おいては、専門家の分野を、チーフアドバイザー、調整員と、土木・衛生・化学または生物・機械・電気等の専門家（長短は区別せず）とした。

専門家派遣計画の確定は、研修ニーズ等の今後の調査によるが、今回の調査と日本側の派遣負担を考慮すると、長期専門家は、チーフアドバイザー、調整員、衛生または土木、機械、水質の５人程度とし、それ以外の分野は、短期専門家数人／年で対応することがひとつの方向と考えられる。その際、タイ国側の研修ニーズの一部はかなり緊急なことから、カリキュラム・シラバス作成、教材作成の負担が大きい１、２年目は、各長期専門家のカバーしきれない細分野を含めて短期専門家を厚く派遣する必要がある。また、長期専門家のうち１人（処理場運転管理全般の指導ができる水質または機械担当が望ましい）は、BMAブランチを主務とすることが考えられる。

なお、研修ニーズの緊急性に加え、下水道研修センターの入るTTI本館は４月に完成予定であることから、無用の混乱を避けるためにも、日本側が実施計画の策定、準備段階から十分参加できるよう、２月の建築工事最終変更前に専門家や機材の概略配置計画案を先方に通知の上、長期専門家グループは95年度（平成７年度）早々着任することが望ましい。

10－４　研修員受入れ計画

要請資料では、年間３人程度とのみ記載されているが、質問書（クエショネア）回答、及び、タイ国側基本計画案では、教官３～５人を２～４ヵ月程度受入れることを希望するとともに、関連集団コースとして、「下水道技術」「生活排水処理」「都市排水」「下水道維持管理」を挙げている。当方から個別研修も必要ではないかと問うたところ、逆に下水道マネジメントコースが欲しいとの要望を受けた。先方要望は規模としておおむね妥当と考えられるので、活動内容を議論の上、受入れ負担も考慮し、集団コースと個別プログラムの組み合わせの可能性も含め、確定する必要がある。

また、早急に、所長他１人を日本の下水道研修事情見学のため受入れて欲しい旨、強く要望があった。R/D調印前の受入れは本件プロジェクトとしては制度的に不可能であるが、これは、このプロジェクトを立ち上げる上で、極めて有効と考えられるので、何らかの別スキームでの対応が望まれる（なお、個別専門家C/P研修は対象者が内定済みのため無理とのこと）。

10－５　機材供与計画

要請資料では、水質分析機器の他、視聴覚機材、コンピュータ関係、テキスト、補足機器、デモ・プラント、ポンプ等モデル、文献、車両等、計２億５千万円と想定されていたが、今回のタイ国側基本計画案では、PWD本部側とBMAブランチ側の必要機材リスト

（要請段階とほぼ同分野、車両を除く）を集計したところ５億１千万円となっている（表－14参照）。

これについては、研修内容などの活動内容を確定したうえで、機材専門家による詳細検討やタイ国側との議論を経て確定するが、特に初年度機材については、調達方法なども含めて早急に確定が必要である。また、現在進行中の建築工事とのすりあわせも急がれる。

なお、機材の詳細設定に当たっては、環境研究研修センターでの機材利用状況等も参考にすることが望ましい。

表－14 NECESSARY EQUIPMENT FOR TCSW

G. TOTAL 511,264
(Thousand yen)

	PWD	BMA	TOTAL	U. PRICE	PRICE
1. AUDIO EQUIPMENT			TOTAL		19,640
* FOR LECTURE ROOMS					
1) Microphone and Speaker	3	1	4	595	2,378
2) VTR and Projector	3	1	4	3,010	12,040
3) OHP	3	1	4	232	928
4) Slide Projector	3	1	4	152	608
* FOR MEETING ROOM					
1) Simultaneous Interpretation	1		1	3,491	3,491
2) Microphones	5		5	18	90
3) Speakers	1		1	24	24
4) Amplifier	1		1	80	80
2. EQUIPMENT FOR PRACTICE			TOTAL		30,462
1) Drawing Equipment	25		25	20	500
2) Surveying Equipment	10		10	609	6,092
3) Pump	1		1	5,270	5,270
4) Surface Aerator	1		1	2,500	2,500
5) Blower & Diffuser	1		1	5,400	5,400
6) Belt-press Dehydrater	1		1	3,620	3,620
7) Measuring Equipment	1		1	3,630	3,630
8) Control Circuit	1		1	3,450	3,450
3. EQUIPMENT FOR WATER QUALITY ANALYSIS			TOTAL		216,050
1) LABORATORY FURNITURE & FACILITIES			SUB TOTAL		76,200
* Center Tables	10	5	15	1,500	22,500
* Side Table	10	5	15	200	3,000
* Balance Table	4	4	8	300	2,400
* Sink	4	2	6	300	1,800
* Hume Hood	4	2	6	3,000	18,000
* Exhaust Gas Washer	2	1	3	5,000	15,000
* Storage Cabinet	4	2	6	400	2,400
* Bottle Cabinet	2	1	3	300	900
* Drying Shelf	4	2	6	500	3,000
* Laboratory Chair	40	20	60	20	1,200
* Waste Fluid Treatment Apparatus	1	1	2	2,500	5,000
* Others(Case, Cart, Work Table, etc.)			1	1,000	1,000
2) LABORATORY INSTRUMENT			SUB TOTAL		40,950
* Ultrasonic Cleaner	2	1	3	1,800	5,400
* Refrigerator(L)	2	1	3	300	900
* Refrigerator(M)	2	2	4	100	400
* Water Purifier	2	1	3	1,500	4,500

