層は除く)
Total 16本の採水が行なわれた。

また, Chao Phraya 河については, 中層の測定を除くものとし, 探水場所は, Nakhon Chai Si と同様, 海から約20km~90km に至る 6 point Total 12本の採水が行なわれた。

(2) 井戸水の水質調査

電気探査と聞き込み調査によって得られた現況での井戸水の利用状況と Ground Water の概況を基に、近い将来に亘っても取水可能と思われる地点についてのみ採水を行なった。

(3) Khlong Water の水質調査

前回の調査対象であった Khlong Watthana をはじめ、その他の各 Khlong Water については、常にほとんどのTest が必要と思われるが、 L-4 (Khlong 13 th)の場合は、位置、人口の張り付き具合から見てL-3 (Khlong 6 th)より比較的清浄と考えられること、 かよびL-2の場合は外見的に汚濁が進行していることから、 L-4と L-2 Khlong については Test 項目を減らし、作業の円滑化をはかる

ものとした。

なお、水質調査は本来継続して行なりもので、今後 Study が進むにつれ、水源として重要な位置付けがなされたものについては、より長期的な調査が必要であることを付け加えておきたい。 以下水質試験結果を表 4 - 6 ~ 4 - 8 に示す。

Table 4-6
Result of Water Quality Analysis

	River	ا جيشيو دانو د نوايد در الماند الانام الماند	na na mana and a statement and a statement and a statement and a statement of the statement	Security of the second of the	والمتعرب والإنساء المتاكات بيدا بالمتاكات المتعرب والإنسان والديان	(bbw)		
	Chao	Phraya Ri	ver	Nakhon Chai Si River				
	Surface	Middlo	Bottom	Surface	Middle	Bottom		
1	11.0		10.0	10.0	9.0	8.0		
2	10.0		11.0	13.0	11.0	11.0		
3	3.3.0		1.0.0	13.0	15.0	14.0		
4	13.0		12.0	14.0	17%0	16.0		
5	30.0		45.0	19.0	18.0	17.0		
6	2,750.0		3,850.0	144.0	€⊐ 5 .	ta.		
	·							

Table 4-7
Result of Water Quality Analysis

Khl ong

Chemical Analysis	R-1-1	R-1-2	R-1-3	R-2	363	L-2	L+3	1,04
Color	ni1	nil	nil	ni1	n11	ويدهدون ورجيح ودورون	ni1	ni1
Odor	×	ц	н	u	u		н	11
Turbidity	125	1.70	80	22.0	88		73	75
pli	7,10	7,22	7.46	7.4	7.3		7.2	7.65
Methyl Orange Alkalinity	110	112	1.36	92	134		82	88
Phenolphthalein Alkalinity	ni.l	nll	ni.1	กร่า	nil		nil	ni1
Total Solids	574	954	436	152	642		303	415
pissotved Solids	206	230	250	1.00	310		120	90
Suspended Solids (by N.F.)	••	-		••	262		154	295
Total Hardness as Calcium	140	1.52	144	94	152		1.06	88
Carbonate	an market may the may the	* *= *******					- 10	The state of the
Carbonate Hardness 2	3.10	112	136	92	134		82	88
Non-Carbonate Hardness ,	30	40	8	2	1.8		24	ni 1
Chloride as Chlorine	25	40	66	8	92		10	8
Sulphate as Sodium Sulphate	42.6	n-4	_	6.4	59.6		52,5	22.7
Oxygen Consumed 37°C, 3 hours	5,782	7.036	6.554	1,620	6.112		2,222	0.889
Ammonia free as Nitrogen	0.700	0.564	1.056	0.336	-		0.496	0.404
Ammonia-albuminoid as Nitroger	1.092	1.348	1,124	0,408			0.604	0.804
Total Organic N. as Nitrogen	•1	-			## 1 TO 1		-	-
Nitrate as Nitrogen	0.625	0,385	0.025	0,250	0.1.75		0.115	nil
Nitrite as Nitrogen	0.0530	0.0374	0.0194	0.002	0.0218		0.0176	0.0046
Calcium		P4		10 ¥0 10 10 10 10 10 10 10 10 10 10 10 10 10				
0-Phosphate	0.14	0.07	0.23	0.13				
Iron	4.0	7.8	2.0	0.52	3.7	. • • · · · ·	1,63	1.77
Fluoride as Fluorine			*** * * * * * * * * * * * * * * * * *	0.39	4.6		44	
Manganese	0.207	0.450	0.070	nil	0.263		ni.l	nil
Magnesium	14 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -		era i de iniciario.	• 2,		in and the second	1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00	
Free Carbon Dioxide	11	14	14	6.0				#4
0,0.	1.5	2.8	1.6	4.7	0,5	0,1	2,6	-
R O D	4.3	5 2	4.5	1.3	2,2	4.2	0,8	
Bacteria 37°C-24hrs.(Number/m1)			35,000		18,000			13,000
	15 000	35,000	44,000	23 000	47,000	l	261,000	ተ ነ162 .በሰ
			81,000		2,000			14,000
THOUGH COLLEGEM (HOMDEL) LOO	1223000	100,000	1227000	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	1 4,000	ì	, ,,,,,,,,	1 2 4 7 7 7 1

Note: R-1-1, Khlong Thawee Wattana

R-1-2, " " "

R-1-3, " "

R-2, Khlong Mac Nam Om

L-1, Khlong Phra Ong Chalya Nuchit

L-2, Khlong Phra Khanong

L-3, Khlong Sam Wa

L-4, Khlong Sip Sam

Well Water

ورود بياد الراب والمراجع والمراجع والمناطق والمساور والمناط وا	August and a comments	*****		r	A WAREN BE THE SAME			Leavent my constitute of
Place	W1	W-2	W-3	W-4	W-5	MQ	V~7	W8
Traca	Bang	Nong	Min	Lat	Bang	Bang	Bang	Bang
	Yai	Chok	Buri	Krabang	Ph1i	Ph1i	Во	Во
Item] . ``]	1.	2	1	2
the state of the second section of the second secon	******	14 / 2 / 14 / 14 / 15 PP A	e announcement manage	. 44.514. 4584. N.J/4 ¹³	N. 401.2 E.N. (16.5.21.21.21.21.21.11.11.11.11.11.11.11.11.	n e les morages.	on on the property.	
Color	nil	nil	\mathbf{ni}, \mathbf{l}	nd.L	nil	nil	ni.l	ni.l
Odor	V.	[# 	. 11	N I	- 11	11	11	11
Turbidity	3.6	0.5	2.3	1.2	14.0	2.8	1.3	3.4
bil	7.1	7.98	7,55	7.5	7.6	7.5	7.92.	7.7
Methyl Orange Alkalinity	256	430	368	386	292	340	328	282
Phenolphthalein Alkalinity	nil	14	- 8	4	ni1	ni l	8	ni 1
Total Solids	364	926	500	534	507	654	567	740
Dissolved Solids	330	730	390	400	375	510	430	595
Suspended Solids		•	<u></u>				in a	
Total Hardness as Calcium	166	120	96	86	136	172	76	148
Carbonate								
Carbonate Hardness	166	120	96	86	136	172	76	1.48
Non-Carbonate Hardness	nil	ni 1	nil	ni.l	ni L	nil	nt1	ni.l
A CONTRACTOR OF THE PROPERTY O						,.,		
Chloride as Chlorine	40	126	18	1.3	43	118	48	166
Sulphate as Sodium Sulphate	9.7	73.8	58,2	48.2	61.1	75	12.8	110
Osygen Consumed 37°C. 3 hours	5-4	u•	-	7-1	•-	~	**	
Ammonia-free as Nitrogen	~		**	-			6-1	
Ammonia-albuminoid as Nitroge		F-1		-	■		a.	
Total Organic N.as Nitrogen	-	•	••			-	~	•
Nitrate as Nitrogen	**	ni 1	nil	ni.1	ni1	nil	nd.1	trace
Mitrite as Mitrogen		trace	trace	trace	trace	0.0026	trace	0.0036
,Calcium	// * · · · · · · · · · · · · · · · · · ·	•••	***			•	•	••
0-Phosphate	0.03	64		-	-	•	-	. 4
Iron	0.40	ni.l	nil	nil	2:4	ni 1	nil.	ni1
Fluoride as Fluorine	0.39	-	••	-	••	••		
Manganese	0.31	trace	trace	trace	trace	nil	ni.1	ni.1
Magnesium	64	••		••			6.	-
Free Carbon Dioxide	56.0	28.0	34.0	36.0	28.0	22.0	16.0	42.0
MPN per 100 ml	0	0	0	0	0	38	0	38
24hr. Total Plate Count at370	0	na Taran		A	2	49 ~	14	11
	[L	1		Lance Survey of the land	المستحديدة ومحروبينا	Laure

第5章 比較設計案の概略

第 5 章 上較設計案の観略

Separate Systemの水需要量に対し、広域的水道計画としては種々の築が 考えられる。

今までの検討結果より、まず水源として可能なものは次の通りである。

- 1) 各 Amphoe の需要量に対応できるWell
- 2) 水量,水質共良好であるKhlong
- 3) Chao Phraya River 及び Nakhon Chai Si River
- 4) Central System よりの送水

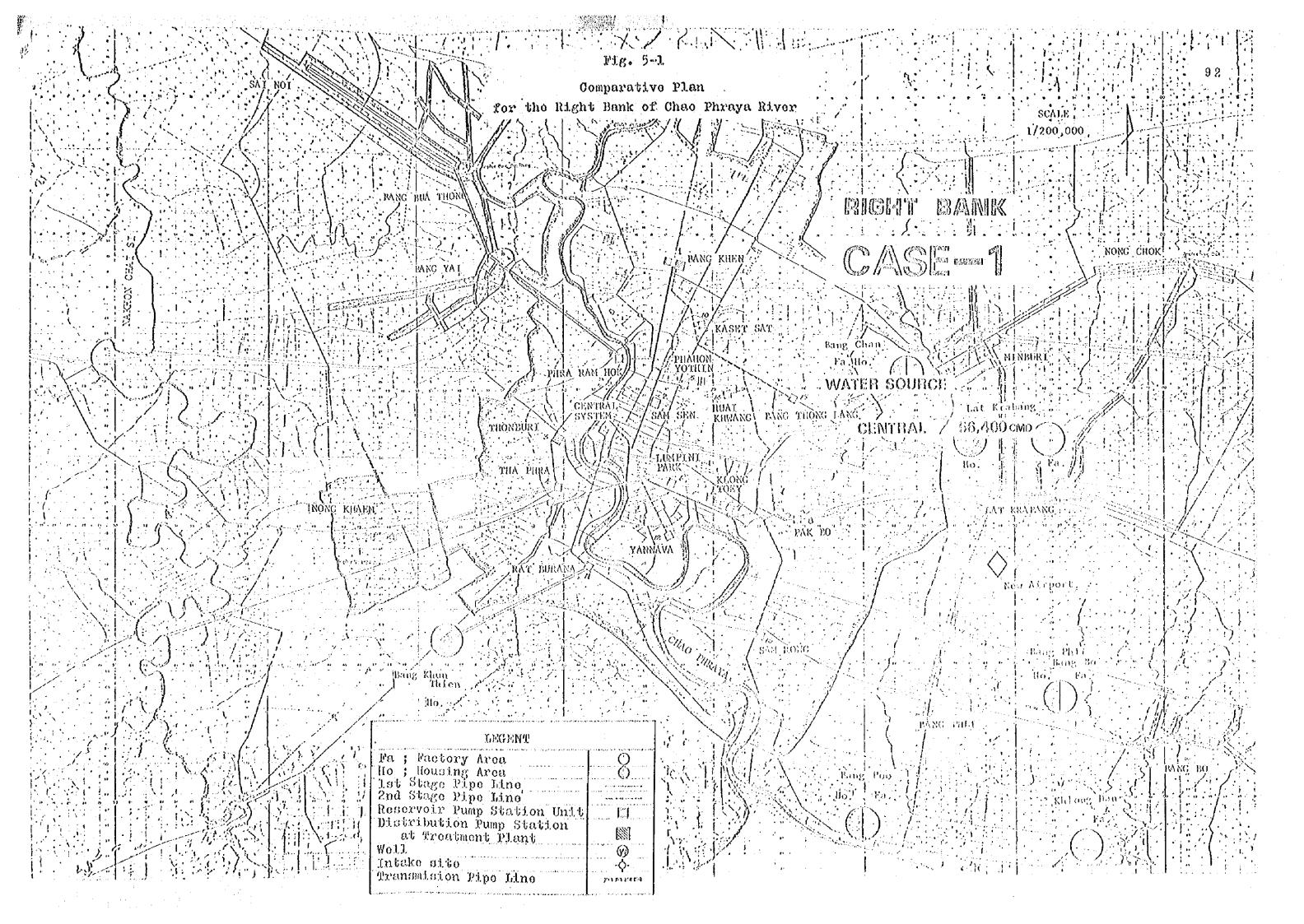
以上の水源を対象として、各地区への給水計画を検討した結果、Right Bankで 5 Case、Left Bankで 4 Caseの比較梁が考えられた。

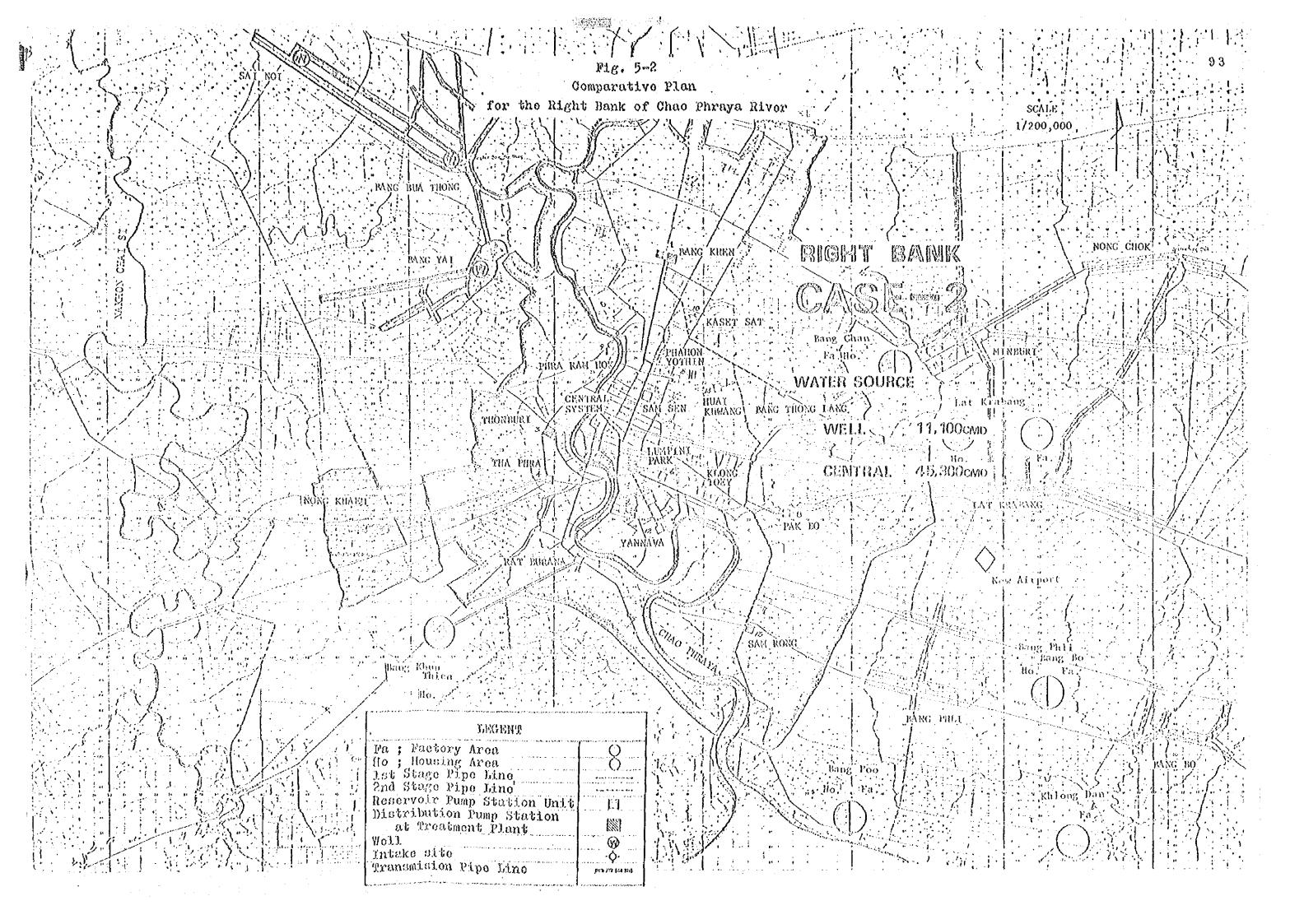
各 Case の水源と給水地区の組合せを表 5-1 , 5-2 化示し、比較概略図は図 $5-1\sim5-9$ 化示すとおりである。

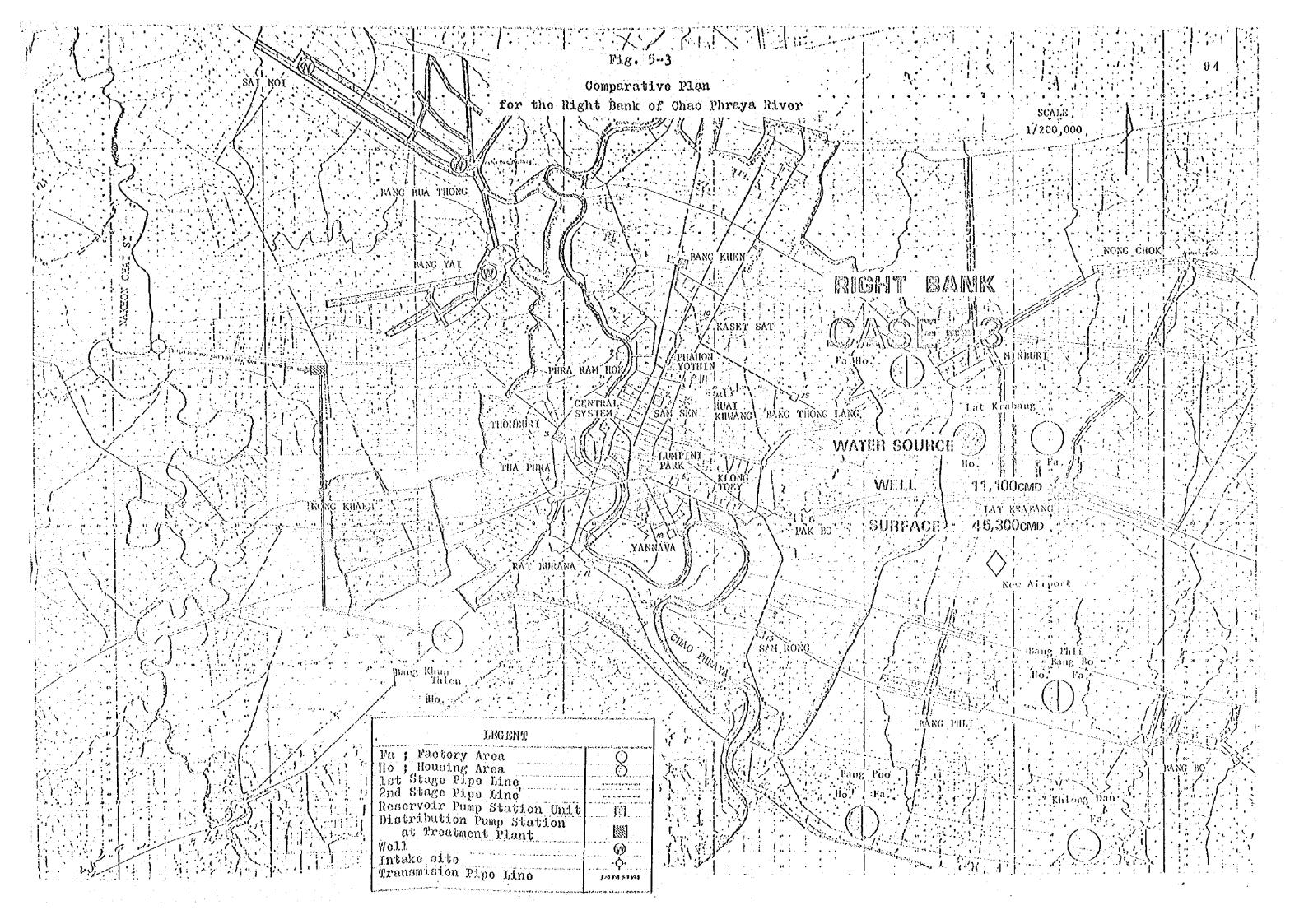
••	Water Source	Water Demand (CCD)	Surved Area
Central	ral System	56,400	Amphoe: Sai Noi, Bang Bua Thong, Beng Yai Nong Khaem
			A
Well		11,100	Amphoe: Sai Noi, Beng Bue Inong, Bang Yei
Cent	Central System	45,300	Amphoe: Nong Kheem
			Additional Area: Bang Knun Thien
i≼ 0 13	p. 4	- 11,100	Amphoe: Sai Noi, Beng Bua Thong, Bang Yai
Surf	Surface (Nakhon Chai Si)	45,300	Amphoe: Nong Knaem
			Additional Area: Bang Khum Thien
Xa16	Khlong (Mae Nam Om)	001,11	Amphoe: Sai Noi, Beng Buz Thong, Bang Yai
Central	ral System	45,300	Amphoe: Nong Khaem
			Additional Area: Bang Khun Thien .
Kalong	ong (Mae Nem Om)	56,400	Amphoe: Sai Noi, Bang Bua Thong, Beng Yai, Nong Khaem
			Acditional Area: Bang Khun Inien

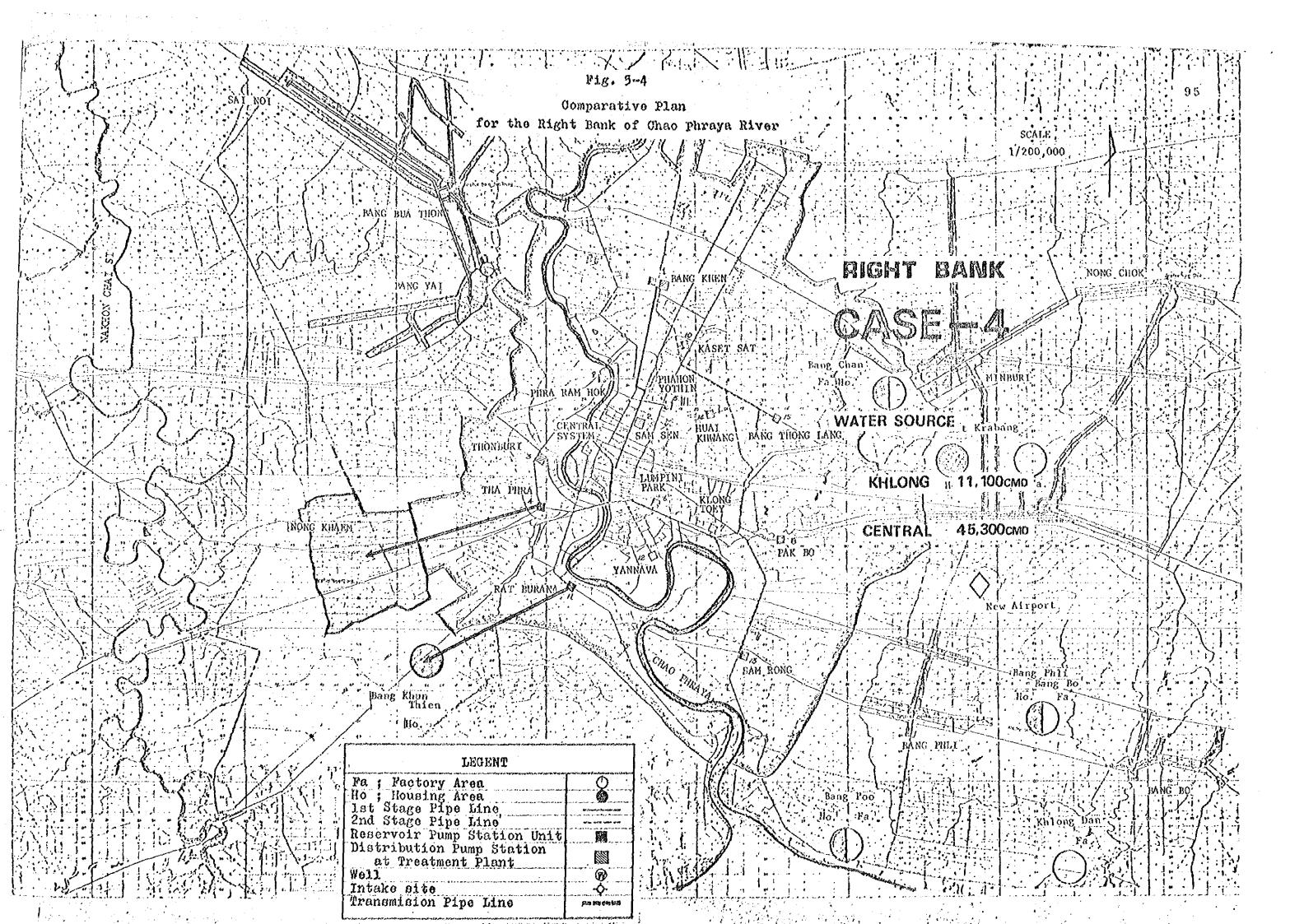
Table 5-2

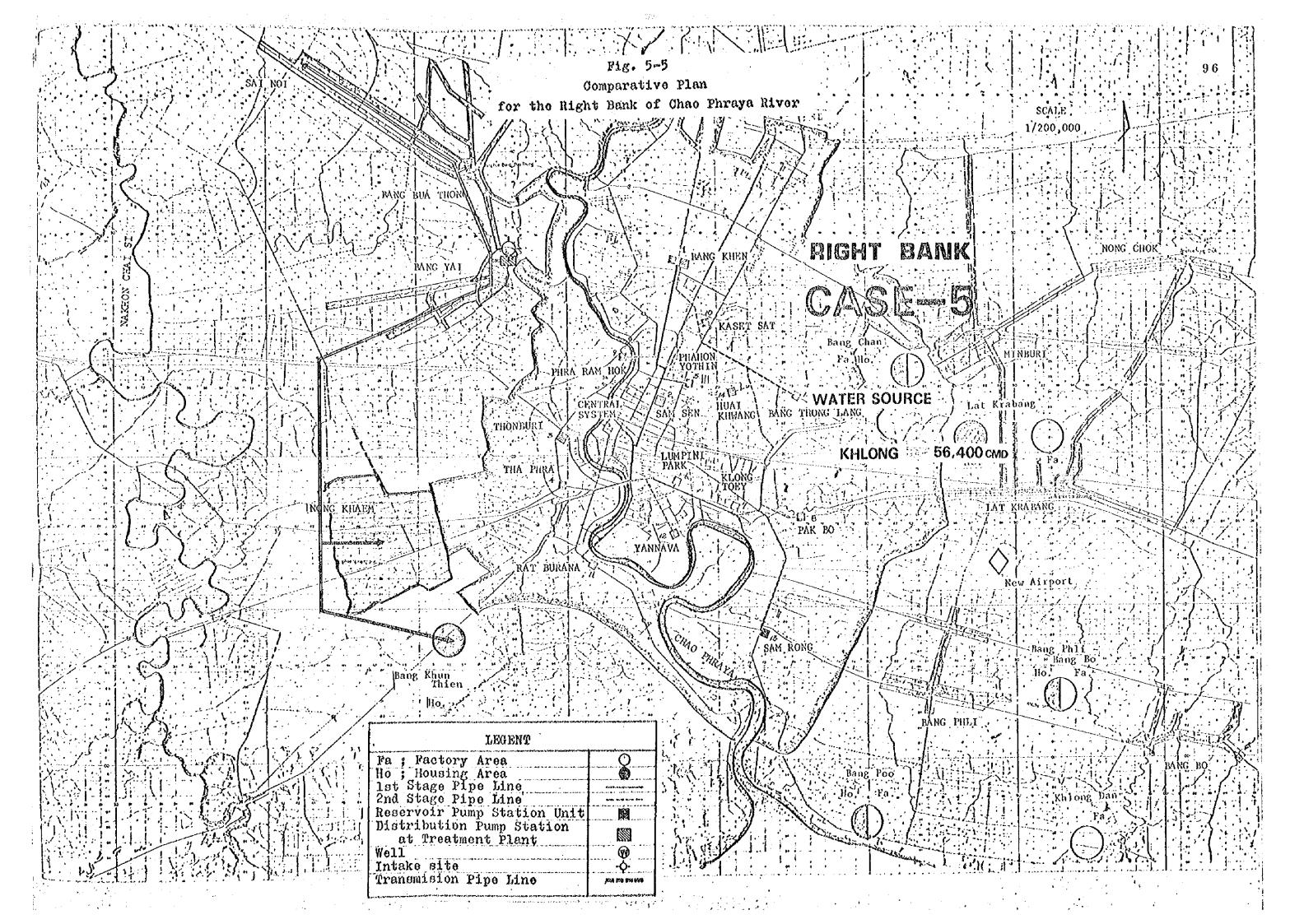
Comparative Plans for The Left Bank of Chao Phraya River