* Drying Oven	4	2	6	400	2,400
* Low Temp. Incubator	4	2	6	1,000	6,000
* Incubator	2	1	3	500	1,500
* Drying Sterilizer	2	1	3	400	1,200
* Autoclave	2	1	3	500	1,500
* Water Bath	2	2	4	400	1,600
* Muffle Furnace	2	2	4	700	2,800
* Distillation Equipment	2	1	3	600	1,800
* Vacuum Pump	2	2	4	150	600
* Hot Plate	2	1	3	150	450
* Centrifuge	2	2	4	500	2,000
* Shaker	5	2	7	300	2,100
* Evapolator	5	2	7	200	1,400
* Disiccator	5	3	8	300	2,400
* Others(Mixer, Stirrer, Heater, Pump)			1	2,000	2,000
3) ANALYTICAL EQUIPMENT				SUB TOTAL	88,900
* pH Meter	10	10	20	200	4,000
* DO Meter	10	10	20	600	12,000
* Spectrophtometer	2	1	3	2,000	6,000
* A.A. Photometer	2	1	3	10,000	30,000
* Analytical Balance	4	4	8	300	2,400
* Balance	4	4	8	200	1,600
* Moisture Balance	4	4	8	250	2,000
* Microscope(with VTR)	2	1	3	3,500	10,500
* Ion Chromatgraph	2	1	3	4,000	12,000
* Gas Chromatgraph	2	0	2	3,000	6,000
* Recorder	4	4	8	300	2,400
4) GLASSWARE			1		10,000
4. DEMONSTRATION PLANT				TOTAL	100,000
1) Oxidation Ditch	1				
2) Aerated Lagoon	1				
3) Stabilization Pond	1				
4) RBC	1				
5. EQUIPMENT FOR FORMATION TEACHING MATERIAL				TOTAL	28,416
1) Video Camera	4	1	5	100	500
2) Camera	4	1	5	100	500
3) Personal Computer and Printer	4	1	5	683	3,416
4) Personal Computer and Slide Projector	2	1	3	8,000	24,000
6. TEXTBOOK FORMATION					30,000
7. BOOKS					10,000
8. DATA BASE	1		1		43,000

9. SUPPLEMENTARY EQUIPMENT					19,860
1) Copy Machine	2	1	3	500	1,500
2) Color Copy Machine	1	1	2	3,840	7,680
3) Facsimile	1	1	2	340	680
4) Others			1		10,000
10. VEHICLES				TOTAL	13,836
1) Mini Bus (25seats)	1		1	6,800	6,800
2) Micro Bus (12seats)	2		2	2,448	4,896
3) Van	1		1	2,140	2,140

11. 相手国との協議結果

11－1　Basic Planに関する協議

第1回事務レベル協議（座長：TTI Deputy Director、BMA側も同席）において、タイ国側要請書の内容をリバイスしたBasic Plan for TCSWが提示された（ミニッツのAnnexとして添付)。この内容について日本側から、プロジェクト開始にむけて必要となる情報を聴取した。この中で機材供与額が5億円と要請されたが、日本側から品目のプライオリティーをつけて整理する必要がある旨申し伝えた。また、専門家の派遣分野とその根拠となる研修コースの分野、内容については、日本側がこのBasic Planをタイ国側案として持ち帰り、その実現可能性につき検討することとした。

Basic Planについては、SED/PWDが中心となって作成し、本計画が本格化してからTTI/PWDに引き継がれた経緯から、TTIスタッフ自身がその内容を十分に理解していない点が見受けられた。また、BMAとPWDとの協力関係業務分担について、十分な整理がされていない点もあり、今後、TTIが実施機関として主体的にプロジェクト開始への準備に取り組むことが期待される。

C/P配置については、タイ国側よりBMA－4、5人（パートタイム)、PWD/TTI－5人、SED－3人、MRD－1人、の配置予定である旨の説明があり、当方から、BMAについてはフルタイムC/Pの配置を行うよう依頼すると同時に、決定済みのC/Pについてはネームリストの提出を依頼した。(本報告書附属資料として添付)

11－2　PCMワークショップ

第1回事務レベル協議の席上で、今回実施予定のPCMワークショップの目的と内容の概要説明を行ったところ、タイ国側から、要請書、Basic Planを既に提出している現状でワークショップを行うのは、どのような意味をもつのかと質問があった。これに対し日本側から、本ワークショップの主たる目的は、現状の問題を整理し、問題解決への最適アプローチを参加者の総意で考えていくことであり、あくまで要請書、Basic Planを念頭に置きつつ実施することを説明し、タイ国側の理解を得た。ただし、この点は団内でも議論があり、プロ技スキームから逸脱したアプローチが出てきた場合の対処法をどうするか、ミニッツに添付するときの位置付けをどのようにするかを団内で検討した。その結果、今回のPDMは、あくまでワークショップの成果として位置付けし、プロジェクトのマスタープランはPCMワークショップの結果に依拠するが、実現可能なマスタープランという点では、一致しないこともありうるということで合意した。これは、ワークショップに参加したのが実施担当者レベルであり、決定権を持つレベルの人物が出席できなかったことにも起因する。

実際のワークショップは1日半をかけて実施した。参加者及び成果はミニッツAnnex 2－1～2－5のとおりである。

このワークショップの結果、

プロジェクト目標：TCSWの機能、活動が確立する。

プロジェクト成果：①TCSWの運営体制が確立される　②技術者、研究者、技能者、運営者が養成される　③データベースシステム開発が準備されている　④研究・開発が始まる

という点をはじめとするPDM上の各項目が確認された。これらは、結果的に、要請書の内容及び日本側が事前に検討していた腹案とほぼ同じものとなった。しかしながら、時間的制約から、PDMのうち指標及び指標入手手段の部分については未記入のままとなった。

当初、先方の英語力などが心配されたが、マニュアルのタイ語版の配布（タイ事務所作成）などもあり、タイ国側からもかなり積極的な参加が見られた。また別添のアンケート結果に見るようにPCM手法への評価はおおむね高かったといえよう。

11－3　ミニッツ案の協議

今回調査団では、必要協議事項についてあらかじめ日本側でミニッツ案を用意し、先方に提示し、説明を行うとともに協議を行った。当初、PWDから、サイナーはRequesting AgencyとしてのPWDだけで十分であり、BMAのサインは必要ないとの意向が示されたが、これに対し日本側は、BMAのBranch Centerもセンターの一部として機能すること、機材も設置されることから、BMAのサインをCo-Signerとして載せる必要性を主張したところ、最終的には先方の理解を得ることができた。

この他タイ国側から、日本大使館が参加するJoint Coordinating Committeeは、Steering Committeeより位置付けが上になることになり、承知できない旨の主張があったが、このCommitteeは日本側とタイ国側の調整を目的とするものであり、機能が異なるだけであって、位置付けの上下は存在しない旨説明し、理解を得た。

また、Joint Coordinating Committeeのタイ国側代表者をDirector General of PWDではなくDeputy Directorにしたいとの要望がタイ国側からあったが、原案どおりとするかわり、Head of Thai sideをつけて標記することにより、位置付けを明確化した。