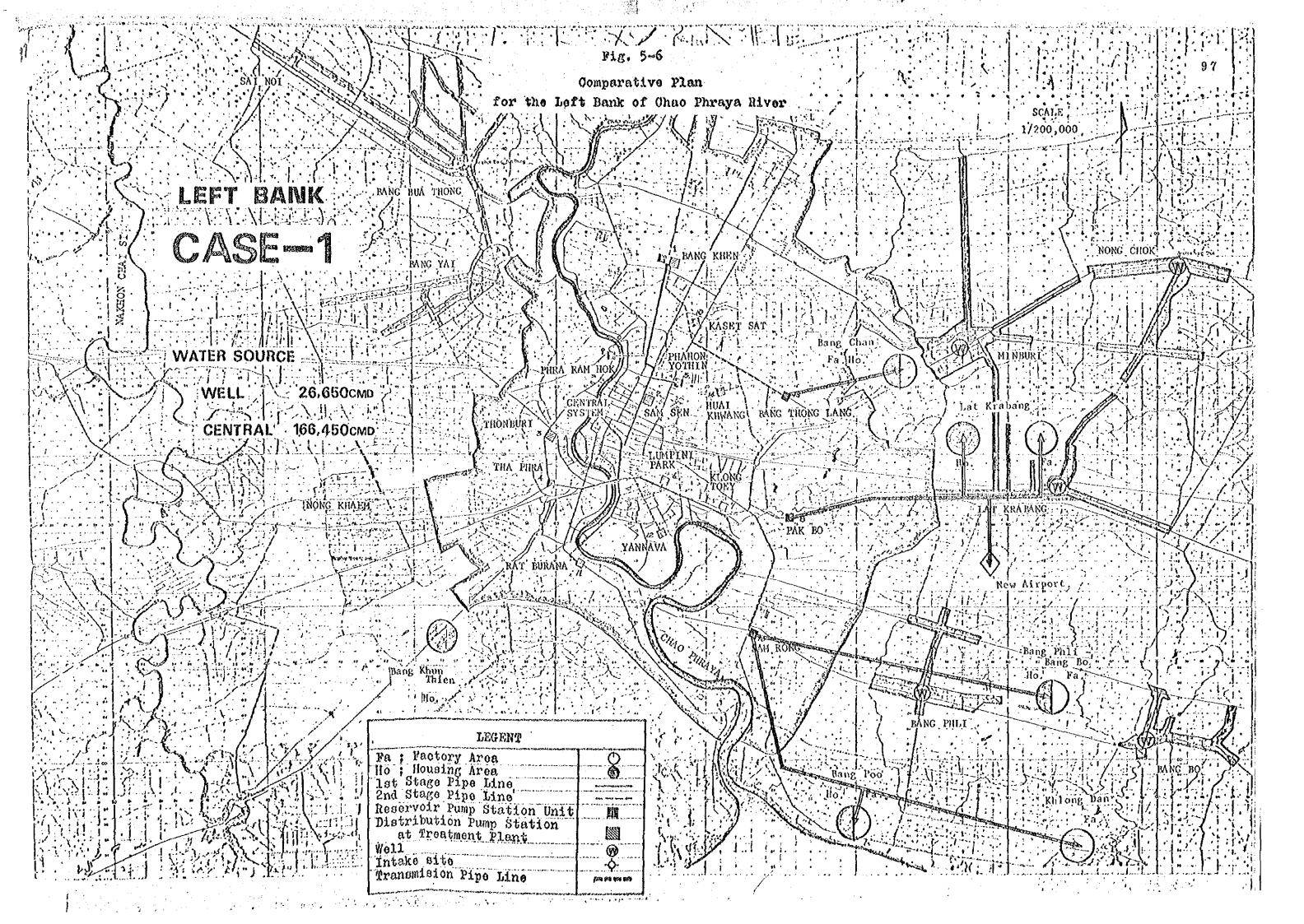


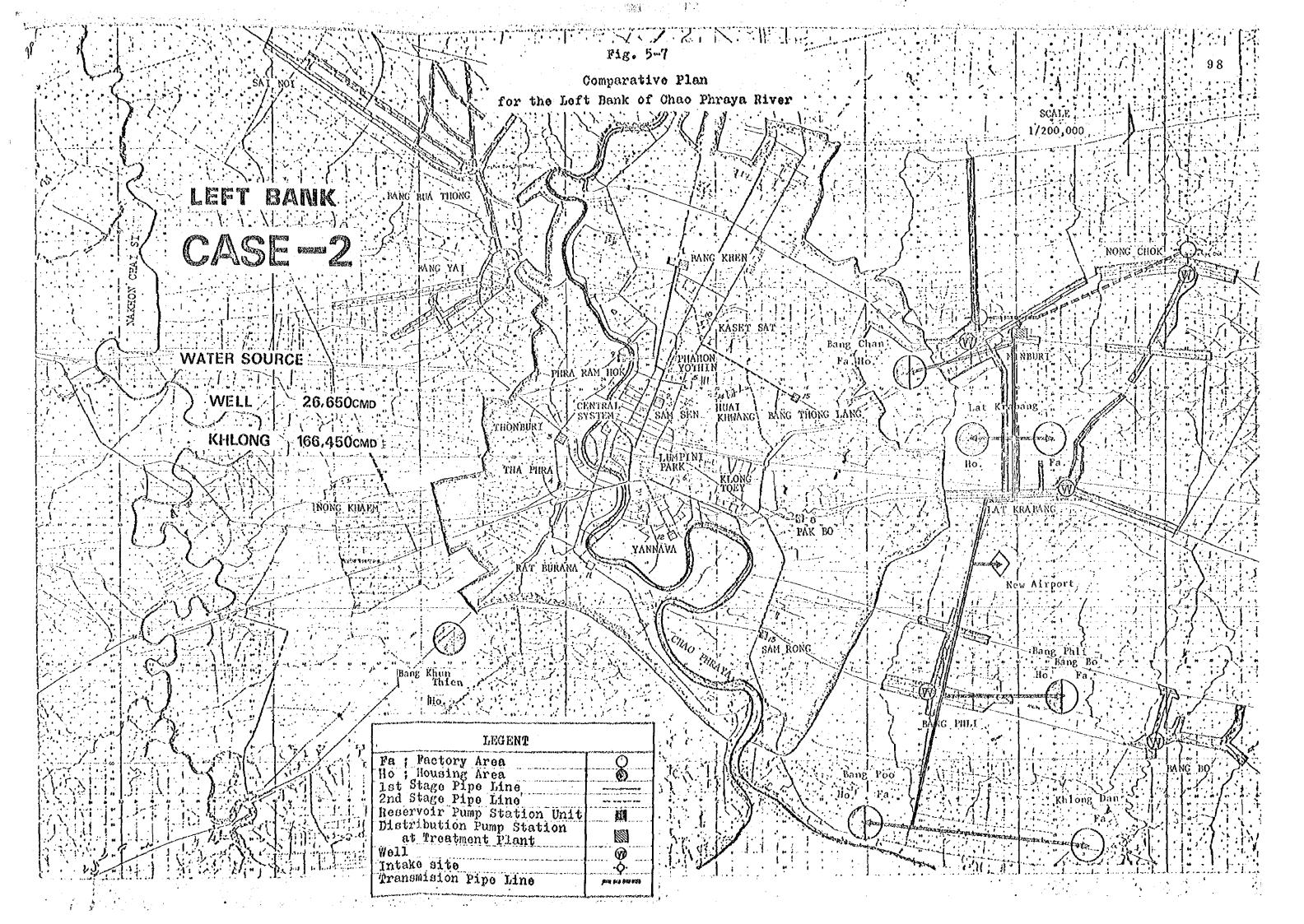


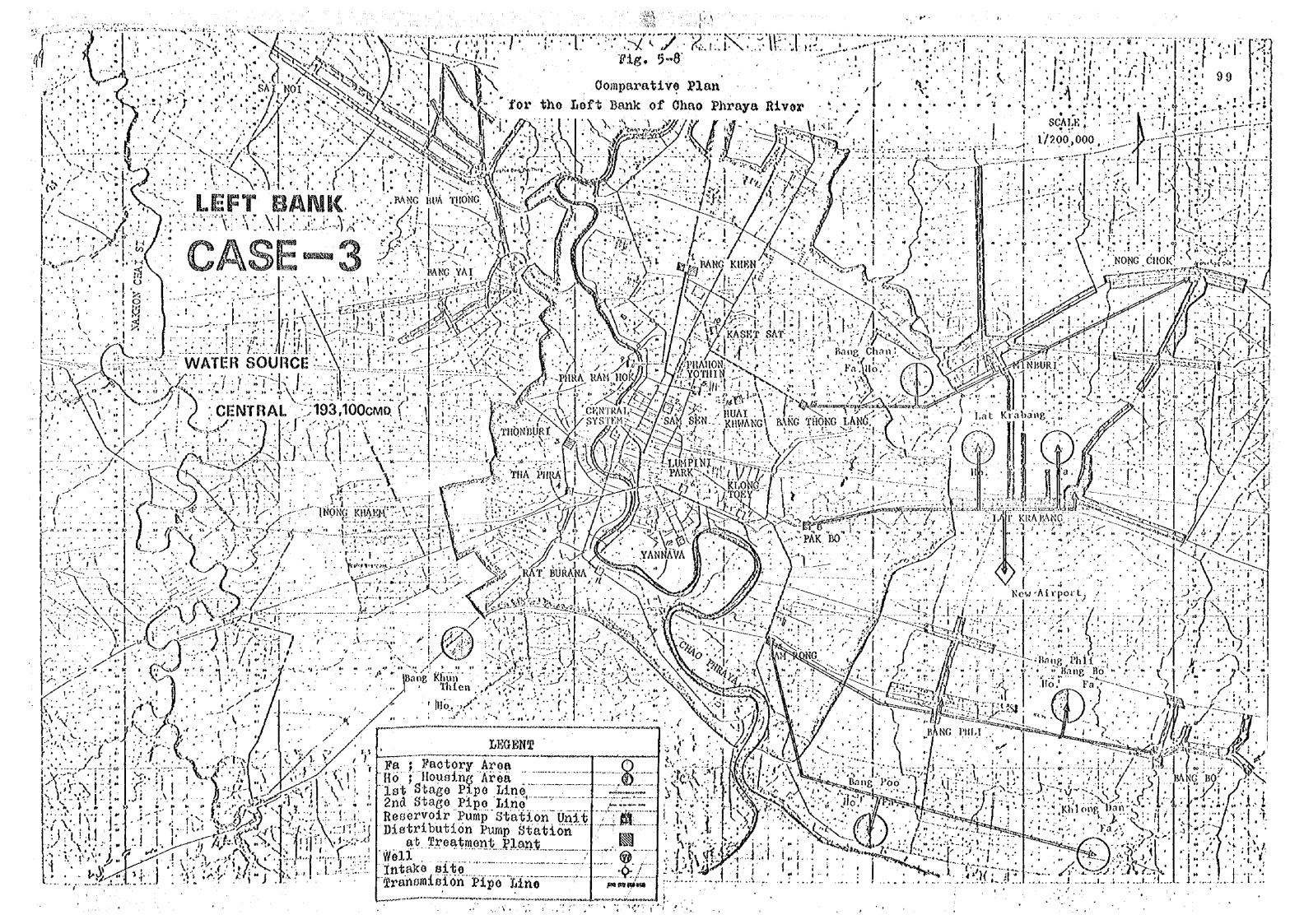


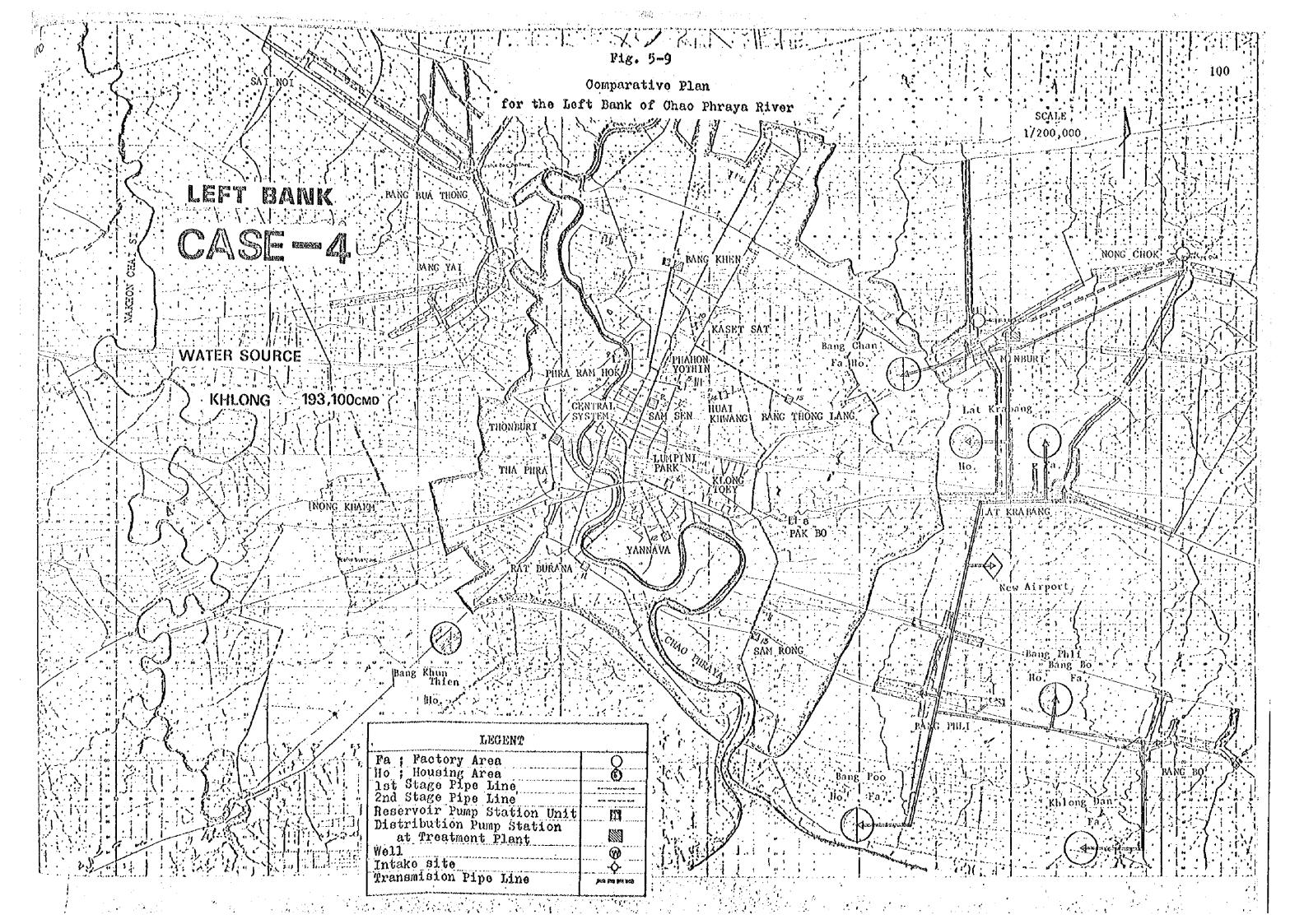












第6章 収集 資料

6-1 Labour and Material Cost

(1) Wages by Occupation at Bangkok Separated System Area

Occupation	Unit (per day)	Cost (Baht)	Remarks
Carpenter	person	100	
Electrician	person	120	
Plasterer	person	150	
Welder	person	150	
Mason	person	150	
Steel Bending Worker	person	120	
Plumber	person	40	
Machine Operator	person	80	
Assistant	person	40	•••••••••••••••••••••••••••••••
Worker	person	30	A MIT OF THE PROPERTY OF STORY AND A STORY

(2) Cost of Materials

(Including Cu	stoms Tar	(ff)	Uni	t: Baht
Item	Unit	Foreign Currency	Domestic Currency	Remarks
DCIP Ø100	1 m	250	135	Include Joint
1 150	11	358	193	11
" 200				11
9 250				
" 300	1 m	740	399)
" 350		851	459	
" 400	н	1,096	579	e)
" 450	11	1,280	689	0
500	11	1,490	805	н
" 600	1 1	1,963	1,057	10
" 700	11	2,590	1,394	11
" 800	H	3,203	1,725	
DCIP Ø100				
150 200			11 11 11 11 11 11	
250				The contract the sequence of the contract of t
300	* * * * * * * * * * * * * * * * * * * *			*** · · · · · · · · · · · · · · · · · ·
	and the second s	Andrew Control of the	errore and the second second second	in the second district operation (second second

Item	Unit	Foreign	Domestic	Remarks
1 6 6 10	OHLU	Currency	Currency	Kemarks
DCIP Ø350	1 kg	14.7	7.9	Include Joint
400		15.1	8.3	H H
450	11	15.0	8,1	N .
500		14.8		H
	11		7.9	H
700	11	14.4	7.8	H
800	1)	14.6		1
000	and the second s	14.0	7.8	
DCIP Ficting \$100				
T	**************************************			
150 200				
A CONTRACTOR OF A CONTRACTOR OF THE CONTRACTOR O				
250	بسما والخاط عمد بالتبيين إ			
300		20.0	12.5	
350	1 kg	32.2	14.5	and the same process of the party control and the same party control and th
400	بالمهاد العدائم هادي تعبأه والديانيمون والرعوان	32.2	14.5	
450	H	32.2	14.5	
500		32.3	14.6	
600		32.3	14.6	
700	ł\$ 	32,3	14.6	
800	#	32.3	14.6	
DCIP Gland \$100	1 set	130	56	
150	J(140	60	
200		236	101	
250	II	319	137	
300	H	335	. 143	
350	If	437	187	
400	II.	715	307	
450	. 19	788	338	
500	11	883	378	
600	11	1,016	436	
700	18	1,577	676	
800	It .	1,890	811	
			:	
SP Ø350 x 6m	1 pc	6,413	3,454	Flange, Tar-Epoxy Coatin
400 x 6m	1)	7,216	3,885	(1
450 x 6m		8,067	4,345	
500 x 6m	11	8,854	4,768	11
600 x 6m	14	1.0,832	5,833	H
800 x 6m	II	14,977	8,065	11
			and the age of Ferres and the experience	
SP Ø350	J. kg	17.4	9,3	H
400	8.2.18	17.0	9.1	H
450	li	16.3	8.8	N
500		15.7	8.5	PI .
600	11	15.5	8.4	or an experimental process and the control of the c
800	Н	13.3	7,2	0
			1	
ep d 10	1	- 1417 as a distanta carried a constitutor e	4.4	(ACI)
SP Ø 12 20	<u> </u>		17	GSP
25		A page of Town A could be care from the forest contract	22	tive trade of the grown of the the most experience that the property of the contract of the co
32			32	- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1
31.			42	11

T 1	The La	Foreign	Domestic	Remarks
I t. em	Unit	Currency	Currency	ACREE KS
sr Ø 35	1 m	nd or Soughthard at later that a residency convention was	48	Flange, Tar-Epo xy Coat
50	. 11	tog	68	H
60	11	he	88	H
80	li li		114	il
100	II	Co. 40 - 100, 81 - 100, 110 - 110, 110 - 110, 110 - 110, 110,	146	11
150	H	ene i es esperado en entre de material de entre en ence	306	H
200	11		808	11
250	11		1,261	GSP
***************************************				H
300 350		1,068	1,612	Tar-Epo xy Coating
400	11	1,203	647	1
,,_,_,,		rapida di kanandari agai administrati di mandari dan di antindra di mandari di mandari di mandari di mandari d		F1 - 1
450		1,344	724 .	
500	11	1,475	795	III III
600		1,805	972	
800	11	2,496	1,344	ti
SP Fitting	1 kg	10 A	40	
13	11	44,2	19.8	
AGP (20) Ø100	1 m		71	Include Fitting
1 125	11			0
1.50	II II		93	- 11
200	11	And	140	11
" 250			185	()
" 300	11		239	88
" 400	11		. 6 × 2	
" 500			685	
" 600	11		709	11
ian (i) d ss			1 &	11
ACP (Λ) Ø 80	1 m		15	
	11	•	17	1
" 150		M4	26	1
Gibault Ø 75	1 set		65	d a reason and a contributed and makes all your for thing broken particle property and a contract of the contr
	1 1 866			
3,00	11		71	
150			124 187	
			1	
430		#4	237	
" 300 " 400	11	*** **********************************	304	
100			595	
11 500			730	
" 600		-	1,041	
ACP Fitting	1 kg	##	15	
.II	11	44.2	19.8	
SV Ø 75	1, set	4,084	1,086	Screw-Type
100		4,748	1,262	H H
125		- 9,790	1.1494	11
150	Indiana and an annual and		4 546	· · · · · · · · · · · · · · · · · · ·
	1	6,701	1,773	
200		8,823	2,436	N
250	0	11,750	3,124	_]

paragraphic destruction destruction destruction and area and a series of an approximately		Mountain	en e	tal historical device the report of the letter of the device of the device of the section of the
Item	Unit	Foreign	Domestic	Remarks
		Currency	Currency	
	in billiperterverstaget bil eskill billi svivide o	a nama di manana di m	والمعارضة المعارضة المعارضة والمعارض وروا المعارض والرواء	والمراجعة
sv ø300	1 set	14,940	3,971	Screw-Type
350	(19.00)	17,347	4,611	THE STATE OF THE STATE OF THE WAS AND A THE WINDOWS WAS AND A STATE OF THE STATE OF
400	· II	23,987	6,376	H
450	H	29,327	7,796	. 0
500	11	50,503	13,425	н
By Ø350	11	32,271	8,578	\$1
400	H.	38,556	10,249	
450	Д	42,555	11,312	H
	Å			ET .
500	1	45,222	12,019	Ĥ.
600	**************************************	53,256	14,156	The second of th
700		76,586	20,358	The same of the control of the same of the
800	M s and the state of the state	86,968	23,916	en et de la companya
us a series de como una associa del participa de deseguira de deseguira de la composición de la composición de	e kongresion di minimizzazione del	a garacones da campio e acore:	i Nethologia www.comunicaliania prepijori	at 10 Mar 5, Mar 6 Mar Mark International gualateirae igniques assigni expensives a species of
Air Valve	1 set	8,518	1,964	
Angle Valve Ø 13	1 set		395	
" 19) I	•	479	
" 35	Н		.1,032	
" 100	ll l		4,000	
			3,000	
mile man an arrangan arrangan arrangan				المؤرور وراويون الداء فيطار سيرمو منطل معطية الشيم ماهالية حالا
PVCP Ø 15 18	1_n		34	enter transco communication and in the article and the second consistency of the second con-
and the second of the second o				
20		400 	5	A CONTROL WITH CONTROL AND CONTROL WAS ARRESTED BY THE CONTROL OF
25				the first time to come a parameter with a second process of the contract of th
35	16		9	Continued the second district of the continued of the second of the seco
40	'u		12	
55	(1)		. 18	
65	1	.	29.	
80	T)	_	40	
100	II		64	
125	11	nerge system is a market system of the syste	99	a ded e de siña a comercia e en manda (en manda en consecuente en comercia en la comercia en la comercia de la
		**,,,,,		Contracting the second
Concrete Pipe Ø100	1	erenalerinistra en en especial	30	Control of the Brick Control only only of the Art of Angelon and Angelon (Angelon) (Angelon) (Angelon) (Angelon)
150	1 m		48	more than the company of the company
er many dia casa di accionale cale cale con				*** **********************************
200		## * * * * * * * * * * * * * * * * * * *	58	the continues of the week and the forest the forest continues of the conti
250		P4	, 81	
300	н		100	
500	II	and	172	
600		**	230	
R.C.P. Ø500	1 m	**	263	Reinforced
Bolt & Packing \$ 75	1 set	An-		
100	O O		1,0	· · · · · · · · · · · · · · · · · · ·
1.50	8		14	
200	#		20	50 - 10 - 10 - 10 - 10 - 10 - 10 - 10 -
	•			
250			32	
300			42	
350	FI			
400	"		68	the contract of the process of the contract of
450	61 	en to the company of	Haran di managari sanci di sa di Milanda da min	

Item	Unit	Foreign Currendy	Domestic Currency	Romarks
Bolt & Packing \$500	1 set	And the Company of the State of the Company of the	106	e y ganned south, day has his health of the first of the first of the first of the order to the usay of the st
" 600	11	***	140	
700	11	••	190	1
11 800	31		250	

Steel Plate	1 kg	4.3	1.0	
L - Steel	11	6.1	1.2	
I · Steel	II .	9.6	2.4	and the state of the second
C. II. Plate	11	5.8	1.0	The second secon
Steel Sheet Pile	11	6.5	1.5	
Trench Sheet Pile	()	6.1	1.9	