12. 技術協力の妥当性

高度成長政策を取り続けてきたタイ国が今直面する問題は多岐にわたるが、その中でも環境保全の問題は深刻で、陸、海、空に問題は広がりつつある。こうした中で、大気汚染、ごみ処理、水質汚染と、数多くの問題を抱える首都及び地方都市で、近年注目を浴びてきたのが下水道の問題である。とりわけ首都バンコクにおいては、ようやく慢性的洪水に対する対応策が確立された昨今、運河や地下水をはじめとする市内の水の汚染が深刻の度を増し、早急な対応策が求められるようになった。

現在内務省公共事業局、バンコク首都圏庁が、国家政策に沿って、水質汚染の主な原因とされる都市生活排水対策の下水道整備事業を推進している。しかしながら、これまであまり重視されなかった本分野における人材の不足は覆うべくもなく、大規模な下水道施設整備のためには、計画、設計、建設、運営、維持管理等の技術者の大量確保が必須かつ急務である。

こうした現状を踏まえ、調査団は先方の要請の背景把握、要請内容の検討、緊急性、先方の本件にかける熱意、実施能力、公共事業局とバンコク首都圏庁との関係、準備状況等を鋭意調査検討した。幸い、現在複数の日本人下水道関係専門家が現地で活躍しており、こうした専門家の意見も聴取し、かつ河川・運河の状況、住民の水とのかかわり、下水道・処理施設等の視察も行った結果、事態は深刻であり、何らかの手を早急に打つべきであるとの結論に至った。同時に現在タイ国側に最も不足しているのは人的資源であり、これを解消するには何らかの組織的かつ計画的方策が策定されねばならないと考えられた。タイ国側自身もこのことを強く感じており、先方の用意したBASIC PLANにおいても、また今回特に実施したPCMワークショップにおいても、こうした点は十分に実証されたところである。

タイ国は既にわが国の無償資金協力対象国としての位置は卒業済みであり、この事実を考慮に入れれば、人材の継続的育成体制の確保にはプロジェクト方式技術協力が最適であることは明らかである。現にタイ国側では、既に研修センターの建設を鋭意進めており、来年半ばまでには主要な部分の完成が見込まれている。こうした事実と、上述の諸点を勘案した結果、事前調査団の結論としては、プロジェクト方式技術協力の必要性と期待される成果を考慮して、わが国の技術協力実施の妥当性を確認するところである。

附　属　資　料

・ミニッツ

・ワークショップアンケート結果

・現地コンサルタント報告書

ミニッツ

MINUTES OF DISCUSSIONS
BETWEEN THE JAPANESE PRELIMINARY STUDY TEAM
AND THE AUTHORITIES CONCERNED OF THE KINGDOM OF THAILAND
ON THE JAPANESE TECHNICAL COOPERATION FOR
THE TRAINING CENTER FOR SEWAGE WORKS PROJECT

In response to the request of the Government of the Kingdom of Thailand, the Government of Japan decided to conduct a Preliminary Study on the Training Center for Sewage Works Project (hereinafter referred to as "the Project"), and the Japan International Cooperation Agency (hereinafter referred to as "JICA") sent the study team (hereinafter referred to as "the Team"), headed by Mr. Akira KASAI from 6th December to 17th December, 1994. During its stay in Thailand the Team had a series of discussions and held a workshop with the authorities concerned of the Kingdom of Thailand and also made field study at the relevant sites and facilities.

As a result of the discussions, both sides came to the understanding concerning the matters referred to in the document attached hereto.

Bangkok, December 15, 1994

Mr. Akira KASAI
Leader,
Preliminary Study Team,
Japan International
Cooperation Agency,
JAPAN

P. Sutabutr

Mr. Prajaya SUTABUTR
Director General,
Public Works Department,
Ministry of Interior,
THE KINGDOM OF
THAILAND

Mana Noppun

Co-Signer
Mr. Mana NOPPUN
Director General,
Department of Drainage
and Sewerage,
Bangkok Metropolitan
Administration,
THE KINGDOM OF
THAILAND

ATTACHED DOCUMENT

I .Formulation of the Project

For the purpose of clarifying the present problems in sewage works and identifying the objectives of the Project, the Team and the Thai side held a two-day consecutive Project Cycle Management (PCM) Workshop. Prior to the Workshop, "Basic Plan for Training Center for Sewage Works (Draft)" was presented by the Thai side. Through the Workshop, the participants recognized that the following issues were significant for the formulation of the Project. Attendance of the workshop is shown in Annex 2-1.

1. Findings from Participation Analysis

Participation Analysis was made to identify the people and institutions concerned in the Project. The results of the analysis are shown in Annex 2-2.

2. Findings from Problem Analysis

Problem Analysis was proceeded to identify and organize the existing problems in the sector of sewage works.

The problem "Insufficient Sewerage Technology" was selected as the core problem, and the participants confirmed that the following four problems were the significant direct causes of the core problem.

(1) Sewerage technology is not systematized
(2) Appropriate sewerage technology is not established
(3) Lack of qualified sewage works manpower (in government and private sectors)
(4) Little experience in sewage works

Outcomes of Problem Analysis are shown as the Problem Tree in Annex 2-3.

3. Findings from Objectives Analysis and Alternatives Analysis

Objectives Analysis was made to seek the means for solving the problems identified in Problem Analysis. The results are shown as the Objective Tree in Annex 2-4.

Objectives Analysis was followed by Alternatives Analysis, in which the contents of technical cooperation were examined. As a result, the areas of the project functions/activities were confirmed as shown in the circles which were drawn on the Objectives Tree in Annex 2-4.

4. Project Design Matrix

Based on the information obtained through the above-mentioned analytical procedures, the participants formulated the Project Design Matrix (PDM) for the Project as shown in Annex 2-5. This PDM shows a summary of the project design and describes the major project components such as Project Purpose, Overall Goal, Outputs, Activities, Assumptions, necessary Inputs, as well as the logical relationships between and among them.

Ⅱ .The Master Plan for the Project

For the formulation of the master plan for the Project, both sides confirmed the followings tentatively as the major items of the plan.

1.Project Title

Training Center for Sewage Works (TCSW)

2.Objectives and Activities of the Project:

(1) Overall Goal

Appropriate sewerage technology is established and sewage works are properly planned, designed, constructed, operated and maintained.

(2) Project Purpose

Functions and activities of TCSW are established.

(3) Outputs of the Project

1) Management of TCSW is established
2) Engineers, scientists, technicians and administrative staff are trained
3) Data-base system development is prepared
4) Research and development (R&D) activity is set up

Mana

(4) Activities of the Project

The symbol (T) refers to the activity which is to be executed exclusively by the Thai side, and (JT) refers to the activity which is to be executed by both Japanese and Thai sides.

1)-1 (T) Set up Steering Committee
1)-2 (T) Recruit staff for TCSW
1)-3 (T) Personnel management
1)-4 (T) Financial management

2)-1 (T) Recruit trainers
2)-2 (JT) Train trainers
2)-3 (JT) Set up training programs
2)-4 (JT) Develop training curriculum
2)-5 (JT) Develop training materials
2)-6 (T) Train sewerage engineers, scientists, technicians and administrative staff

3)-1 (JT) Make a plan for data-base system
3)-2 (T) Collect documents / data
3)-3 (JT) Categonze the documents / data
3)-4 (T) Serve for proper use

4)-1 (JT) Develop research and development program
4)-2 (JT) Prepare research and development facilities

3.Duration of the Project

The duration of the Project will be five years, commencing from the designated date to be stipulated in the Record of Discussions of the Project signed between the Thai authorities and the JICA Implementation Study Team.

4.Administration of the Project

(1)Responsible Agencies

Public Works Department, Ministry of Interior (hereinafter referred to as "PWD") will take overall responsibilities for the TCSW as the requesting agency, and Bangkok Metropolitan Administration (hereinafter referred to as"BMA"), will closely cooperate with PWD to support the Project, based on the memorandum about "Establishment of Training Center for Sewage Works (January 21,1993)" between the two organizations.

(2) Relevant Authorities of the Project

The relevant authorities of the Project is shown in Annex 3.

(3) Committees

For the smooth management of the Project, the following Committees will be established.

1) Steering Committee

a.Function

To make proper operation of TCSW, the Steering Committee issues its policy on the activities of TCSW. The chairman of the Steering Committee is responsible for the implementation of the Project.

b.Composition

· Director General of PWD	Chairman
· Deputy Director General of Department of Local Administration	Member
· Chairman of National Municipal League of Thailand	Member
· A representative of Department of Technical and Economic Cooperation (DTEC)	Member
· A representative of the Budget Bureau	Member
· Director General of Department of Drainage and Sewerage (DDS) of BMA	Member
· Director of Water Quality Control Division,DDS/BMA	Member
· Director of Dhamrong-Rajanuparb Institute	Member
· Director of Sanitary Engineering Division/PWD	Member
· Director of Technical Training Institute (TTI)	Member/Secretary
· Director of TCSW (Deputy Director of TTI)	Member/ Assistant Secretary
· Chief Advisor of Japanese Experts	Member

2) Joint Coordinating Committee

a.Function

To make proper operation of TCSW, the Joint Coordinating Committee will deal with the followings:

· To formulate the annual work plan of the Project

· To review the overall progress of the Project, and to evaluate the achievement of the objectives

· To find out proper ways and means for the solution of the major issues arising from or in connection with the Project

Mana

b.Members

-The Thai side-

- Director General of PWD (Head of the Thai side)
- Director General of DDS of BMA
- A representative of DTEC
- Director of TTI
- Director of TCSW and other persons concerned

-The Japanese side-

- Chief Advisor of Japanese expert team (Head of the Japanese side)
- Coordinator of Japanese expert team
- Japanese experts
- A representative of Embassy of Japan
- A representative of JICA Thailand Office
- Members of JICA study team and other persons concerned

5.Site and Facilities for the Project

The Project will be implemented in TCSW, in Pratunam Pa-In, Ayuttaya Province and in BMA Branch Center at Si Phraya Wastewater Treatment Plant.

Ⅲ.Measures to be Taken by Both Sides

For the implementation of the Project, both sides will take necessary measures described below.

1.Measures to be Taken by the Japanese Side

(1) Dispatch of Experts

The Japanese side will dispatch the following necessary experts :

1) Chief advisor
2) Coordinator
3) Experts in the field of civil engineering, sanitary engineering, chemistry or biology, mechanical engineering, electrical engineering and others

(2) The Japanese side will receive Thai counterparts in Japan for training.

(3) The Japanese side will provide necessary equipments for the Project. Detail of the items of equipments will be decided through the further discussion between both sides.

Maina

2.Measures to be Taken by the Thai Side

(1) The Thai side will assign the necessary number of qualified personnel, including counterparts.

(2) The Thai side will secure the facilities of TCSW including BMA Branch Center.

(3) The Thai side will secure the budget for recurrent expense.

Ⅳ. Other Relevant Issues

1.Actions for Commencement of the Project

(1) The Implementation Study Team will follow up the Preliminary Study Team on condition that the recommendation of the Team for the Project to the Government of Japan is accepted.

(2) The Thai side will proceed the necessary arrangements for the smooth commencement of the Project.

2.Mutual Consultation

There will be mutual consultation between the two governments on any major issues arising from or in connection with this document.

Annex

1: LIST OF ATTENDANCE OF MEETINGS

2: PCM WORKSHOP OUTCOMES

2-1 WORKSHOP ATTENDANCE LIST

2-2 PARTICIPATION ANALYSIS

2-3 PROBLEM ANALYSIS

2-4 OBJECTIVES ANALYSIS AND ALTERNATIVES ANALYSIS

2-5 PROJECT DESIGN MATRIX

3: RELEVANT AUTHORITIES CHART OF THE PROJECT

4: ORGANIZATION CHART OF TCSW

5: BASIC PLAN FOR TRAINING CENTER FOR SEWAGE WORKS (DRAFT)

Mana

LIST OF ATTENDANCE OF MEETINGS

JAPANESE PRELIMINARY STUDY TEAM

Mr. Akira Kasai	Leader (JICA)
Dr. Shunsoku Kyosai	Member (Ministry of Construction)
Mr. Nobuyuki Horie	Member (Housing and Urban Development Corporation)
Mr. Masayuki Hirabayashi	Member (Japan Sewage Works Agency)
Mr. Motoharu Watanabe	Member (JICA)
Ms. Takako Haraguthi	Member (Global Link Management Inc.)