(3) Unit Cost Estimations for the Various Categories

(Including Custo	ms Tarr	iff)		0	(u	nit: Baht)
		Mate	cials	Labor		'
Item	Unit	F. Cost	D. Cost	D. Cost	Cost	Remarks
Excavation	4-16-16-16-16-16-16-16-16-16-16-16-16-16-	The state of the s				
(a) By Hand	1 cum		••	27	27	
(b) By Bulldozer	ŧŧ	-,	10	1	11	10 ton
(c) Cost of Opera-	1 hr	-	37	19	56	
ting						
(d) By Shove1	1 cum	- .	20	1	21	Cap: 0.6cum
(e) By Dragline	1)		57	1	58	н
(f) Cost of Operat-	1 hr	***	49	19	68	
ing	- :					***************************************
Surplus Soil						
(a) By lland	1 cum			21	21	
(b) By Dump Trucks	11		32	3	35	
(c) Cost of Operat-	1 hr	-	46	19	65	
ing			a character of the contract			
Concrete Pile			************			
(a) 300mm J≈6m	1 pc		975	62	1,037	
(b) Cost of Operat-	1 day	-	13	32	45	
ing						
(c) 300m L=8m	1 pc	-	1,289	106	1,395	
(d) Cost of Operat-		~-	19	46	65	
Rubble Stone	1 cum		1.74	21	195	
Forms						
(a) Class-A	1 sqm	,	68	28	96	and the second s
(b) Class-B	1 sqm		56	15	71	
(c) Class-C	1 8qm	44	34	15	49	
Timbering	1 cum	-	7	3	10	
Staging	11	-	10	4	14	
Reinforcing						
(a) Round Bar less	1 ton		6,953	900	7,853	
than 199mm				<u> </u>		5.1
(b) Round Bar Ø12mm	11.11		6,953	900	7,853	
Ø22nm						
(c) Deformed Bar	и		6,926	750	7,676	*
Ø1.2mm-Ø23mm						
Concrete	ļ					
(a) 1:4:8	1 cum		350	147	497	e e a a a cara e a espara espara espara espara e espara espara espara espara espara espara espara espara espara

produce and recognized constructions of the second section of the section			en e	والمستحدث والمراجع		107
Item	Unit	CONTRACTOR CONTRACTOR	rials	Labor	Cost	Remarks
		F, Cost	D. Cost	D. Cost		will be since a second of the
(b) 1:3:6	1 cum	••	407	174	581	
(c) 1:2:4	μ		522	222	744	
Mortar			,		• • •	to the contract of
(a) 1:2	1 cum	,	849	27	876	
(b) 1:2 t=20m/m	1 sqm		17	1.7	34	
(c) 1:2 t=20m/m	[* * * * * * * * * * * * * * * * * * * *
The second secon	* 1** * * 7		129	17	146	
Water Proof						
(d) Expansion Joint	1 m _;	340	1.60	14	494	Rubber
Pump Drainage						
(a) Engine 10ps	1 day		62	95	157	
(b) Engine 5ps	8		27	80	107	
(c) By Hand Pump	11		· •	60	60	
Walling				,		The state of the s
(a) 1.6 x 2.2m both	1 m		, 98	4.7	145	Wood
side		Japan Basar Basin Kabupatèn Kesal Ja		ronne-milletin	X.T.X	nation Value of an accordance of a con-
(b) 1.3 x 1.5m ."	11	Congression and the second control of the second	66	44	110	н
The state of the s	10	1.4		1	* ****	
(c) Trench Sheet Pile		173	234	272_	679	and the state of t
The second residence of the Contract of the Co						
(d) Cost of Operat-	1 day		80	304	384	
ing					المحاجي المحسا	te de la companya del companya de la companya del companya de la c
Revetment	1 m	. .	4,640	214	4,854	
Concrete Slab Pitch	1 sqn		121	41	162	
Lug						
Solding	1 sqm		13	2	15	
Paving			-1,	,	:	
(a) Concrete Pave-	1 sam		73	52	125	
ment	Lanca Tarren.	e de la reconstrucción de la r				de Bereit of second Schillerschie diffile I fan dê 12 dieuw wege de 1 jaar differen is '
(b) Asphalt Pave-	1		126	30	104	Zanga Baharanga dan dan dan dan dan dan dan dan dan da
	1 squ		1.40	30	156	
ment	1				90	
(c) Brick Pavement	l sqm	**************************************	65		70	
Planting	1 tree	***	305	60	365	
Fence	<u>'</u>					
(a) Silaraeng Fence	1 m		313	155	468	t total to a graph proper to see the contract of the contract of
(b) Barbed Wire		ad Contract to the second second second second	74	38	112	
Fence				- 1		
(c) Net Wire Fence	1 m	₩.	189	15	204	
Gutter & Open			. ** * ** ** **	in the second of the second	province in profession to the con- traction of the con- traction of the con-	
Channel						
(a) 500 x 735mm	1. m		287	162	449	
(b) 800 x 1,220mm	11		353	195	548	
(c) 450 x 450mm	Ú		70	7	77	
Alter the second of the second of	11	• 00 t • 0 t				
(d) 200 x 200mm			35	2	37	. :
(e) Brick Gutter			4	15	19	
(f) Concrete Cutter			23	10	33	
(g) Drain Pit	1 set		119	64	183	
Coffering						
(a) Closing Dyke	1 m		262	62	324	
(b) Driving Sheet	11	778	1,322	482	2,582	
Pile						
(c) Removing Sheet	ù		19	257	276	
Pile					April (P. C. Albaria)	\$2,450.000
Stone Masonry	1 m		193	68	261	
Steel Bar Screen	1 set	6,385	812	6,437	13,634	• • • • • • • • • •
The same of the sa	L.,		*** ** *** (**************************		20 - 3 - 3 - 3 - 7 	

Item	Unit	Mate	rials	Labor	Cost	Remarks
***************************************	"""	F. Cost	Dr. Cost	D. Cost	0000	
Sluice Gate	1 set	96,380	25,620	1,404	123,404	
Drain Pit (A)	н	••	2,470	2,435	4,905	
Drain Pit (B)	"		4,430	3,174	7,604	., .
Flow-Meter Chamber	n l		1.7,750	4,239	21,989	
(Back Washing)		a grada transcriberatur, og 10-11-	and a second	11.0 11.1 Tall #40 4 4	AND	A. G. E. C. E. C.
Flow-Meter Chamber	1 set	**	21,318	9,076	30,394	
(Raw Water)	1.42 1 W. M. M. W.		m e. 3 pr. e. pr			read on the real process of the same of the same of the same of
Flow-Meter Chamber	1 set	14 (m) 10 (m)	24,535	9,579	34,114	
(Distribution)				n ng Karasan	. 9 () ~ 2	
Laying Pipes		animati wiin jeeng cii jida ii				
75 Coupling	1 m			1.5	1.5	
100	0	1		2.0	2.0	, designation of the second section is defect to
150	. 13			2,5	2,5	ing capital from the constraint of the constrain
200	11			3.9	3.9	en egite in the second entered
250 ^M	li			4.8	4.8	
300	, II			6.1	6.1	
350 Mechanical	H H			10	10	-
400 "	11			12	12	
450 "	N			13	13	
500	11			17	1.7	and the state of t
600	11			21	21	
700	11			26	26	agin, aga aga an isil sa nam ganganan kanasan mada
				4.9		
Angle Valve Box			ro.	4,	.,,	
(a) Less than \$75mm	4		58	14	72	
(b) More than \$100mm		**	88	15.	103	and the control of th
Cost of Jointing	1		,			
75 Gibault	1 set		65	6.2	71.2	
100 "	ļ .	• • • • • • • • • • • • • • • • • • •	71.	8.2	792	
150 "	18		124	10	134	
200 "	11	**	187		202	
250 "	- 11	**************************************	237	19	256	
300 "	11		304	24	328	
350 Mechanical	11	437	187	60	684	
400 "	11	715	307	72	1,094	
430		788	338	83	1,209	,
500 "		883	378	104	1,365	
600 "	11 	1,016	436	131	1,583	,,,,
700 "	11	1,577	676	157	2,410	
Sluice Valve		,	4 4 4 4 4	L	, , , , ,	
75 Screw	1 set	4,084	1,086	59	5,229	
100 "	H	4,748	1,262	62	6,072	
150 "	11	6,701	1,773		8,552	
200 "	11.	8,823	2,436	93	11,262	
250 "	41	11,750	3,124	120	14,994	
300 "	11	14,940	3,971	150	19,061	in water or a second particles of the second
350 Hat	0	17,347	4,611	167	22,125	
400 "	41	23,987	6,376	222	30,585	Company of the Compan
450 "	4f	29,327	7,796	288	37,411	
500 "	0	50,503	13,425	387	64,315	
600 "	11	80,447	21,385	468	102,300	
700 "	II.	103,428	28,822	549_	137,799	
Butterfly Valve	į					
350 Screw	1 set	32,271	8,578	167	41,016	

angun di mananan ang ingay(umpa ayan daksa danarang (p in sa di ay salah sa	And the second second second	Mate	rials	Labor	and the second s	Donney also
Item	Unlt	F. Cost	D. Cost	D. Cost	Cost	Remarks
400 Screw	1 set	38,556		222	49,027	the state of the s
450 "	11	42,555	11,312	288	54,155	with any or was a second constraint.
500 "	11	45,222	12,019	387	57,630	·
600 "	i1	53,256	14,157	468	67,881	i kanana anaka ata mantah sa mirin ka
700 "	• • • • • • • • • • • • • • • • • • •	76,586	20,358	549	97,493	raning and are to a large street of
800 "	11	89,968	23,916	588	114,472	ing or response time of a proper to the the of
Welding						
350	1. pc		319	1,29	448	den majaranja spir urbandrana a dirinam dropan di bili ili ili ili ili ili ili ili ili i
400	11	H.	346	151	497	wake majarapiyasi wake wa maji mara iyo
450	Hillia short eagains	ing the state of t	372	173	545	and metalogue of the sound between the control of t
500		## ***********************************	398	191	589	Valoria servici e successo de constitución de
Anchor Block (T)						
100 x 100	1 set		89	34	123	and the second second
200 x 100	1).	***************************************	141	55	1,96	
200 x 150	11		150	58	208	
200 x 200	H	M	162	63	225	
250 x 200	н		220	86	306	
300 x 200) 11 		286	112	398	<u> </u>
300 x 300			335	130	465	
350 x 250	11		367	143	510	
350 x 300	11		421	164	585	,
450 x 450	111	~	768	304	1,072	and the second s
500 x 500	<u> </u>		898	356	1,254	
600 x 600	n	······································	967	381	1,348	
Anchor Block (II 90'			A		20"	
200	1 set	***	216	89	305	and the second of the second o
250			338 441	139 182	477 623	
300]	·	and the second second second second	La special of contract		
350		· · · · · · · · · · · · · · · · · · ·	720	296	1,016	
400			980	404	1,384	
450			1,296.	532 688	1,828 2,336	
500		· 100	1,648	000	2,550	and a second contract of the second contract
Anchor Block (II 45'	1		85	34	119	
100	1 set					and the second s
150	}		158	64	222	
200			269 387	109 158	378 545	
250	11		570	232	802	
300	It		705	288	993	
350			980	401	1,381	
450	. 11	}	1,401	577	1,978	
500	H		1,762	726	2,488	
600		[1,762	726	2,488	
Anchor Block (V, U,	45')	I Ti	1,,02		",,,,,,,	
200	l set	_	230	93	323	
250	H BCC	-	443	182	625	
300	11	11. m	686	285	971	2
350	11		726	303	1,028	
400	l u	#4	1,532	643	2,175	
450	14		1,791	753	2,544	
500	11		2,212	930	3,142	1
	45')]	
200	1 set		228	91	319	And the second s
Bangal Valleranian market was a septiment to be	. g . P.C. 1 485 a \$6 485 a . a . a	, to -> tree -> 2 F4-46 b: 5 -17/25	THE REST OF PARTY OF STREET			

problem among the material control of the forms of the label sector for the street of	and the second s	Rote	venione no em	Labor	Company on the Charles September 1800	क्षेत्रकृतका सम्बद्धाः । वर्षेत्रकृतका क्षेत्रकृतका । वर्षेत्रकृतका । वर्षेत्रक क्षेत्रका । वर्षेत्रका सम्बद्ध -
Ttem	Unit	F. Cost	rials D. Cost	D. Cost	Cost	Remarks
250	1 cot	enante da tipose a la consección		S WAR AND	439	angan daga daga ang mada kang daga daga kang ang mang daga daga kang daga daga daga daga daga daga daga d
300	l set	ii ia <mark>T</mark> aabaa ee i	313 438	126 177	615	in regional entropy of the second entropy of
350	11	e a manage graduur er soorg	489	1.97	686	in expensive and a complete person of the com-
400	11	garaga a sagaran sa	504	203	707	especial surject of the entire surface of the con-
450	11	· continues of				The second section of the sect
			617	249	866	The second secon
500		resident from the first to the co	751	304	1,055	الاستكام فالمراوية المستدانية
Laying Plain Concre		٨.	106	22	120	
Entragilitation of the first book and market are an arranged and the second	1 m	Marie Company (Company Company	106	33	139	a magnifyria a channol de angles ad Carolic III.
500 "	11	en e	184	63	247	Contract Con
600 "			244	80	324	
800 "	a de la composition della comp	. · ·	383	124	507	
1000 "		, 21. , 4 m	629	1.73	802	Carrier and the Carrier Control of the
Laying Polyviny1 Ch	loride	Pipe				
20	1 10	### 	6.4	8:6	15_	Commission was a second to the filter of the filter of
25	11	***	8,6	9,4	18	range game and a grange sum of the sum of th
30	Н		11.6	17.4	29	
40	11	end St. grade de park allege aktive skildere i s	15.0	18.0	33:	CLASE CONTRACTOR CONTRACTOR
50	11	No.	21.6	18.4	39	Company of the Board Arms of the Board Balton of the Company
75	Н	-	46,8	27.2	74	
100	H	-	73.3	27.7	1.01	
Cutting of Asphalt	Pavemen		, , , , , , , , , , , , , , , , , , , ,			
(a) Cost of Operat-	\$ 4 0 1 2 2 2 2 2 4 4 4 4 4 4 4 4 4 4 4 4 4 4	1 -	48	32	80	
ing		a security of the section of			The same probabilities and the same same same same same same same sam	The state of the s
******* ******* ******* ******** ******	1 1.50		4	2.6	6 6	Line type of the enterpolicy of the transport of the enterpolicy of th
Cost of Operat-	Fru.	The state of the s		men varifi 🛊 🔾 je r	6.6	ارىيىدى بەرىپىچەرىيىڭ دەرىيىتىدى بولوپىي
and the same of th			4 44 6			a galanti ya enganaka ta asaba yang yang nang nang nang nang nang nan
Hand Rail	1 m		1.78	82	260	a de la persancia de la constanta de la consta
Air Valve	1 set	8,281	2,855	391	11,527	A STATE OF THE STA
Fire Hydrant		end and the contract of the con-	1,379	51	1.430	To Birth service control of the control of the first control of the control of th
Gate		-	:	!		
(a) Proposed Plant	1 set		7,017	1,275	8,292	Annual grande in a simple of the term of the
(b) Intake Site	11	~	2,507	910	3,417	The second contract of
Name Plate of W.T.P	()		4,665	1,905	6,570	
Flag Pole of W.T.P.	11	-	9,614	3,684	13,298	
Brick Masonry	1. sqm		83	9	92	u rangeau i e e e e e e e e e e e e e e e e e e
Finishing Mortar	11	**	9	41	50	andream digent and the special artists of
Coping Finishing	11		51	54	1.05	
Mortar			Tripute an extract filters			
Window Frame Mortar	1 in	-	3	26	29	Company of the service of the servic
Finishing Mortar	1 squ		11	21	32	
Floor	<u> </u>		****			Programme and the second section to the stay of the second of the second section of the second section of the second section of the second section sec
the annual and registers are a second and a	1 8200		11	41.	52.	to a some a regular destruction destruction of
Finishing Nortar Wall	1 sqm			}	24	gar a society Ayardy Company Company Company (1997)
The state of the s				angerial construction participate at pro-	ang a yeg ara seret e ce ca is gel ata at	Carrier San Carrier and Carrier and Carrier Conference
	1.m.,	368	92	45	505	and the state of t
Checkered Steel	1	107	38	36	181	A CONTRACTOR CONTRACTOR OF STREET
Plate		'****.	a consistence of the second	.,,.,		
Tile	1 8qm		291	66	357.	
Antificial Stone	11		159	71	230	
Ground						
Finish		<u> </u>				
Artificial Stone Wei	l sam	}	1,59	71	230	
Brush Texturing				A REST OF THE CONTROL OF	Name da san ning pasa as	
Wood Brackets for	1. squ		32	10	42	
Ceiling	'*'				Leide war eastern	The state of the s
•		AT		,		and the second s

Teem	La para de para de dir a manustra de para manustra de proposo. The control of th	TT. J.	Mat	erials	Labor	Carlotte Control of the Control of t	a cultura personana in imperior compressione in manda de la compressione in manda de l
Textile Finishing 1 sqm - 170 3 173 Leveling Morten " 14 21 35 Silaraceng Masonry " 22 57 79 Polding Door 1 set - 5,394 4,900 10,294 I-Steel Beam 350mm 1 m 533 133 51 717 Sub-Station Foundation 1 set - 37,872 19,950 57,822 I-Steel Beam 350mm 1 m - 257 130 387 Retaining Wall 1 m - 257 130 387		unic			. 1	Gost	Kemarks
Silarang Masonry	Textile Finishing	1 sqm				173	The second secon
Folding Door	Leveling Mortar	н	•• ••• •••			35	
L-Steel Beam 350mm 1 m 533 133 51 717			ee Comments of the contract of				
Sub-Station Founda- 1 act - 37,872 19,950 57,822 1100 Retaining Noll 1 .m - 257 130 387			and the second second				The state of the recommendation of the state
tion Retaining Mall 3.m - 257 130 387			533				Name and the state of the state
Retaining Woll 3. m = 257 130 387	Sub-Station Founda-	1 set		37,872	19,250	57,822	a dienni ordinaria arabah apa da da mari ni
	The state of the s	School State	y sia Sashamana a uga		100		and and any of the straight services so an investment
	Recaining wall	7 W	Section 1 to 10 to	451	130	387	o land official the admits a file of the dispersion of property and a second of the control of t
	الما بالرواعي المراجع في عليه من المنها المحمد والمناسسة المراجع والمناسسة والمناسسة والمناسسة والمناسسة والمن المناسبة المناسسة المناسسة المناسسة المناسسة المناسسة المناسسة والمناسسة والمناسسة والمناسسة والمناسسة والمناس	i andra angles (alamba a li I	a i gradu protoco po desentra diferen- e	te and defector recovery their trans	record form in incomprising and a	Antonia a grandana proprio	. The same and was word during the same first.
	Commence of the second		Carrier Company of the Company of th	TO MARKETAN	ather demonstrates the second persons	at the management was a security	and the second of the second control of the second of the
	 Companies de la propriación de la care a copé y him servicione de confrance, qui des la confrance. 		e demonstration in accommission	THE PARTY OF THE WAR IN A SHIRLE	mingophilanouphings State of the control of the con	ing and equition by Batan Bir	. Harristan en april Colombia antibación.
	the second secon	12,1,2,2,2,2,1,1	,				a constitution of the desired of the constitution of the constitut
	The state of the format and the state of the		1511710-17 8-19 2-11 8 7-19	rewrest to the section with the section of the sect	*************		
	carries a programmed as hold any moderning of dates highwise consideration in	resolved the process of the	المائينية والمراجع فيأتمسونيونه	and the second street and the second	combination society and supplicated	university and the second	
	and the second s						ing a series of the series of
	, installed the control of the contr				and a magazina dar Arabina dar matagarin ta	ir inii see agawa maadan boombing.	er og ender med elektrikense med alle beskelet i det beskelet i det beskelet i det beskelet i det beskelet i d
			Laster and a superior of				
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	and managements of sustaining the principle of such a series of the second sector (20.5).		a grand				
			. gref in mysepperatoristics	a consideration of the constant	, fraktion Albert Approximation of Arman State on Arman State of S	The state of the s	No accordance construction
	en e				totomore a presidenta per conse		to adopt the constant to the constant of
	and the second and the second angular content of the second field of the second of the		:			a a mar a designada menganan	Carroscanos antendas este dade en carrollare
	The state of the s	a construction		rapina api karangan pengerangan antangan dan karan			Emery and more than the control of t
	and the second s	Commence of the second		1.000 230 00.000 (1.000 4/1 - 4.0	The holy of a secular	Bullion of the season of the s	
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		and the second second second		e tijk digemenging ding granist same	were to act of the second of the property of the second	a pagnia di pagnana as ana sa sa	ng pagan diga pangaha ang agai agai again an ang again ad an an a
		consistent markets to the		a a Aleger Blanchard (1978), 1874 at 1	and the second section of the section	es as en ajuent som ofte eile a s	Contract of the second
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	a papara ana ayaya ya na ayanaya kanangangan saninga a mahay ka da ya makamasa sa ka masa a ka masa a mahay ka	**************************************	columnic and work district species of			re, where I we have a that a thind of the highest	Control of the contro
		n en manda el facto de la cons		tioner, and a sequential expension	the speciments and deposit for		indicated specification and consequent to the property of the
	and a single-country space and the property complete from parties of Medical and the Art Country for the Count			The state of the s			and the second s
	a consistent was expenses the second and the second according to the second ac	4 C 1117 - # 4 7 4 m F 1	to the first week of the	garan gagine (ngarangan garan s	*** ******* \$-*****	talis in the design of the old State of	April Committee
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	a san an agrammer an agus serang in a sinn na agus de a serante note encompression en						
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	the company of the co			************			- 1314 11 23 24 2 VI 2, 20 MI 2 1 1 2 1
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	And the second of the second o				Section 1.		The second second second second
	a security management of the continuous of					{	
	Marie Carlos Car						
	Company of the second s					<u> </u>	
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the second of	the first of the second	15 21 1					
towns which the state of the st	A CONTRACTOR CONTRACTO				Autorities bines and an	L. manufactures	Assett of the Self-self-self-self-self-self-self-self-s