JICA THAILAND OFFICE

Mr. Toshio Asano	Deputy Resident Representative
Mr. Yoshiharu Yoneyama	Assistant Resident Representative

JAPANESE EXPERTS

Mr. Hiroyuki Fujimoto	SED, PWD
Mr. Kazuyuki Ono	MRD, PWD
Mr. Tsuyoshi Yanagi	DDS, BMA

PWD

Mr. Prajaya Sutabutr	Director General
Mr. Sujin Charmnarong	Deputy Director General
Mr. Vichan Vongvivat	Chief Engineer
Mr. Sudhee Kornkamonphurk	Director of TTI
Mr. Surapol Pongthaipatana	Deputy Director of TTI (Director of TCSW)
Ms. Panee Rattianasamphun	Deputy Director of TTI (Administration)
Mr. Vichai Suthirajthada	Deputy Director of TTI (Administration)
Mr. Kamalas Phandee	Technical Training Officer, TTI
Miss Prapaporn Wattanajaleamging	Administration Officer, TTI
Mr. Kamalag Phandee	TTI
Mr. *Vijit Santipatanakij*	*Civil Engineer 6, TCSW*
Mr. Suriya Thanawatdej	Mechanical Engineer 6, TCSW
Mrs. Vanida Bunopas	Scientist 8, MRD
Dr. Kreeta Sroikeeree	Civil Engineer 7, SED
Mr. Tepchai Seri-Umnuoy	Civil Engineer 5, SED
Mrs. Kalaya Khanchanusthiti	Civil Engineer 4, SED
Miss Arunnee Kasem	SED

DOLA

Mr. Wichien Chawalit

BMA

Mr.	Mana Noppun	Director General, DDS
Mr.	Thongchai Klankrong	Director, Water Quality Control Division, DDS
Mr.	Somsak Klanpoj	Director, Drainage Systems Development Division, DDS
Ms.	Apinan Jaruchaiyakul	Chief of Sub-Division 3, Water Quality Control Division, DDS
Mr.	Tavachai Sapaporam	Chief of Si-praya Wastewater Treatment Plant
Mr.	Ophat Seangtonprakai	Sanitary Scientist
Ms.	Danaya Jayawan	Sanitary Scientist
Mr.	Prachote Krabkran	Sanitary Scientist

DTEC

Mr.	Krisda Piampongsant	Director, External Cooperation Division I
Mr.	Wichai Choowisetsuk	Programme Officer, Japan Sub-Division
Mr.	Michimasa Numata	Aid Coordinator, Japan Sub-Division
Mr.	Nipon Sirivat	

ABBREVIATION

PWD : Public Works Department, Ministry of Interior
SED : Sanitary Engineering Division
TTI : Technical Training Institute
BMA : Bangkok Metropolitan Administration
DOLA: Department of Local Administration, Ministry of Interior
MRD : Material and Research Division
TCSW: Training Center for Sewage Works
DDS : Department of Drainage and Sewerage

Mana

Annex 2-1

PCM WORKSHOP ATTENDANCE LIST

9 December 1994, 12 December 1994 at PWD Phanfa

JAPANESE PRELIMINARY STUDY TEAM

Mr.	Akira Kasai	Leader (JICA)
Dr.	Shunsoku Kyosai	Member (Ministry of Construction)
Mr.	Nobuyuki Horie	Member (Housing and Urban Development Corporation)
Mr.	Masayuki Hirabayashi	Member (Japan Sewage Works Agency)
Mr.	Motoharu Watanabe	Member (JICA)
Ms.	Takako Haraguthi	Member / Moderator (Global Link Management Inc.)

JICA THAILAND OFFICE

Mr.	Yoshiharu Yoneyama	Assistant Resident Representative
Mr.	Athorn Charoenlai	Manager

JAPANESE EXPERTS

Mr.	Hiroyuki Fujimoto	SED, PWD
Mr.	Kazuyuki Ono	MRD, PWD
Mr.	Tsuyoshi Yanagi	DDS, BMA

PWD

Mr.	Surapol Pongthaipatana	Deputy Director of TTI (Director of TCSW)
Ms.	Panee Rattianasamphun	Deputy Director of TTI (Administration)
Miss	Prapaporn Wattanajalearnging	Administration Officer, TTI
Mr.	Vijit Santipatanakij	Civil Engineer 6, TCSW
Mr.	Suriya Thanawatdej	Mechanical Engineer 6, TCSW
Mrs.	Vanida Bunopas	Scientist 8, MRD
Miss	Arunnee Kasen	Waste Water Section, MRD
Dr.	Kreeta Sroikeeree	Civil Engineer 7, SED
Mr.	Tepchai Seri-Umnuoy	Civil Engineer 5, SED
Mr.	Pornput Nutthee	Civil Engineer
Mrs.	Kalaya Khanchanusthiti	SED
Mr.	Thaveesak Vangpaisal	SED
Mr.	Amorn Chansakul	Civil Engineer 4, Phuket Public Works Provincial Office

BMA

Ms.	Apinan Jaruchaiyakal	Chief of Sub-Division 3, Water Quality Control Division, DDS
Mr.	Phisit Jainkiatfu	Section Chief, Water Quality Control Division, DDS

ABBREVIATION

PWD : Public Works Department, Ministry of Interior
SED : Sanitary Engineering Division
TTI : Technical Training Institute
MRD : Material and Research Division
TCSW : Training Center for Sewage Works

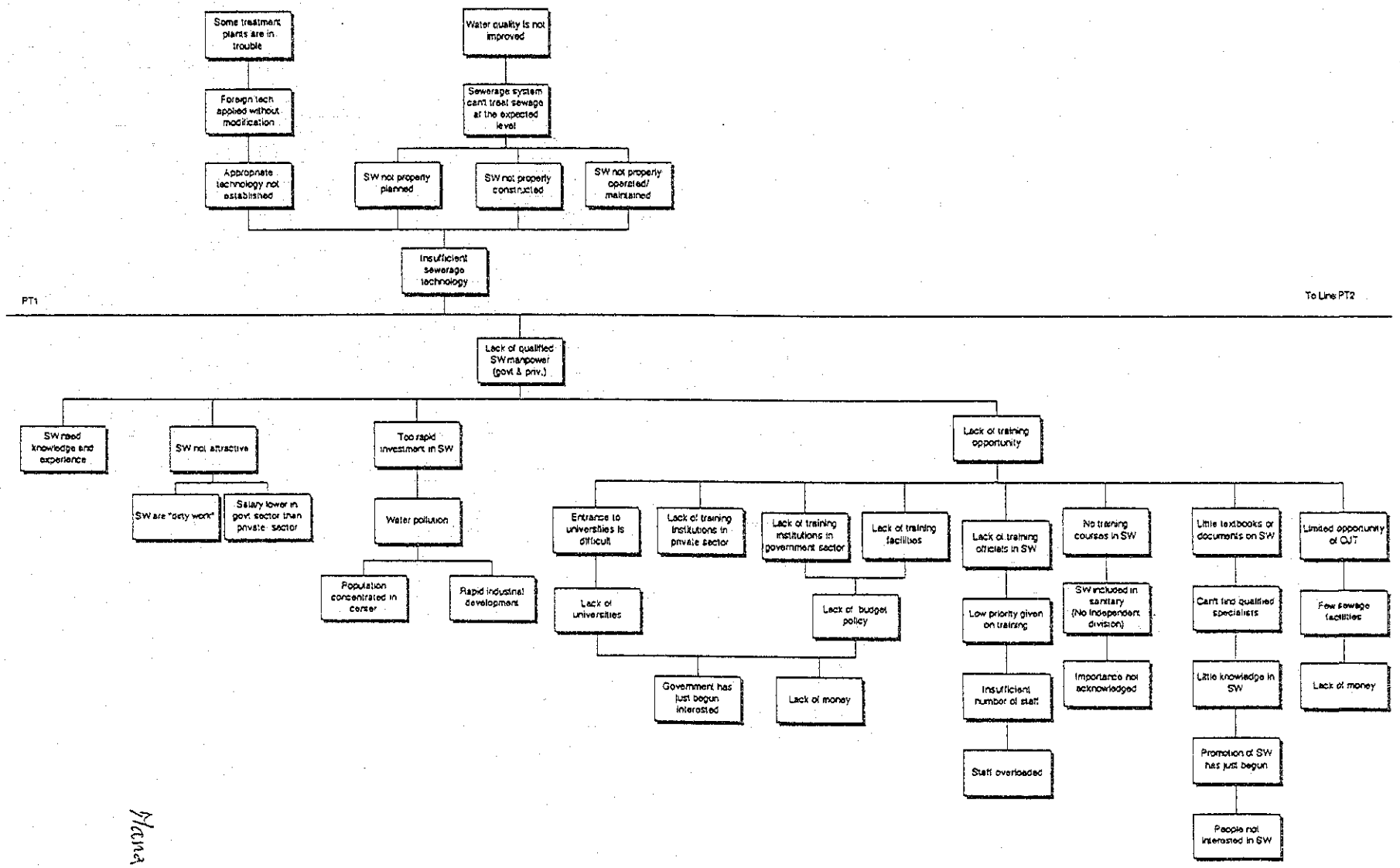
Participation Analysis

Beneficiaries	Cooperating Agencies	Other Affected Groups	Implementors	Funding Agencies
PWD BMA TCSW Users of sewage works People in Thailand Local authorities	Local authorities Sewage treatment plants Universities and other educational facilities Members of Steering Committee Local Administration Dept National Municipal League of Thailand DTEC NGOs	Private agencies in charge of SW Private research institutions Universities	PWD BMA JICA	Thai government (Budget Bureau) Japanese government BMA

Annex 2-3

Problem Tree
1 / 2

Problem Analysis


Some treatment plants are in trouble
Water quality is not improved
Foreign tech applied without modification
Sewerage system can't treat sewage at the expected level
Appropriate technology not established
SW not properly planned
SW not properly constructed
SW not properly operated/ maintained
Insufficient sewerage technology
PT1
To Line PT2
Lack of qualified SW manpower (govt & priv.)
SW need knowledge and experience
SW not attractive
Too rapid investment in SW
Lack of training opportunity
SW are "dirty work"
Salary lower in govt. sector than private sector
Water pollution
Population concentrated in corser
Rapid industrial development
Entrance to universities is difficult
Lack of training institutions in private sector
Lack of training institutions in government sector
Lack of training facilities
Lack of training officials in SW
No training courses in SW
Little textbooks or documents on SW
Limited opportunity of OJT
Lack of universities
Lack of budget policy
Low priority given on training
SW included in sanitary (No independent division)
Can't find qualified specialists
Few sewage facilities
Government has just begun interested
Lack of money
Insufficient number of staff
Importance not acknowledged
Little knowledge in SW
Lack of money
Staff overloaded
Promotion of SW has just begun
People not interested in SW