(4) Running Cost for Thomburt - Treatment

a. Power Cost

	Demand of Electrical Energy	Cost
First	1000 kw	39_B/kwh
Over	1000 kw	36 B/kwh

. According to the rate using by Metropolitan Electricity Authority

b. Chemical Cost

enderfor die field har bruik in die einzel de die einde de verfein De vergein vergein de de de de vergein de de de vergein de de de vergein de vergein de vergein de vergein de v	and increasing and regard that is a study on application and and a study of the stu	·····································
A1um	1,700 B/ton	$A1_2(804)_3$: 18 11_20 $A1_2(80_4)_3$ must not less than 50% $A1_20_3$ must not less than 7.6% Density at 20^9 C must not less than 1.31 (Fiscal Year 1976-1977)
Lime Chorine	600 \$/ton 11,690 \$/ton	(Fiscal Year 1976-1977) Liquid Chlorine (Fiscal Year 1977)

1. Text Concerning Water Law

There is no overall water law in Thailand. All water resources are deemed to be state property. The State of Thailand holds and has reserved the full right to regulate water distribution and allocation for any kind of utilization. The right to use water is not covered completely by any statute. The Civil and Commercial Code of Thailand which was put into operation on 1 April 1932 contains some sections which give right to the ownership of land to extend above and below the surface but this land ownership does not automatically entail ownership of the water located above or under this land. The ownership of land which waterway passes has merely right to use these waters but is not entitled to draw more water than is necessary for his reasonable needs. While the right to use water for various purposes may be exercised freely, a number of limitation have been provided in various laws and regulations with respect to major utilization for which a permit has to be secured.

2. Main Principles of These Laws

The legal provisions concerning water resources conservation and development are derived directly or indirectly either from legal texts or from customary laws or else from special laws regulating one or more water utilization.

The main principles of these laws concerning the use of water may be summarized as follows:

(a) For Agricultural Uses

The Agricultural uses of water are governed by the following laws:

- (1) Act on Conservation of Canal, B.E. 2444(1901).
- (2) The People Irrigation Act, B.E. 2482(1939).
- (3) The State Irrigation Act, B.E. 2485(1942) and its amendment.
- (4) The Dykes and Ditches Act, B.E. 2505(1962).

The main principles of these acts concern the use of water for Irrigation purpose which may be carried out under 4 different systems: Private Irrigation, Contractual Irrigation, People Irrigation and State Irrigation.

The Private Prigation means an irrigation system constructed by one or more persons for his own cultivation. Any person desirous of constructing private irrigation work must apply for permission to doso. The granting of the permission shall be referred to didderent authorities, according to sizes of the areas to be irrigated.

The Contractual Irrigation means an irrigation work constructed by any person for remuneration to be obtained from those who are desirous of making use of water from such irrigation for their cultivation. This type of undertaking prescribes for construction of such work, a concession from the Ministry of Agriculture and Co-operatives. The concession establishes the conditions concerning the extent of the works, the remuneration, the reports to be submitted, and other obligations of the person holding such concession.

The People Irrigation is any irrigation system jointly constructed by the people for the benefit of cultivation by people within that locality. While such People Irrigation is put under government control, the work to be constructed either by individual or by the Government or jointly have to be approved by the majority of the users benefiting from them.

These above mentioned three systems are governed by the People Irrigation Act, B.E. 2482(1939).

State Irrigation is defined as any work constructed by the Government to supply water from any waterways or reservoirs for cultivation including the prevention of damage to cultivation with regards to water as well as navigation within the irrigation area. This type of water utilization is governed by the State Irrigation Act B.E. 2485(1942). However, this law also provides for control, on the part of the Royal Irrigation Department, of the water uses or activities such as conservation or storage of water, irrigation, drainage, reclamation, flood control, hydro-power, water communication and transportation,

The State Irrigation Act divides the Waterways into 4 categories as follows:

1st category: for supplying, drawing, conserving or retaining water for irrigation purposes.

2nd category: for navigation and irrigation within the area benefited from irrigation works.

3rd category: reserved only for irrigation purposes; and 4th category: accessory to irrigation.

(b) For Domestic Uses

The Laws relating to domestic uses of water are the follow-

- (1) Act on Conservation of Canals, B.E. 2444(1901) and its amendments.
- (2) Royal Proclamation an Establishment of Public Water Supply, B.E. 2451(1908).
- (3) Act on Conservation of Public Water Supply Canals, B.E. 2456(1913).
 - (4) Municipality Act, B.E. 2496(1953).

According to the Act on Conservation of Canals, general rules are established in order to maintain and conserve the water and structures of the canals. The Act also lays down general rules for protection, maintenance and conservation of canals for public uses.

The first public water supply system to provide water for domestic uses was established for the city of Bangkok by the Royal Proclamation of B.E. 2451(1908). The works was put under the control of the Sanitation Department of the Ministry of Metropolitan Affairs (now the Ministry of Interior). The Department was responsible for digging canals, supplying water to the town, establishing a pumping station and supplying equipment to ensure potability of water. Subsequently, by the Municipality Act, B.E. 2496(1953), the responsibility for providing domestic water for cities and people living in municipal areas was given to the Municipalities under the control of the Ministry of Interior.

In the Act on Conservation of Public Water Supply Canals, the control over water supply was established for keeping the water clean and potable.

(c) For Industrial Uses

The industrial uses of water especially concerning hydropower production, are governed by the following laws:

- (1) National Energy Authority Act, B.E. 2496(1953).
- (2) The Yanhee Electricity Authority Act, B.E. 2500(1957).
- (3) The Metropolitan Electricity Authority Act, B.E. 2501(1958).
- (4) The Provincial Electricity Authority Act, B.E. 2503(1960).
- (5) The Northeastern Electricity Authority Act, B.E. 2505(1962).
- (6) The Electricity Generating Authority of Thailand Act, B.E. 2511(1968).

The National Energy Admistration was established by the legislation in 1953, with a view to unifying power production, standardization, transmission, and distribution in the whole Thailand. The National Energy Alministration has the power to set up sub-committee, request information or enter the premises of any ministry, to declare any locality as a National Energy Area for conservation of energy and sources of energy, and to grant permits for the production of energy.

Special energy organization may be set up by Royal Decree. The first one of autonomous authorities to be set up was the Yanhee Electricity Authority established by the Yanhee Electricity Authority Act, B.E. 2500(1957), as an autonomous body with statutory powers and fundtions to generate, acquire, transmit and supply electrical energy within the geographical area specified by the Royal Decree. The Authority authorized and delegated its responsibilities for the construction of the Bhumibol Dam to the Royal Irrigation Department, completed in 1964.

The similar autonomous authorities have been created by subsequent legislation for the purpose of producting and/or distributing electricity in specified areas and regions. They are the following: the Provincial Electricity Authority in 1960; and the Metropolitan Electricity Authority in 1958.

In 1969, the Government established, under the Electricity Generating Authority of Thailand Act, B.E. 2511(1968), the new autonomous authority, the Electricity Generating Authority of Thailand, to take over the works on electric power generation of the recent three authorities, viz, the Yanhee Electricity Authority, the Northeastern Electricity Authority and the Lignite Authority.

(d) For Transportation Uses

The laws relating to transportation uses of water are the following:

- (1) The Navigation in Thai Waters Act, B.E. 2456(1913) and its amendment.
- (2) The Act on Control of Mooring of Vessels in Rivers and Canals, B.E. 2479(1936).
- (3) The State Irrigation Act, B.E. 2485(1942) and its amendment.
- (4) Ministerial Regulation, B.E. 2497(1954) issued under State Trrigation Act, B.E. 2485(1942) concerning irrigation materways maintenance fees.
- (5) The Act on Prevention of Collision of Vessels, B.E. 2497(1954).

On the basis of the above legislation, no clear distinc-

tion is made between inland waters and sea territorial waters, although different Government Agencies are responsible for such Thai Waters.

The State Irrigation Act, B.E. 2485(1942) empowers the Royal Irrigation Department to collect irrigation waterway maintenance from persons using irrigation waterways of the first and second categories for transportation purposes.

The Navigation in Thai Waters Act, B.E. 2456(1913), with amendments defines Thai waters and provides the granting of any permission to use Thai waters with charging of fees for such permits. The Act and its amendments regulate in detail all navigation requirements, formalities, and rules concerning Thai waters, including inland canals, as well as general regulations concerning the licensing and registration of vessels and boats, pilots and other provisions on navigation requirements and different types of fees and rates to be collected.

(e) For Waste Water, Quality and Pollution Control

The legislation concerning water wastage, quality and pollution control is the following:

- (1) Public Health Act, B.E. 2484(1941).
- (2) The State Irrigation Act, B.E. 2485(1942) and its amendment
 - (3) Sanitation Act, B.E. 2495(1952).

No special enactment has been promulgated concerning waste and misuses of water. There is one section of the State Irrigation Act, B.E. 2485(1942), referring to retaining of flood water from flowing to waste so as to allow the neighbouring land to be reasonably inundated. Many sections of this Act refer to various kinds of misuse of water which are prohibited.

The Factories Act of B.E. 2485(1942) establishes a prohibition against the factories discharging wastes into waterways and canals without having treated such wastes so as not to cause water pollution endangering human life, water quality or cultivations.

(f) Use of Underground Waters

No specific provisions exist concerning the use of underground water in Thailand. However, a ground water committee has been established to study all aspects of ground water resources. The Ground Water Act is being drafted and accepted on principle by the Cabinet. The Act is hopefully to be enacted within 1978.

The principle of the draft Act is to make provision for the control of the drilling for ground water, the use of ground water and the disposal of water or liquid into the aquifers through wells; and for the protection of the ground water resources. The Act shall be applied only in specific areas where ground water resources are critical with respect to quantity, quality and environment. No person shall engage in activities relating to ground water in the legally proclaimed "ground water area", no matter whether such activities are being undertaken in places which are within the rights of a person unless he has received the permits. Provision is made that the legal "ground water" in the "ground water area" shall mean underground water occurring in layers of earth or rocks at depth from the surface greater than the depth stipulated in the ministerial regulations. Under such principles, a person can still enjoy the privilege in his ground water activities outside the ground water area or in the ground water area so far as his activities are limited to an uncontrolled depth. However, the Minister may proclaim as many ground water areas as he deems appropriate.

The Act is entirely legal in format and no detailed description and technical comment are offered. At any rate, provisions are made for the Minister to issue the ministerial regulations for properly executing the Act. The following are set out as the ministerial regulations under the draft Act.

- 1. Prescription of the ground water area for the purpose of the Act. The depth from ground surface of the prescribed area which is exempted from the provisions of the Act shall be specified.
- 2. Description of a permit application procedure and information required in the permit application.
- 3. The condition or stipulation under which a permit may be approved and issued or revoked.
- 4. Application for Well Driller's Licence and information required in the application.
- 5. Prescription of procedures in drilling for ground water, well completion and development, well abandonment, testing well for yield, and submission of geologic and hydrologic data including drilling report and well records.
- 6. Guidelines and technical standards for withdrawal rof ground water from well with respect to water requirement, water allotment, conservation of ground water, and protection of public health and environment. The requirement for permit holder to install and maintain the flow meter and water level indicator shall be also specified.
 - 7. Prescription of quantity and quality of water or 11-

quids to be disposed of into the aquifer by means of a well, including the methods and thechniques of disposal. The establishment of a system of monitoring the disposed aquifer and the reighbouring aquifers shall be also specified so that the sanitation and environment can be safe-guarded.

- 8. Procedure and information required for registration of existing ground water activities prior to the enactment of the Act, including a permit application description.
- 9. Assignment of the Department of Mineral Resources to carry out a study and research on the simulation of the aquifers in the ground water area so that ground water resource can be properly managed.
- 10. Regulations on the fees which shall not exceed the rates shown in the list attached to the Act.

3. Strength and Weakness of These Laws

As it has been described, the water resources utilization in Thailand are controlled by different acts by which the full provision for various beneficial uses are not covered completely in any statute. The weakness of these laws is that the right of water users is not clearly defined. Hence, when water becomes more heavily utilized and scarce, it creates conflicts among various users. Many acts that have been enacted since more than 20 years ago are now considered inadequate. Another point is that the offences and punishments that have been provided in such laws are not fully enforced. The punishments are not strong enough compared to present conditions that has been changed radically. Considering that water is a valuable commodity there should be clear legal little to its uses. Many things which are now problems could be covered in a new Act. The comprehensive use and management of both surface water and ground water resources should also be considered for inclusion.

1) Thailand Country Report; United Nations Water Conference, Escap Regional Preparatory Meeting, Ministry of Agriculture and Cooperatives, 14 May 1976

6-3 Organizations

1. Section Relationships 1)

Apart from Bangkok which receives its water from a parastatal organization, the Metropolitan Water Works Authority, three ministress have central roles in providing improved water supplies to the population the Ministry of Health, the Ministry of Interior and the Ministry of Industry. All three are involved in supplying water to the rufal

sector but only the Ministry of Interior is concerned with providing urban water supplies. Draft legislation which would estiblish an Urban Water Authority encompassing the activities of the Ministry of Interior dealing with water supplies in Municipalities and Sanitary Districts, is under consideration. If the Authority is properly structured providing adequate administrative flexibility with respect to rates, financing of connexion charges, and borrowing and sets reasonable standards for financial performance, the urban sector should be enabled to improve its effectiveness.

In contrast to the situation in the urban areas where one t_{i}^{α} agency in the Ministry of Interior is responsible for water supplies, seven agencies in three ministries have responsibilities for water ? supplies in the rural area. Each agency has its own programme and seemingly are not duplicating each others work. There is, however, no overall planning for the sector - no overall data base, strategy or common criteria. Evaluation of progress is therefore virtually impossible with any degree of accuracy and the validity of future programmes difficult to assess. This has been a long standing problem which the Government has previously tried to solve by establishing various com-There is now recognition that a more permanent organization is required and a proposal has been made to establish a "Rural Water Supply Center", which would, at least in the initial stage, be attached to the NESDB. The mission strongly supports this proposal and recommends that a small group of about 5 - 6 professional staff members be detached from the various agencies presently concerned with rural water to form the nucleus of the "Center".

Both the Ministry of Health and Ministry of Interior have responsibilities for sanitation in rural and urban areas respectively. In the reral sector, financial and technical assistance is couple with the individual effort of villagers; in urban areas assistance is limited to technical advice.

2. Urban Water 1)

(a) Organization, Responsibilities and Administration

Urban water systems as used in this report refer to systems which serve populations in Metropolitan Bangkok, Municipalities and the larger Sanitary Districts throughout Thailand. Generally the communities have more than 5,000 inhabitants and total about 9,000,000 people, about 21% of the entire population. Class to 40% of the urban dwellers are concentrated in the Metropolitan Bangkok area. The remain 60% are distributed among 118 municipalities and about 290 Sanitary Districts. Two organizations are responsible for the urban water sec-

tor; the Metropolitan Water Works Authority and the Provincial Water Supply Division (PWSD) of the Public Works Department in the Ministry of Interior. About 41% of the urban population is served by these agencies.

(b) Metropolitan Water Works Authority (MWWA)

Bangkok and Thonburi and a few small communities extending over 3 130 km2. Approximately 63% of the population is served and capacity needs to be increased to provide water to the population which is growing at 6% per year. A large expansion project financed by the Government, the World Bank, the Asian Development Bank and MWWA's own funds, is being constructed which is expected to meet the areas needs until 1982 and possibly until 1985. Compared to other urban and the rural communities with piped water systems, consumers in Bangkok pay far less for water even though in general they are more affluent. From an equity standpoint, this situation deserves greater attention and if adjusted would free more resources for less favoured urban areas.

(c) Provincial Water Supply Division (PWSD)

PWSD, which is responsible for all urban water supplies outside Metropolitan Bangkok, either owns the systems or grants concessions to Municipalities and Sanitary Districts. For those it owns, PWSD plans, designs, constructs, manages, operates and maintains the systems. Concessions are owned, operated and maintained either by private enterprises or communities but in all cases PWSD must approve plant design and construction. There are 226 communities served by these systems.

Six regional offices of IWSD provide technical support to its own systems, conduct surveys of new projects, and are the principal channels for administrative supervision. Monthly data on sales, water produced and expenses are submitted to Bangkok by each system manager. All capital expenditures must be approved by PWSD and each manager has only a small (3,000 baht) petty cash fund for minor day to day expenses. New plants and expansions of PWSD owned systems are financed by the Central Budget but concession systems must finance their own construction. A loan fund operated by the Ministry of Interior provides limited funds at 5% to municipal and Sanitary District concessions.

During 1969 - 1971, three bi-lateral agencies, in collaboration with national staff prepared master plans for the expansion of 15 municipal water supply systems. Most of these studies related to concession operated systems and to the extent that they were considered suitable have been used by PWSD in preparing expansion plans which were financed internally. Chiang Mai, the largest of the cities studied, is likely to

be the beneficiary of an externally financed project. Before it is approved, however, there should be a through investigation to ensure that an expensive expansion using surface water is not neglecting the possibility of using low cost ground water sources.

3. Rural Water 1)

(a) Organization Responsibilities

Responsibility for providing or assisting approximately 31 million rural inhabitants to have improved water supplies can be roughly divided into two groups: (1) Piped water supplies systems and (2) other types of water supplies. About 6 million people or 19% of the rural population falls in the first group and 25 million or 81% in the second.