Problem Tree
3 / 3

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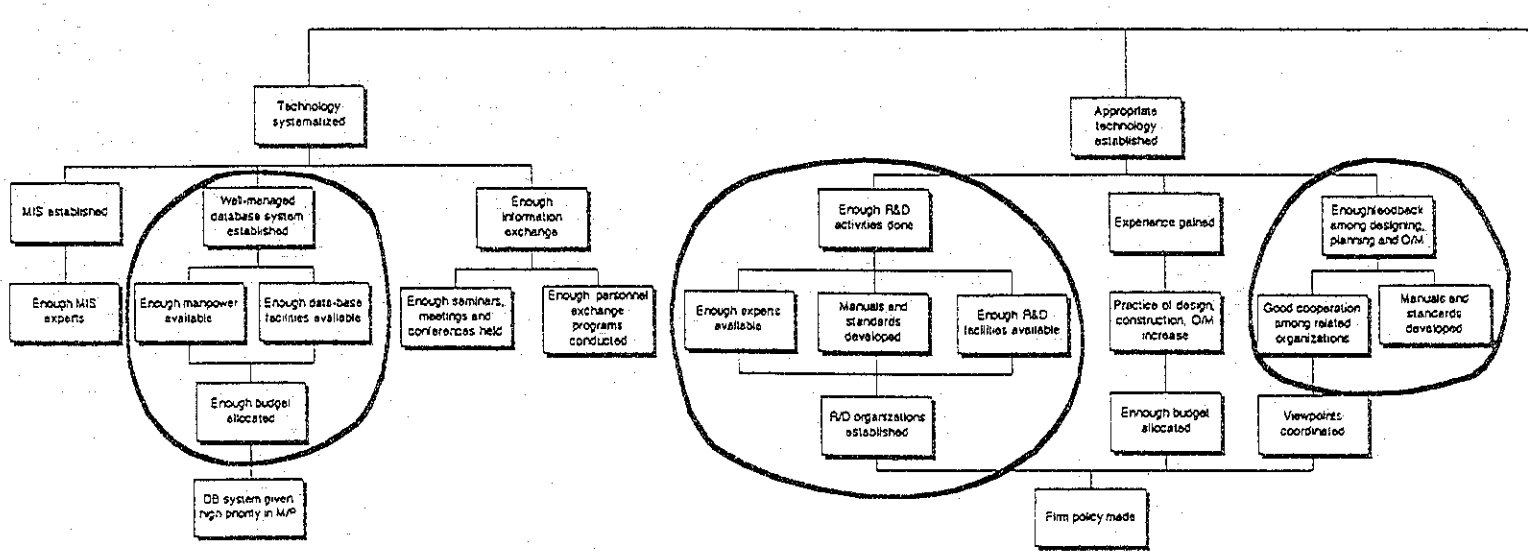
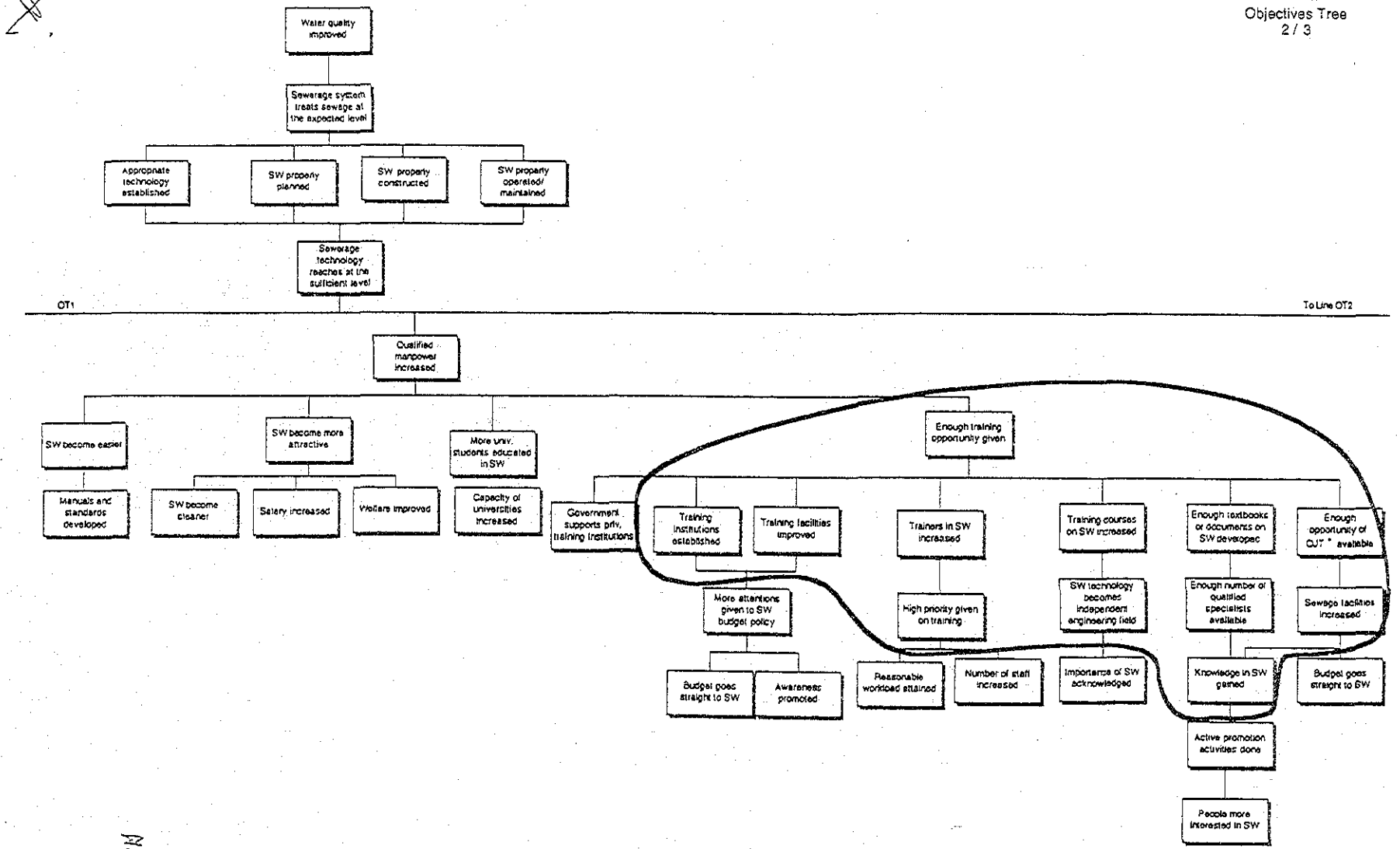
Objectives Analysis

Alternatives Analysis



To be dealt with by the proposed project



* Definition of OJT unsettled

Objectives Tree
3 / 3

Project Design Matrix : Training Center for Sewage Works

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Appropriate sewage works technology is established and sewage works are properly planned, designed, constructed, operated and maintained			
Project Purpose Functions and activities of TCSW are established		-	
Outputs 1. Management of TCSW is established 2. Engineers, scientists, technicians and managers are trained 3. Data-base system is prepared 4. Research and development (R&D) activity is set up			Trained personnel do not leave SW sector
Activities T (J) : to be executed by Thai (Japanese) side 1-1 (T) Set up Steering Committee 1-2 (T) Recruit staff for TCSW 1-3 (T) Personnel management 1-4 (T) Financial management 2-1 (T) Recruit trainers 2-2 (JT) Train trainers 2-3 (JT) Set up training programs 2-4 (JT) Develop training curriculum 2-5 (JT) Develop training materials 2-6 (T) Train engineers, scientists technicians and managers 3-1 (JT) Make a plan for data-base system 3-2 (T) Collect documents / data 3-3 (JT) Categorize the documents 3-4 (T) Serve for proper use 4-1 (JT) Develop R&D program 4-2 (JT) Prepare R&D facilities	**Inputs** Thai side Japanese side	Necessary personnel to implement the project TCSW building Necessary expenses to implement the project Leader Coordinator Experts in the field of civil engineering, sanitary engineering, chemistry or biology, mechanical engineering, electrical engineering and others Equipments for training Counterpart training in Japan	- Trained trainers remain at TCSW - Documents and data exist **Pre-conditions** - TC building completed - Capable candidates for trainees are available