Communities with population from about 1,000 to 5,000 are being provided with piped water supplies by the Rural Water Supply Division (RWS), of the Ministry of Health. RWS designs and constructs these systems using either ground or surface sources. When deep wells are required, RWS may be assisted by the Department of Mineral Resources (MR) or Provincial Water Supply Division (PWSD) of the Public Works Department or the Accelerated Rural Development (ARD) Organization.

Communities with less than 1,000 population are assisted in obtaining improved water supplies by a number of Governmental agencies. These are not piped systems but improved dug or drilled wells with hand pumps, storage tanks for rain water, and construction of small surface ponds or storage reservoirs. These agencies are:-

- (a) The Ground Water Division of MRD- Ministry of Industry
- (b) The Sanitation Division (SD) of the Ministry of Health
- (c) The PWSD Well Drilling Section Ministry of Interior
- (d) ARD (Accelerated Rural Development) Minkstry of Intetior
- (e) The Department of Local Administration (DOLA) Ministry of Interior
- (f) The Department of Community Development (CD) Ministry of Interior

The activities of the six agencies are coordinated at the Provincial level by a committee headed by the provincial planning officer, and also at the National level by a "Clean Water Committee" whose chairman is the Under Secretary of the Ministry of Interior. There is sample work for all agencies and there does not seem to be any serious duplication of effort in implementing the vaiours programmes. There are, however, questions whether some agencies should be operating as they now are, if potable water is to be provided at the least cost.

There is a number of Government Agencies, Organizations, and Authorities whose functions involve in the management, administration and control of national water resources. Their names and functions may be described as follows:

- 1) The Royal Irrigation Department of the Ministry of Agriculture and Cooperatives has jurisdiction and control over the following water uses, utilization and related activities: (1) Irrigation, (2) Drainage, (3) Reclamation, (4) Flood Control, (5) Hydroelectric power production, (6) Water Communication in Irrigation Waterways, (7) Conservation or storage of waters. Its function covers the works involving in investigation, survey planning, design, construction and operation of such water resources projects.
- 2). The Department of Fisheries, Ministry of Agriculture and Cooperatives, has jurisdiction and control over the use of water for fishing purposes in all That waters including inland and sea waters.
- 3) The National Energy Administration, Office of Prime Minister, has jurisdiction to control and coordinate over the use of all energy potentials of the country including hydro-power production. The Administration also has control over special autonomous power production and/or distribution authorities.
- 4) The Electricity Generating Authority of Thailand has come into existence with the merger of the Yanhee Electricity, the Lignite, and the Northeastern Electricity Authorities since May 1969. The Authority is an autonomous body with power and function to generate, acquire, transmit and supply electric energy, and to undertake all types of activities related to electric energy.
- 5) The Metropolitan Water Works Authority, Ministry of Interior is the agency that is responsible for provision of domestic water supply for Bangkok Metropolitan Area and surroundings which at present activity does not involve in water resources development as its present raw water requirement of about 1 million m³ per day can be met by the surplus flow of the Chao Phraya River throughout the year. Its future enlargement of activities requires a definite plan for a reservoir project built particularly for the purpose.
- 6) The Public Works Department, Ministry of Interior, through its Provincial Water Supply Division is responsible for providing piped water supplies in provincial municipalities, sanitary districts and towns with population above 5,000. Its main activities include design construction, management and operation of urban water supply systems, and shares responsibility with the Ground Water Division of the Department of Mineral

Resources in a well drilling programme for rural water supplies.

7) The Department of Health, Ministry of Public Health, exercises juridiction over water quality, pollution control and health preservation together with the local authorities and municipalities under the overall control of the Ministry of Interior.

The Department if also responsible for providing potable water supply in rural communities with population between 1,000 to 5,000.

- 8) The Harbour Department is responsible for control and has jurisdiction over the use of water for transportation and navigation purposes; this competence is shared with similar one on water communication in the irrigation canal controlled by the Royal Irrigation Department.
- 9) The Department of Mineral Resources through its Ground Water Division is responsible for the investigation, development and control of ground water resources.
- ponsible for social and economic developments. Its involvement in water resources is to establish policy, make decision and set up priority of projects proposed by various Government Agencies in order to conform with well-co-ordinated plan of the country.
- 11) National Environment Board with authorities to develop national plan for pollution abatement and resources conservation, is coordinating the activities of various implementing agencies in water resources management with emphasis on water pollution control.
- cies that are engaged in the construction and development of small reservoirs and water wells for purposes which fall within their particular responsibilities. They are: (1) Land Co-operative Department, Ministry of Agriculture and Cooperatives, carries out very limited activity on well drilling; (2) Public Welfare Department, Ministry of Interior, carries out a limited programme of well construction; (3) Office of Accelerated Rural Development, Ministry of Interior, carries out small reservoir constructions and well drilling programme located primarily in politically sensitive areas of the country; (4) Mobile Development Unit of the Supreme Command Office, Ministry of Defence carries out similar activity as that of the Office of Accelerated Rural Development in the areas located primarily in politically sensitive areas of the country.

5. Agencies of Ground Water 2)

Ground Water has played a less important role in solution of Thailand's water problems although its utilization could be dated back to the last six or seven decades. Ground water where feasible, is now being increasingly preferred as a source for urban and rural domestic supply, even

where surface water is available. The development of the ground water for such purposes is under the responsibility of four government agencies: the Department of Mineral Resources, the Public Works Department, the Department of Health and the Office of Accelerated Rural Development. The Metropolitan Water Works Authority which is responsible for municipal water supply in Bangkok Metropolitan Areas also utilizes ground water for about one-third of its public water supply. An attempt to provide ground water for agricultural use is undertaken by the Royal Irrigation Department, Among these government agencies, only the Department of Mineral Resources has been assigned the ground water resource investigation and evaluation as well as the development.

- 1) Water Supply and Sewoge Sector Study. Workd Health Organization/World Bank Cooperative Programme, 1976.
- 2) Thailand Country Report; United Nations Water Conference, Escap Regional Preparatory Meeting, Ministry of Agriculture and Cooperatives. 14 May 1976.

6-4 City Planning (Future Population)

1. Population in Bangkok 1)

It is proposed to plan Bangkok Metropolitan District, its public utilities, services and facilities for a population of 6.5 millions by the year 2000. This design population is very much lower than the projected population would be in three decades at the present annual increase rate of 5.1%. In order to limit the population to 6.5 millions in the year 2000, the following measures are recommended:

- (1) Encourage the growth and economic development of other cities throughout the country.
 - (2) Improve the urban and regional transportation facilities.
 - (3) Establish Regional Planning as a national policy.
- (4) Encourage family planning by establishing clinics in the Metropolitan area.

2. Land Use in Bangkok 1)

In order to accommodate an urban population of 6.5 millions, the following steps are recommended on land use and zoning.

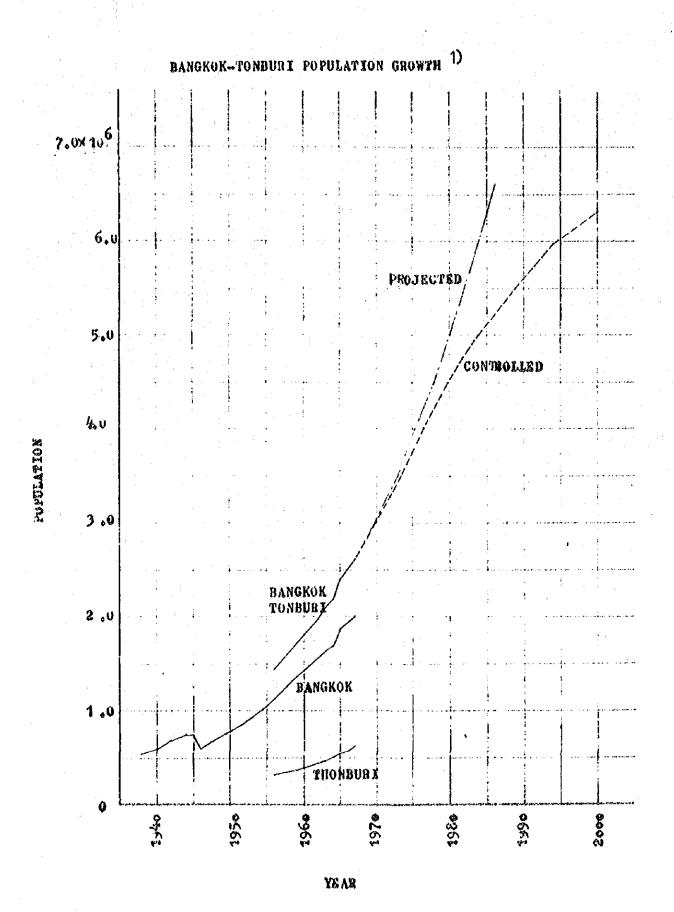
- (1) Expand the limits of the municipalities of Bangkok and Thonburi to a Metropolitan District three times-their present size.
- (2) Encourage the "finger type" land development along main traffic routes.
 - (3) Group the industrial areas into three specific districts,

chosen for the availability of adequate transport and other facilities.

- (4) Develop "industrial park" units where workers can live in close proximity to their jobs.
- (5) Disperse sub-commercial and government offices to avoid congestion in the center of the city.
 - (6) Encourage high and medium density residential development.
- (7) Create a park system by providing green strips along the major canals existing in the metropolitan area. Expand the strips to large parks where feasible.

PROPOSED LAND USE 2000 1) (For a Population Of 6.5 Millions)

Land Use		•	sq. kilometers
Residential			293
N 130-264 G(126-216)	High Density (30%)	24	
N 42-96 G (39-75)	Medium Density (55%)	143	
N 14-24 G (12-16)	Low Density (15%)	112	
	For flexible change 5%		
Commercial			30
Industrial			70
Government			60
Utilities & Serv	lces		37
Recreation			30
	Tota1		520
Agriculture			300
doistannesserversed the same	Total Planning Area	nakan Profitorio and paper desiral relief	820 km ²
	Control of the Contro		(514,000 rai)



Consus Date	Census Year B.E. A.D.	Δ	<u>B</u>	<u>c</u>	D
April 1	2462 1919	9,207,355	•	10,110,000	••
July 15	2472 1929	11,506,207	2.19	12,130,000	1.8
May 23	2480 1937	14,464,105	2.96	14,410,000	2.2
May 23	2490 1947	17,442,689	1.89	18,450,000	2.5
April 25	2503 1960	26,257,916	3.22	26,860,000 35,000,000 ⁽²⁾	3.0
April 1	2454 1911	8,266,408 (3)	,	
Feb. 23	2499 1956	20,095,139 ⁽⁴⁾)		

Note: A Enumerated Total Population

- B Annual Percentage Rate of Growth
- C Adjusted (1) Total Population
- D Adjusted Annual Percentage Rate of Growth
- (1) Adjusted by UN, Population Division (3) Too incomplete to be of value
- (2) See text for explanation (4) Under-estimated to the point of being unadjustable

FUTURE POPULATION OF THAILAND 2)

Year	The second secon	PREDICTED POPULA	و - المناسعة و المراسعة المراسعة المناسعة المناسعة والمناسعة والراوات
B.B. A	D. Minimum	Probable	Maximum
2512 1	969 35,000,000	35,000,000	35,000,000
6 years	$(2.3)^{(1)}$	(2.7)	(3.0)
2518 1	975 40,000,000	41,000,000	42,000,000
10 years	(2.3)	(2.7)	(3.0)
2528 1	985 50,000,000	54,000,000	57,000,000
15 years	(2.3)	(2.5)	(3.0)
2543 2	70,000,000	78,000,000	90,000,000

Noce:

(1) (2.3) * Annual percentage rate of growth

<u></u>	lear	,	GKOK MUNIC			MUNICIPAL d Populati	
BrE.	A.D.	Minimum	Probable	Maximum	Minimum	Probable	Maximum
2512	1969			2,141,000	670,000	670,000	670,000
6	years	$(2.3)^{\left(1\right)}$	(4.0)	(5.2)	(2.3)	(5.6)	(6.0)
2518	1975	2,450,000	2,675,000	2,900,000 ⁽²	770,000	930,000	940,000
10	years	1	(4.3)	(4.7)	(2.3)	(4.4)	
2528	1985	3,100,000	4,095,000	4,600,000 ⁽²	960,000	1,430,000	1,700,000
. 15	years	(2.3)	(3.0)	(4.7)	(2.3)	(3.0)	(6.0)
2543	2000	4,300,000	6,345,000	9,000,000 1	,320,000	2,300,000	3,900,000
		•		e e			
:			, iai and ii iai an ii iai an ii iai an				
11 1	l'ear .	,	ABURI MUNIC dicated Pop			PRAKAN MUNI icated Popy	
B.E.		Minimum	Probable	Maximum	Minimum	Probable	Maximum
2512	1969	22,500	22,500	22,500	41,500	41,500	41,500
6	years	(2.3)	(5.5)	(7.0),	(2.3)	(4.8)	(7.0
2518	1975	26,000	31,000	35,000	47,000	55,000	60,000
10	years	(2.3)	(4,9)	(7.0)	(2.3)	(4.6)	(7.0
2528	1985	32,000	50,000	70,000	59,000	86,000	120,000
1.5	years	Large	Boundary I	ncrease	Large	Boundary	Increase
2543	2000	300,000	530,000	800,000	500,000	745,000	900,00
							÷

^{(1) (2,3) -} Annual percentage rate of growth

^{(2) 90} percent of the maximum changwat population was assumed as the controlling limit.

SUMMARY OF PROJECTED MUNICIPAL POPULATIONS AND POPULATION DENSITY 2)

	Year 2	Year 2512 (1969)		Year 2	Year 2518 (1975)	()	Year 25	Year 2528 (1985)	2	Year 2543 (2000)	3 (2000)	
		P44	Persons		1	Persons		, ,	Persons		ŭ	Persons
Municipality	Population	Area(I)	Per sq.km	Population (2) sq.kg	2.) Sq. km	Per Sq.km	Population	Area sq.km	Per sq.km	Population	Area . sq.km	Per sq.kn
Bangkok	2,121,000	238.6	9,000	2,675,000	238.6	11,200	4,095,000	293	14,000	6,345,000	387	16,400
Nonthaburi	22,500	2.5	000,6	31,000	2.5	12,400	50,000	የ 2	5,000	530,000	3 %	9,200
Semut Praken		7.3	5,700	55,000	7.3	7,500	86,000	ä	5,800	745,000	62	12,000
Total (Density)	2,875,000	300.4	(009,6)	000,169,8 (009,6)	300.4	(12,300)	5,661,000	410	410 (13,800)	9,920,000	663	663 (15,000)
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					-							

(1) Area from Table 4.6

⁽²⁾ Probable future population from other Table

SUMMARY OF PAST, PRESENT AND PROJECTED FUTURE POPULATION OF THAILAND FOUR CHANGMAIS AND FOUR MUNICIPALITIES 2)

		Percentage Thailand					7-2		· · ·	•				
: :		As a Perc				:	4.3%	6.5		8.2		9.0	10.5	12 6
	s	Total					801,000	1,744,000	:	41,500 2,875,000		55,000 2,691,000	86,000_5,661,000	745,000(19,920,000
*****	Municipalities	Samut Prakarn					10,000	22,000		41,500		55,000		745,000
	Muni	Montînaburi Samut Prakar	•				10,000	18,000		22,500		31,000	50,000	530,000(11)
		Thonburi					177,000	404,000		670,000		930,000	1,430,000	2,300,000
		Bangkok					604,000	1300,000		2141,000		2,675,000	7,305,000 4095,000 1,430,000	11,820,000 6345,000 2,300,000
		Total		752,000	971,000	1,135,000	1,550,000	2,674,000 1300,000	1 00 18	3,944,000 2141,000	Control of the contro	4,920,000 2,675,000	7,305,000	11,820,000
	Changwats	i Samut Prakarn		110,000	112,000	132,000	172,000	255,000		318,000	. :	395,000	580,000	1,340,000
-		Thonburi Nonthaburi		95,000	108,000	115,000	306,000 141,000	568,000 201,000		266,000		325,000	500,000	1,320,000
1		Taonbuzi	+	156,000	193,000	683,000 205,000 115,000		568,000		000,096		1240,000	1,750,000	2330,000
		Bangkok		391,000	558,000	683,000	941,000	1,650,000	angostis e-	2,400,000		2,960,000	4,475,000 1,750,000	6,830,000
*		Thailand		000,011,01 6161	1929 12,130,000	1937 14,410,000	1947 18,460,000	1960 26,860,000		1969 35,000,000 2,400,000 960,000 266,000	-	1975 41,000,000 2,960,000 1240,000 325,000	1985 54,000,000	2000 78,000,000 6,830,000 2330,000 1,320,000 1,340,000
•	Year	A D	PAST	1919 1	1929 1	1937 1	1947 1	1960 2	PRESENT	1969 3	FUTURE	1975 4	1985	2000 7
:	Þ	ių m	ឥ	2462	2472	3480	2490	2503	<u>ائ</u> ھ	2512	E.	2518	2528	2543

(1) Large boundary increase

PRESENT AND FUTURE POPULATION OF AMPHOE TOWNS OUTSIDE THE CENTRAL SYSTEM 2)

			Year 251	2 (1969)	Year 2528	Ver 2528 (1985)	Year 2543 (2000)	(2000)
Amphoe	Total Amphoe	Amphoe Town	Total Amphoe	Amphoe Town	Total Amphoe	Amphoe Town	Total Amphoe	Amphoe Town
(Bengkok)			1			*		
Minburi	161	2.0	39,000	6,500	54,400	20,000	97,000	20,000
Nong Chok	822	8.0	43,000	4,500	52,400	15,000	77,000	30,000
Lat Krebang	149	0	30,000	5,500	41,200	20,000	000*59	35,000
(Thomburi)		د است میشود		and the second				
Nong Khaem	3	9.0	20,600	3,400	41,000	20,000	62,000	35,000
	~ ·v* 110						4 1 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	
(Nonthaburi)		COM F ACC					ertekirgan.	
Beng Bus Thong	2 F1 F1	0	32,800	8,500	53,000	20,000	88,000	40,000
Bang Yai	92	Z - ref	30,800	3,300	43,000	20,000	63,000	40,000
Sai Noi	194	1.0	.27,200	1,000	39,000	10,000	55,000	15,000
(Semut Prekan)	Ten of Migration of	. ندماً در درد	,				4	
Bang Phii	308	0	59,800	2,000	82,000	20,000	129,000	35,000
විස වූරු පිර	ri N	۵ ن ن	56,100	4,100	70,000	16,000	103,000	25,000
TOTAL	1,513	12.1	339,300	43,800	476,000	156,000	739,000	305,000

(1) Sanitary District or Consultant's estimate The Amphoe Town area estimates are somewhat arbitrary... In the future, the area of each Amphoe Town is expected to increase considerably.

SUMMARY OF PRESENT AND FUTURE POPULATION SERVED BY SEPARATE SYSTEMS 2)

Changwat	Year	Year 2512 (1969)	(696	Vear	2518 (1975)	975)	Year	2528 (1985)	85)	Year	Year 2543 (2000)	(000)
ತಿರದ	Total	Percent	Served	Total	Percent	Served	Total	Percent	Served	Total	Percent	Served
Amphoe	Population	Served	Population Served PopulationPopulation		Served	Population	PopulationServed	Served	Population	PopulationServed	nServed	Populatio
Bangkok		•		•								September 1
Min Buri	905*9	75	2,700	10,000	65	6,500	20,000	. 75	15,000	20,000	80	000,04
Nong Chok	4,500	20	900	8,000	δ	4,000	15,000	29	10,000	30,000	67	20,000
Lat Krabang	5,500	22	1,200	10,000	9	6,000	20,000	70	14,000	35,000	72	25,000
Thomburi		*.										
Nong Khaem	3,400	٥	Φ*	5,000	20	2,500	20,000	2	14,000	35,000	85	30,000
Nonthaburi												
Beng Bus Thong	8,500	39	3,300	12,600	 	000,9	20,000	9	12,000	000,04	75	30,000
Bang Yai	3,300	35	200	8,000	20	4,000	20,000	9	12,000	40,000	75	30,000
Sai Noi	1,000	20	200	5,600	07	2,000	10,000	20	5,000	15,000	29	10,000
Samut Prakan											:	
Bang Fhii	7,000	26	1,800	10,000	70	7,000	20,000	50	10,000	35,000	72	25,000
Bang Bo	4,100	50	800	8,000	88	3,000	16,000	50	8,000	25,000	09	15,000
IOIAI	43,800	192	11,400	76,000	18	38,000	161,000	[29	100,000	305,000	14	225,000
Other Separate Systems in 2512 (1969) which are expected to become part of the MWA System:	ems in 2512 (1) ome part of th	969) whi		System Phra Pradaeng Fhasi Charoen Bang Khen Bang Kapi	Served 7, 7, 25, 3, 3, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,	ved Population 7,000 25,000 3,600 2,500		1 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	rks Thonburi by 2518 Thonburi by 2518 Bangkok by 2518 Bangkok by 2518	18 (1975) 18 (1975) 18 (1975) 18 (1975)		

Population (1973-1976)

 Zeng 30	58,346	59,354	60,046	61,051
Rang Phii	997,99	. 67,056	68,352	69,977
Reng Yed	32,628	30,649	30,814	31,385
Sai Not	26,305	26,568	26,786	. 28,463
Name Bus Thome out of (mumicipality)	25,247	28,584	29,011	26,492
Serg Sus Thong Reng Bus Thong out of (numicipality)	9,505	979.6	7,806	7,959
Nong Khaesa	28,679	30,519	32,308	34,015
Lat Krabang	33,185	22,959	34,951	36,065
Maburi	309°97	45,309	45,342	\$7,135
Nong Chok	776 77	46,197	46,939	47,666
8253	1973	1974	1975	29.76

Resources of Data 1973 - 1975: Statistical Report Division: Office of National Statistics

1976: Registration Division

: Department of Adalulatration, "Ministry of Interior

- 1) THE GREATER BANGKOK PLAN FOR YEAR 2000,
 CITY PLANNING DIVISION OFFICE OF THE CITY CLERK
 BANGKOK MUNICIPALITY
- 2) MASTER PIAN; WATER SUPPLY AND DISTRIBUTION, CDM, 1970

6-5 Geology 1)

Geologic History. The mountains surrounding the Chao Phya Plain were formed during the late or Post Miocene orogeny. The present Chao Phya River I basin was possibly the result of the development of structural basins in the late Tertiary epoch followed by heavy alluvial depositions during the Quarternary epoch. These first deposits, consisting of layers of fine gravel sand and sandy clay, are now located at a depth of 300 meters or more below the surface A thick layer of grey, relatively homogeneous clay was later deposited after the major movement of the earth's crust had stopped.

The delta steadily advanced into the Gulf waters to the south About 500 years ago the present site of Bangkok was at the shore of the Gulf of Thailand Recent flood control and irrigation projects have caused most of the silt to precipitate before it reaches the Gulf but the southward growth of the delta, although slowed, is continuing.

been filled with sediment. The upper formations underlying the Bangkok metropolitan area consist of alternating beds of sand, gravel, clay, and silt. However, a few thin cemented layers on the order of 3 to 6 meters thick have been encountered at depths as shallow as approximately 100 meters. Although no test wells have been drilled through the entire sequence of unconsolidated deposits in the Bangkok metropolitan area, it is reported that the rock was encountered at a depth of 365 meters at Ayudhya, 70 kilometers north of Bangkok. A test well drilled in Samut Prakan in December 2511 (1968) during this investigation penetrated 457 meters of unconsolidated deposits without encountering bedrock.

Subsurface conditions in the area are relatively uniform. Borings to a depth of 20 meters recently made during the preparation of the master plan for sewerage, drainage and flood protection, indicate that there are basically two types of clay, one soft and one stiff. The soft clay is on the upper level. The change from solt to stiff occurs at an average depth of 13.5 meters and varies from 11 to 17 meters. During the dry season, however, the top one or two meters of the natural ground surface dries and becomes a relatively stiff brown clay. An evaluation of the load carrying capacity

of these soils is presented in other Chapter, Construction Methods and Materials.

1) Master Plan; Water Supply and Distribution, CDM, 1970.

6-6 Climate

Thailand has a tropical climate which is influenced by monsoons blowing from the northeast from November to February and from the southwest from May to September. Most of the rainfall occurs during this latter period and ranges from 1,000mm to 3,000mm per year. 1)

Thailand has three generally recognized seasons: the "Cold Season", which includes November, December and January; the "Hot Season", extending from February through May, and the "Wet Season", covering the other five months of June through October. The relatively dry period extends from November through April with practically no rainfall in December and January.

The mountains around Bangkok dissipate the forces of the typhoons or cyclones that create such havor in the South China Sea and the Bay of Bengal. While gentle breezes of more than 15 kilometers per hous prevail about two thirds of the time these breezes seldom exceed 12 kilometers per hour. Maximum winds up to 122 kilometers per hour have been recorded, however. The prevailing winds are either from the north or the south. 2)

- 1) Water Supply and Sewerage Sector Study; World Health Organization/ World Bank Cooperative Programme, 1975.
 - 2) Master Plan; Water Supply and Distribution, CDM, 1970.

WELL LOG NO 5-03

Kilomotor 50 Sukumvit Rd Samutprakan

started January 10 1960

Soule to 779

1.00	Surface soll	4.65	
14.2	Soft clay, grey		:
39:81	Clay, Broy with sholls	6,40	
25.17	Clay, yellowish white Clay, light yellow	4:04	
31:43 Elizabeth	Clay, black yellow Coarso sand, yellow with clay	3 (4) 3 (4)	
37.52	Coarge sand, black yellow	6.09	:
46.66	Coarso sand, white	e .14	
52.75 <u>0.0.0</u> 58.84	Clay, yellow withgravel Clay, yellow with fine sand	6.03 6.07	
61.88	Fine sand, white	3.84	
74.94	Clay, yellow	50.06	
78.08	Fine sand, white	6,14	÷
93.51	- and Date (Day vo	€/ 9	
104.52	Clay, yollow with fine sand	47.51	
109.58	Fine sand, yellow and white	16.20	
114.80	Coarse sand, yellow with clay	28.1	. *
121.90	Fine sand, white	6: V	
127/.88	Clay, yellow		
131.88	Course sand, white and yellow	7.50	
135.63	Clay, yellow Course sand, yellow with clay	5.75 4.00	:
141.85	fine sund, yellow Clay, yellow with coarse sand	and limestone	•
149.10	Clay; yellow with coarse sand	•	
151.25	Fine sand, yellow Coarse sand, white and yellow		• •
154.50	Clay, yellow whit hard shale		
160.20	Clay-vellaw, yethow and white		
168.80	Coarse sand, white		
179.00			
194.30	Coarse sand with yellow clay		
205.10			
and and and	Clay, yellowish white and gree	n with sand	
[]	Alay, yellow white with coarse		.е
226.65	1	The second section is	•
المعاوضة ومرضم ودها فالمتازم ورمويها والواقسها ومطا			F .

A.PARKLET CH. NONTHABURI

started 11 June 1962 Completed 20 July 1962 Soule 1:750

	Formation	Description
300	Annual Control of the	Clay, brownish
7.50	MARTIALI	Clay, black with sells
12.2)	Clay, grey
20.00	*** ***	Clay, brown with coarse sand
23.00		Clay, black
25.90	al an digita sami silandinan nyanggangga ganggangan pilipin, Bara sami Bara sami Bara sami Bara sami sami sami sami sami sami sami Bara sami sami sami sami sami sami sami sam	Clay, light brown and yellow
33.55	marage we say	Olay, grey
36.30	where good actions and	Coarse sand with clay
45.70	0.00	Coarse sand, with gravel
52.00		Clay, brown
55.35 59.10		Clay, brown, with sand Coarse sand, white with gravel
72010	protein der bis dansk	Clay, brown
· ·		
#C 00	and the second second	
76.20 78.25		Clay, grey with sand
1 2		Sand, dark brown
84.35 87.75		Fine sand with Clay, brownish
	0.0	Coarse sand, white with gravel
97.05		
105.	0	Clay, brown Clay, brown with shale
183:7		Clay, brown . Clay, brownish with coarse sand
118:46		Coarse sand, dark brown
120.99	**** *****	
126.50	7///	Clay, brown, with limestone
130.60		Coarse sand with Soil with gravel Coarse sand with gravel
136.20		Clay, brown with limestone
142.29	***	Clay, brown with coarse sand
		Coarse sand, light brown
160.25		
161.30		Clay brown

	MRT.	11 POG A T00\J.J00
		rdyoa A, Bangkhen CH.Bangkok
•	B PEAEP 8.50	m. Started 20 February 1963
Capacity '	7.50 Cu.m/hr	Completed 5 March 1963
Hardness	132 P.P.M.	Scale 1:750
1.50	project tradition programs of the selection for the selection of the selec	Clay, black
4.50	· 1116	Clay, yellowish white and yellow
		Muddy clay, black with shells
15.75	0 1100	mund coult artice attentions
21.35		Clay, yellow with fine sand
	a construction and a second second second	
29.75		Small grain sand, red and yellow
	### ### ### ##########################	with fine sand
37.05		Clay, yellowish white with yellow fine sand
		Coarso sand, red
52.30		
57.80		Fine sand, white
21.00	and the second	
66.00		Clay, yellow with coarse white sand
	management of the control of the book of t	
73.65		Coarse sund, white and yellow with yellow clay
77.80		Small grain sand with fine white sand
0,4 0,4		Andreas
85.85		Coarse sand, red with yellow clay
91.95		Small grain sand, red and yellow
		Coarse sand, white and yellow
99.10	***************************************	
102.75		Clay, yellowish white with white and yellow coarse sand
116.35		Coarse sand, white and yellow
123.00		Clay, grey with white coarse sand
125:50		Fine sand, white
132.65		Clay, yellow with red small grain sand
	155 75 1	
		Coarse sand, red and white
1/4.25		
149.90		Clay, yellow with red sand
156.00	13/3/3/3/	Small grain coarse sand, red and white
* 70 *00		
ا المراجعة المواجعة المراجعة المواجعة المراجعة المراجعة المراجعة المراجعة المراجعة المراجعة المراجعة المراجعة ال		Coarse sand, white and yellow
166.50		
173.10	atana at	Clay, white with white and yellow coarse sand
		Sand, yellow and white
183.45	and the respective of the second	Static water level 8.20 ss.
•	• • • •	भूत्रकाच्यक्तक शब्दाच्याच्या व्यवस्थातः व्यवस्थात् व्यवस्थातः

Watmal, Nong Pracog, Tamble Suantuang, A Katumban

Changrad Samusakorn

Boring started: 19 August 1965

Boring Completed: 24 August 1965

	ATION	Scale: 1:750 Clay, black
300	the participation of the parti	
	S man D man ()	Muddy clay, black
12.00	0 0 0	Clay, yellow
16.00	arrange distant makes alexand distant	A003 2 A00444
		Fine sand, yellos
26.00	pateria article gista berenaa in anii 	Clay, yellow
30 . 80	And the state of t	Fine sand, yellow with clay
34.00		Clay, yellow
37.00		Clay, yellow with shale
39.40 46.10	amenta Bright	Area de des de la companya del companya de la companya della compa
10110	· · · · · · ·	Coarse sand with gravel
54.70	0.0.0	
60,20	garand byong Baran baran pama	Clay, yollow
		Small grained sand, white
		TREBUG BONDIAN DAILOR & LANDA
74.20	***	Small grained sand with yellow clay
78.00		Coarse sand, white and yellew
83.00		
41.00		Clay, yellew
41100		
		Coarse sand, yellew
120.00		
		A
107.7		Coars sand, white
112.00	Artis Bridge	Clay, yellow
	3 3 6 6 6 5	Asses and mallage
121.50		Coars sand, yellow
	and server	
400.00	many and an analysis	Clay, yeller
129.00 132.00	majorata di antidi Surannesti napor dinantalpari di surprisor di sala di di di di di di di di di	Coarso yelles send with clay
4 Ja 404	Andrew State	
138.00	4-44 24-44 4-44 	Clay, yeller
	-QO	Gravel with yellow clay
144.50	00	Contain thinking and an annual
ልዊት ትላ	standards Brooks	
154,40	Secure Secure Control Secure S	Clay, yellowish white
	anger process desired	61 wallan
162.00	agenda servida	Clay, yollow
167.60		Clay, yollow with shale
,	A triming and A section of monthly and	▼ ▼ ▼

WELL LOG 1-386/30-11

WAT BANGKUNIENNAT T. BANGMOT A. BANGKUNTIEN CH. THONBURI

Started 1 Feb. 1968
Completed II Feb. 1968
Scale I:1000

4.00		Clay, black
14.50	O series of interest of intere	Clay, yellow.
21.00	1	Clay, grey with shells
25.50	graphs prose graphs prove society and prove of some	Clay, yellow
42,50	0,710,771,0	Clay, yellowish white, with shells
		Coarse sand, yellow and white
49.00	galanda urum kend usahun kendang membenyanan mula usan sepanjukan pendapan	Clay, yellow
53.00		Clay, yellow with coarse sand
63.50		Coarse sand, yellow and white
70.50	m + 4 + 4 + 4 + 1	Clay, yellow with coarse sand
72.50		Clay, yellowish white
		Coarse sand, yellow and white
87.00		Coarse sand, yellow with Clay
92.00		Clay, yellow white and yellow
94.00		Coarse sand, yellow and white
18g:38		Clay, yellow white fine sand
111.00		Coarse sand, yellow and white
123.50		Clay, yellow
124.00		Clay, yellow white coarse sand
3.54.00		Coarse sand, yellow and white Clay, yellowish white with sand
144.20	B 44 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	Oley, you tours it will be wron band
150.00 152.30	A-100 CAL	Coarse sand, yellow and white, with gravel
155.10		Glay, yellow Glay, yellow, wallow, and white
164.50	10:0:00	Coarse sand, yellow and white, with gravel
170.50		Clay, yellow
175.20	1 . 4 44 . 4 4	Coarse sand, yellow and white
182.00		Clay, yellow
	0	
	D.	
	10 m.	
550.00	10.0.	
660.00	1	

TABLE CLIMATOLOGICAL DATA FOR METROPOLITAN BANGKOK (1)

	Jan.	Feb.	Mar	Apr.	May	June	J:12	Arg.	Sept.	j S	Nov.	Dec	Zear Tear
Temperature, °C					, .					****			
, दशम	36	36	07	86	33	37	38	35	35	*	*	35	07
202	2	9	17	20	22	22	22	뒪	17	20	97	11	01
Mean	26	28	58	ဗ္ဗ	8	53	28	88	58	83	27	26	83
Relative Humidity	er to see		•		· merri		*******	en ell un more de n	* ************************************	•••		· · · ·	
Percent (Mean)	2	76	7.2	77	80	8	88	8	\$	85		75	79
Evaporation	de compression and the			: :				****	• • .			1 8/141 9 11	
Millimeters (Fiche)	601	96	85 124 124	120	101	8	83	77	9	89	7/2	86	1087
Days of Reinfall	en en ensead				1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	• • • • • • • • • • • • • • • • • • •					·	*****	
Per Month	N	m	4	vo	. 57	44	8	2	23	60 r-1	•	ped .	133
Rainfall, Millimeters	gar bil a malan		** *						-*\ (4 <i>e)</i>	**********			•
Mean	φh	35		99	182	149	193	218	364	254	97	M	1549
Greatest in 24 nours	07	r r	9	¥2,	87	8	109	8	115	ឌ	45	ij	134
Wind Velocities			. 4.4.4					-Fijhu≏an I		•		***************************************	
Max: ½m/hr	57	69	8	75	. 78	80	80	ð	83	72	8	57	
Mean: km/hr	88	pol proj	72	정	2	뻔	(A	엄	Ø1	60	60	60	
			* * * * * * * * * * * * * * * * * * *										

(1) Station: Thre Nakhon

Latitude: 13° 44'N. Longitude: 100° 30'E.

Period: 2494 - 2508 (1951 - 1965)

Master Plan: Water Supply and Distribution, CDM, 1970.

6-7 Statistic of Ground Water

(1) Statistic of Ground Water Distribution in Central System (NWWA) from 1960 - 1976

Amount of Water Distribution

Year	E. Maria and Maria and Maria and Maria		***************************************		Total
	Bangkok (cum)	Thonburi (cum)	Nonthaburi (cum)	Samut Prakan (cum)	(cum)
1960	25,696,000	12,775,000	175,200	876,000	39,522,000
1961	50,516,000	12,775,000	182,500	1,051,200	64,524,700
1962	49,056,000	12,775,000	335,800	1,226,400	63,393,200
1963	51,100,000	12,775,000	1,058,500	1,810,400	66,743,900
1964	50,990,500	12,775,000	1,095,000	2,102,400	66,962,900
1965	14,495,650	12,775,000	1,401,600	2,102,400	30,774,650
1966	50,709,600	18,250,000	1,635,200	2,102,400	72,697,200
1967	87,619,392	24,090,000	1,879,750	2,102,400	115,691,542
1968	91,453,596	28,843,880	2,482,000	2,102,400	124,881,876
1969	81,438,800	21,931,025	5,743,275	4,036,900	113,150,000
1970	75,649,900	27,542,900	5,190,300	3,869,000	112,252,100
1971	83,979,200	27,459,100	6,299,900	3,429,300	121,167,500
1972	79,080,160	23,987,890	7,869,220	5,233,360	116,170,630
1973	95,597,386	23,595,187	7,927,941	5,295,185	132,415,699
1974	97,849,551	22,274,291	9,593,755	5,344,105	135,061,702
1975	95,406,968	17,657,125	9,487,383	5,467,548	128,019,024
1976	89,740,099	13,353,048	10,196,824	6,668,977	119,958,948

Year	Bangkok (cum/day)	Thonburi (cum/day)	Nonthaburi (cum/day)	Samut Prakan (cum/day)	Total (cum/day)
1960	70,400	35,000	480	2,400	270,480
1961	138,400	35,000	500	2,880	345,780
1962	134,400	35,000	920	3,360	367,880
1963	140,000	35,000	2,900	4,960	423,270
1964	142,800	35,000	3,000	5,760	573,685
1965	26,080	35,000	3,840	5,760	636,480
1966	93,000	50,000	4,480	5,760	725,740
1967	157,200	66,000	5,150	5,760	820,410
1968	213,500	80,000	6,800	7,760	887,560
1969	223,120	60,085	15,735	11,060	895,800
1970	207,300	75,500	14,200	10,600	917,500
1971	230,100	76,600	17,300	9,700	959,000
1972	216,700	65,720	21,600	14,500	1,061,020
1973	261,910	64,640	21,720	14,510	1,208,500
1974	268,080	61,025	26,285	14,640	1,222,645
1975	261,390	48,375	25,990	14,980	1,208,175
1976	245,190	36,485	27,860	18,220	1,178,825

(3) Statistic of Ground Water Production in Fiscal Year 1976

Naus	Ce	ipacity of Wat	er Distributio	n	C C 1 1 1 1 1 1 1 1 1 1
Date	Bangkok (cum)	Thonburi (cum)	Nonthaburi (com)	Samut Prakan (cum)	Total (cum)
Out 175	7,581,412	1,091,332	838,250	504,247	10,015,24
Nov 175	7,115,819	1,024,230	766,86 0	529,897	9,436,800
Dec 175	7,704,680	1,170,470	837,560	559,592	10,272,302
Jan '76	7,716,131	1,190,110	896,520	560,904	10,363,665
Feb 76	7,226,335	1,023,003	822,230	510,968	9,582,530
Mar '76	7,414,615	1,093,566;	893,460	628,561	10,030,20
Apr 176	7,368,040	1,162,925	948,960	577,122	10,057,04
May 176	7,703,843	1,139,739	965,580	558,363	10,367,52
June 176	7,314,777	1,112,300	848,160	553,701	9,828,93
Ju1y¹76	7,707,675	1,111,806	847,530	593,180	10,260,19
Aug 176	7,539,729	1,110,687	805,394	556,095	10,012,71
Sept'76	7,347,043	1,122,880	726,320	535,537	9,731,78
Total	89,740,099	13,353,048	10,196,824	6,668,977	119,958,948

Ref: Deep Well Div. Dept. of Production

Research: Development Div.

Reference No. ;

Date :

Subject ;

Feb. 4, 1977
Field Study of Separate System
Riviced Schedule - Feb. 7 - Mar. 25, 1977
K. Miyakura, T. Ogawa Reference

Prepared

Sect.	Date	Party 1 Electrical Prospecting Team	Party 2 Data Collection Team	Party 3 Water Supply Survey Team (Including Water Analysis)	Remarks
a de pro-	Feb. 7(Mon)	Office Work	Office Work	Sai Noi Field survey (Mr. Kawamura & Mr. Miyakura) Discussion about Additional Area	
1	8(Tue)	Field Survey Using L-10 & N-S	Same as left	Same as left	
	9(#ed)	Ditto Using L-10	Industrial Area of Bang Bo and Bang Phli	Bang Yai & bang Bua Thong Field Survey	
	10(Thu)	Using L-10	Industrial Area of Min Buri	Nong Kheem & Additional Area Field Survey	
2	11(Fri)	Ditto	Industrial Area of Nong Chok	Ditto and Water Analysis at Samsen T. Plant	
	12(Sat)	Analysis	Office Work	Office Work	
	14(Mon)	Field Survey Using N-S		Bang Bo, Bang Phli & additional Area Field Survey	
3	15(Tue)	Ditto Using N-S	Analys i s	Ditto	
	1.6 (Wed)	Ditto Using N-S	Analysis	Office Work	

}

sect.	Date	Party 1 Electrical Prospecting Team	Party 2 Data Collection Team	Party 3 Water Supply Survey Team (Including Water Analysis)	Remarks
ales of the second	17(Thu)	Analysis	Analysis	Nong Chok Field Survey	
4	18(Fri)	Analysis	Preparation of Summary Ground Water Report	Lat Krabang & Min Buri Field Survey	and the state of t
	19(Sat)	Analisis	Ditto	Office Work	
4 4	21(Mon)	Discussion & Party 1,2 &	Coordination 3	between	ar first om og anstalener og tilsten harrindelt og skape herselle å hanssammen.
5	22(Tue)	Ditto	maraman milit dan di sendari di silimini silan ayu yara sa da da daga gar paradar di sili sa ga sagar	ه ۱ ۱ ۱ ۱ ۱ ۱ ۱ ۱ ۱ ۱ ۱ ۱ ۱ ۱ ۱ ۱ ۱ ۱ ۱	The state of the s
	23(#ed)	Ditto	era erre til delig tilgetid stil för til er en det gerenn de tryunja jundet de til i ungder.	مىيى <u>دى ئى ئىسلىمىدىلى سىسى</u> قىرىل بىرىنى <u>سى</u> يود 1 قىياناتۇپ دىرى بۇلان قات دەرىدىدىلى توپۇ دىرى بۇلاندىدى	
6	24(Thu)	Conclision on nine (9) Amp Additional D	hoe including	Summary in every five (5)	A part of Svev. Team Leave for Japan.
	25(Fri)	Ditto	an mili marina saman ya 174 mili mijakutu a kata mijakutu kata ma ya mili mana kata mili sama kata mili saka k Kata mili marina sama ya 174 mili mili mili sama kata mili sama kata mili sama kata mili sama kata mili sama k	them the section of an action of the section of the	The control of the co
	26(Sat)	Ditto	re i di distribuce anti di Bi Milit Trope e seri i li i i i i i neme dispoliti di rispore di .	rt (darm) was the research Aussia selection of Grassey Angles (Armine) selection for the besides selection for Pr	A series de la companya del companya del companya de la companya d
7	Feb.28 Mar.12	(2) Construc (3) Selectio (4) Preparat	Study ion of Alterna tion Cost Esti n of Feasible ion of Draft R Japanese)	mation Plans	
8	14	(in	of Progress Re English) y Works and Da		Mar. 12, Dr. Naito Mr Okazawa Mr. Shiozawa in Bangkok
9	21 ₂₅	Discussion w about Progre	ith MWWAand DY ss Report	EC if necessary	The state of the s
nd delice philosophical color of	Mar.26	annestrikyty potytomotrikyty tytyty tytyty tytyty (a. p. c. a.		Marie Carlotte and the September of the	Leave for Japan

٠.

Reference No.: 2

Date ; Feb. 4, 1977

Subject; Field Study of Separate System

Reference : Request to MWWA

Prepared ; K. Miyakura

- (1) Data of 5 Test Wells which were already carried out at Lat Krabang, Min Buri and Nong Chok, mentioned as page 3 of Inception Report.
- (2) The latest population data of every 9 Amphur and Amphur Town.
- (3) The latest Survey Map (prepared in 1969) of 10 sets of each Amphur and 2 sets of central area.
- (4) To dispatch us 1 counterpart, who can test Dissolved Oxygen (DO.) at site on 11th Feb., at Klong Tawi Watthana.
 - And to arrange meeting with the Water Analysis Engineer in the afternoon on 9th Feb.

(5) Car Arrangement

i,

	Microbus	Car	Wagon
Party 1	7th-12th 14th-16th	San and the same of the same o	7th-12th 14th-16th
Party 2	*******	9th-1.1th	Admid
Party 3	7th-18th 1 Vehicle		Market part &
Party 4	Works State		•

Reference No.; 3

Date

; Feb. 4, 1977

Subject

Field Study of Separate System

Reference

; Organization of Survey Team

Prepared

; Dr. Naito, Mr. Okazawa

p all allungs and the staff of only blinds of south allungs about the succession of the staff of	and the second section of the section of t	ngantaine or announce grap and grap may decisive you, it has been been as the construction of the construc	And the Date of the State and the state of t
- 1		Combination A	Combination B
	Party 1. Electrical Prospecting	Mr. Muto(Chief) Mr. Varavut(Coun- terpart) 1 Geologist 4 Assistants	Mr. Muto(Chief) Mr. Varavut(Coun- terpart) 1 Geologist 4 Assistants
Manager	Party 2 Data Collec- tion on Water Resources		Dr. Ogawa(Chief) Mr. Miyakura Mr. Takemoto Mr. Borrirak (Counterpart)
(Mr.Kawamura)	Party 3 Planning of Water Supply Systems	Mr. Miyakura., (Chief) Mr. Nakamura Mr. Takemoto Mr. Komatsu Mr. Prasat	Mr. Miyakura (Chief) Mr. Nakamura Mr. Kawabata Mr. Hashizi Mr. Komatsu Mr. Prasat (Counterpart)
	Party 4 Economic Analysis & Financial Program T	Mr. Kawamura (Chiof) Mr. Kawabata Mr. Hashizi Miss Tidachan (Cour	ıterpart)

Rof	eronce No.; 4
Dat	
	ject ; Field Study of Separate System
	'erence ; Request to Industrial Estate Office & Housing Proje
	pared; Office Mr. Kawamura & Mr. Miyakura
1.	Location shown on the map
	(1) Existing
	(2) Future
2.	Water Supply for Factory
	(1) Existing Condition
	(2) Future Planningwhether will include to Separate
	System or not
3.	Water Supply for Worker
<i>3</i>	(1) Existing Condition
	(2) Future Planningwhether will include to Separate
	System or not
4.	Water Supply for Surrounding Area of Industrial District
	(1) Existing Condition
	(2) Future Planningwhether will include to Separate
	System of not
5.	Water Demand Estimate
	(1) Existing Condition
	i) Factory
	(a) Number of Factories
	(b) Typo of Factories & Each Ratio
	(¢) Water Demand in Seasonaly, Daily, Hourly in detail
	it) Worker
	(a) Working Time
	(b) Number of Workers/2

- (c) Water Demand in Seasonaly, Daily, Hourly, in detail iii) Persons, Surrounding Area
 - (a) Population
 - (b) Water Demand in Seasonaly, Daily, Hourly, in detail

(2) Future

- i) Factory
 - (a) Number of Factories according to future planning year by year until 2000 AD
 - (b) Type of Factories & Each Ratio according to future planning year by year until 2000 AD
 - (c) Water Demand according to future planning year by year until 2000 AD, in Seasonaly, Daily, Hourly, in detail

Lii) Worker

- (a) Working Time in future
- (b) Number of Workers according to future planning year by year until 2000 AD
- (o) Water Demand according to future planning year by year until 2000 AD, in Seasonaly, Daily, Hourly, in detail
- (iii) Persons Surrounding Area
 - (a) Population according to future planning year by year until 2000 AD

(cum)

(m)

6. Existing Deep Well

Name of Industrial District:-

(6) Capacity of the Elevated Tank

(7) Effective Water Level

พลาา

W G.J. J.	
(1) Diameter	(mm)
(2) Depth of the Well	(m)
(3) Static Water Level	(m)
(4) Operating Water Level	(m)
(5) The Year of Construction	
Pump & Elevated Tank	
(1) Type of Pump & Number	
(2) Diameter of Section Pipe	(mm)
(3) Capacity of the Pump	(cum/min)
(4) Lift Head	(m)
(5) Operating Time	(hr/day)

Reference No.; 5

Date

Feb. 9, 1977

Subject

Field Study of Separate System

Reference

; Water Quality Analysis

Propared

; Mr. K. Miyakura, Mr. Takemoto

Schedule -	Klong Tawi Watthana Sampling 1300. 0, 1277
	1 Field Work (1) Water Sampling for i) usual test ii) jar test
Feb.11(Fri	(2) Water Sampling for BOD 5 i) sample for present dissolved oxygen (DO) - 100 ^{ml} incubation bottel x 2 (Necessary to fix DO at site) ii) sample for 5-day DO-100 ^{ml} incubation bottle x 3 (Not necessary to fix DO at site)
	2 Laboratory Work measuring fixed DO value x 2
Feb.12(Sat)	1 Usual Water Quality Analysis
Feb.15(Tue)	2 Jar Test
Feb.15(Wed)	1 Measuring 5-day DO value x 3
	2 Calculation BOD ₅

List of Equipment on Feb. 11, 1977

- (1) P.V.C. Bottle; 5^1 , capacity x 1
- (2) Incubation Bottle; 100^{ml} capacity x 15
- (3) Chemical: Manganese Sulfate Solution (Mn 804) Alkali - iodide
- (4) Others: Incubation bottle storage Pipet

Reference No.; 6

pate : Feb. 10. 1977

Subject ; Field Study of Separate System

Reference ; Minutes of Meeting; Additional Industrial Area

Prepared ; K. Miyakura

Attendants; Japanese Survey Team: Mr. K. Kawamura

Mr. K. Miyakura

Industrial Estate Authority: MR. JAROEN VATTASINGH

Place ; Meeting Room of Industrial Estate Authority

Discussion; Ahead of the discussion, Japanese Survey Team expressed purpose of visit to Industrial Estate Authority. The meeting carried out for one hour.

Following are summary content of meeting.

1. General Condition of Industrial Area.

There are 5 industrial area to supply water mentioned bellow as a part of Seperate System.

- Bang Chan, near Min Buri
- Min-Buri near Lat Krabang
- Bang Phli Bang Poo.
- Dang roo.
- ; Klong Dan, near Bang Bo

Among these only Bang Chan is existing industrial area and others are future planning.

As a past, Record of Water Consumption at Bang Chan was about 4,000 cum/day.

2. Another Informations

As for the another informations such as existing well date, number of factories according to future planning, will be given to Japanese Survey Team at the beginning of next week.

Reference No.; 7

Date ; Feb. 14, 1977

Subject ; Field Study of Separate System

Reference ; Minutes of Meeting; Additional New Airport

Prepared ; K. Miyakura

Attendants; Japanese Survey Team: Mr. K. Kawamura

Mr. K. Miyakura

Department of Commercial Aviation: Dr. Boonsorn Boonsukha

(Director General)

Place ; Meeting Room of Department of Commercial Aviation

Discussion; Ahead of the discussion, Japanese Survey Team expressed purpose of visit to Department of Commercial Aviation. The meeting carried out for one hour.

Following are summary content of meeting.

1. General Condition;
Feasibility study of new airport will carry out
from Feb. 1977 to Dec. 1977 with the joint-venture
between T.A.M.S. (The American Consultants) and
T.E.C. (That Engineering Consultants).

Proposed site of new airport is near Amphoe Lat Krabang and four km. away from super highway.

This airport will have two runway with the length of four km. each.

2. Number of Passengers of DON-MUANG Airport; Number of passenger of don-muang airport is 4,200,000 person per year including transit.

Reference No.; 8

Date

Feb. 16, 1977

Subject

Field Study of Separate System

Reference

Minutes of Meeting: Additional Housing Project

Prepared

K. Miyakura

Attendants: Japanese Survey Team;

Mr. K. Kawamura

Dr. T. Ogawa

Mr. S. Komatsu

Mr. Y. Nakamura

Mr. E. Kawabata

Mr. K. Miyakura

Mr. T. Hashizi

Mr. H. Takemoto

National Housing Authority;

Mr. Sidhijai Tauphiphat Mr. Thitanon Pibulnakarin

Place ; Office of Japanese Survey Team.

Discussion; Ahead of the discussion, Japanese Survey Team expressed purpose of meeting to National Housing Authority.

The meeting carried out for one and half hours.

Following are summary content of meeting.

General Condition;
 National Housing Authority will carry out five housing projects which have relation to separate system.

Those proposed districts are follows;

- (1) Left bank of Chao Phya; Minburi, Lat-Krabang, Bang Phli - Bang Bo and Bang Poo
- (2) Right bank of Chao Phya; Bangkumtien
- Water Consumption Ratio; Water consumption per capita per day is 2001itre/ capita day.
- 3 Date Collected;

(1) population year by year

(2) Number of workers in combined district where housing and factory are belonging together.

Reference No.: 9

Date

: Fob. 15, 1977

Subject

; Field Study of Separate System

Reference

: Information of Water Sources

Prepared

; Mr. Ratana, Mr. K. Miyakura

Source of Information:

Chief of Water Resource Distribu-Mr. Chatchaval: tion Center, RID

Right Bank of Chao Phya River 1.

> R-1; Khlong Thawi Wattana

(1) Flood Season - 2cum/sec = 172,800cum/day

(2) Dry Season - Ocum/sec

(3) Necessary to negotiate with RID

- R-2; Khlong Maenum Om (near Chao Phya River) Less than 0.loum/sec = 8,640cum/day is available for separate system.
- R-3; Khlong Phra Phimol no flow capacity
- Left Bank of Chao Phya River 2.
 - L-1; Khlong Phraongchao Chaiyanuchit

(1) no flow capacity for separate system

(2) Necessary to negotiate with RID

L-2: Khlong Phra Khanong

(1) Less than 0.1cum/sec = 8,640cum/day is available for separate system

(2) Be careful water pollution

L-3; Khlong 6th Less than 0.1cum/sec = 8,640cum/day is available for separate system

L-4; Khlong 13rd (Transmission Canal)

(1) Flood Season - 20cum/sec = 1,728,000 cum/day

432,000

- 5cum/sec = (2) Dry Season cum/day

23,6,000 (3) Less than 2.5cum/sec cum/day is available for separate system

Reference No.; 10

Date ; March 4, 1977

Subject ; Field Study of Separate System

Reference ; Request to MWWA

Prepared ; Mr. K. Miyakura

- (1) The latest population date of every 9 Amphoe and Amphoe Town, already requested Reference No. 2 on Feb. 4, 1977.
- (2) Basic data for amortization schedule:
 - i Personal expenditure (per month) of each occupations
 - Super Intendant
 - Senior Engineer
 - ~ Junior Engineer
 - Mechanios
 - Workers
 - ii General management expenditure such as repair expenditure etc.
 - iii Running cost for Treatment Plant itself
 - Power Cost per KWH
 - ~ Chemical Cost per cu.m.
 - . Alum
 - . Lime
 - Chlorine
- (3) The basic line of the land elavation shown on the map which prepared your authority.
- (4) The below mentioned tidal lange of Gulf of Thailand or somewhere else with relating to the basic line mentioned item (3);
 - i High sea water level.
 - ii Mean sea water level
 - tii Low sea water level
- (5) Reports
 - 1 Ground Water Level in Bangkok prepared by Ground Water Division Department Industry.
 - ii Results of test boring at Bang Bo, carried out your authority.

ili Capacity of existing deep well industries & Central System area from 1960 to 1976, if any.