Annex 2-5

Relevant Authorities Chart of the Project

Annex 4

ORGANIZATION CHART OF TCSW
Ministry of Interior
Public Works Department
Technical Training Institute
Board of Institute
Institutional Committee
Steering Committee
Training Center for Sewerage Works (TCSW)
Training Administration Division
Technical Training Section
Management Training Section
Operation Training Section
Document Printing Section
Audio Visual Section
Training Section-1
Training Section-2
Administrative Section
BMA Branch Center
Technical Group
* Construction
* Sanitary & Environment
* Road & Bridge
* Dam
* Architectural
* Electrical
* Law
* Water Resource
etc.
Management Division
General Management Section
Policy & Planning Section
Finance Section
Monitoring & Evaluation Section
Procurement, Building & Vehicle Section

BASIC PLAN

FOR

TRAINING CENTER FOR SEWAGE WORKS

TCSW

AUGUST 1994 (B.E.2537)

PUBLIC WORKS DEPARTMENT

MINISTRY OF INTERIOR

ROYAL THAI GOVERNMENT

Mang Noppun

TABLE OF CONTENT

1.1 BACKGROUND OF PROJECT PROPOSAL

As a result of rapid economic growth and development in recent years , the environmental deterioration became very serious in Thailand . Especially , water pollution is one of the biggest issues , and the construction of sewerage system is spotlighted as basic countermeasure for the water pollution control in public water bodies . Thai government already realized the necessity of sewerage system and has been promoting the sewage works in these years. Currently , 8 sewage treatment plants are already in operation in Thailand .

In order to implement the sewerage projects including planning , designing , construction , and operation & maintenance (O&M) of sewerage system , engineers , scientists and technicians in various fields such as sanitary engineering , mechanical engineering , electrical engineering , chemical engineering , biology and etc., are necessary .

However , the sewerage technology is quite new to Thailand and human resources are quite limited in these fields .
Therefore , foreign technology were applied to sewerage projects in the past without necessary modification . But as foreign technology is not always appropriate in Thailand , some existing sewage treatment plants are in trouble .

In case that the sewerage system is not properly planned , designed , constructed and operated , the system cannot treat sewage at the expected level , and the water quality of receiving water body cannot be improved .

In order to cope with these problems , it is urgently necessary to develop and transfer the appropriate technology to Thai engineers . And at the same time , it has become an important task to increase the number of well-qualified and experienced engineers , scientists and technicians through the systematicly-organized training program .

Under these circumstances , Thai Government decided to establish the Training Center for Sewage Works (TCSW) under the Technical Training Institute (TTI) of the Pubilc Works Department (PWD) , Ministry of Interior .
PWD already started the construction of the buildings of TCSW/TTI . However , because of the lack of experiences in the field of sewerage technology , technical assistance from Japanese Government is being requested for training know-how and equipment donation under JICA's project-type technical cooperation program.

1.2 CURRENT SITUATION OF SEWAGE WORKS IN THAILAND

1.2.1 Administrative and Institutional Set-up

In the past , the Public Works Department (PWD) was the main organization in charge of water pollution control . Later , due to the rapid growth of Bangkok Metropolis , the Bangkok Metropolitan Administration (BMA) was established and it took over the responsibility of water pollution control in Bangkok . The Office of the National Environment Board (ONEB) ,which was re-organized to three (3) departments under the Ministry of Science , Technology and Environment (MOSTE) in 1992 , was also established in 1975 to carry out the main responsibility of environmental management in Thailand .

Due to the urgency and difficulty of solving water pollution problems , countermeasures are being provided through the cooperation of several agencies including PWD , BMA , Pollution Control Department (PCD) (re-organized from ONEB) , Department of Industrial Works (DIW) , Department of Health (DOH) , Royal Irrigation Department (RID) , and others .

Among the above-mentioned organizations , PWD and BMA are main organizations in charge of the implementation of sewerage system. PCD is going to start sewerage projects in some areas ,by using Environmental Fund.

(1) Public Works Department (PWD)

PWD is one of the departments under the Ministry of Interior (MOI) , and its main areas of responsibilities comprise the followings :

1) Technical Services ;
These services include planning , design work , construction supervision of both governmental and private projects, construction of public utilities , and supply of equipment, etc..

2) Legal Aspect ;
Primarily enforcement of building codes .

3) Urban Area Development ;
Providing solutions to basic problems , such as traffic , water supply , wastewater treatment , solid waste disposal, etc..

4) Rural Development
Construction/provision of basic infrastructure like roads , water and power supply , and other public itilities .

PWD has regional administration offices which are directly under central office. The regional offices manage atotal of 75 provincial offices . Among the divisions of PWD , the Sanitary Engineering Division (SED) is in charge of implementation of sewerage system . Its main functions are planning and design of flood protection , drainage , solid waste disposal and sewerage works for municipalities and sanitary districts , etc.. Other responsibilities include application and research activities such as standardization and improvement of sanitary works . The organization chart of PWD is shown in Figure 1-1 .

(2) Bangkok Metropolitan Administration (BMA)

The Bangkok Metropolitan Administration was established in 1972 and Bureau of Sanitation was in charge of drainage and waste disposal . It was re-organized to Bureau of Drainage and Sewerage in 1977, and in 1981 ,re-organized again and became to Department of Drainage and Sewerage (DDS) , which is incharge of drainage and sewerage .

The main areas of responsibilities of DDS are as follows ;

(1) Master plan and executive plan for drainage and sewerage system

(2) Construction and improvement of drainage and sewerage facilities

(3) Operation and maintenance of drainage and sewerage facilities

(4) Countermeasures against flooding

(5) Water quality monitoring in the canals

(6) Regulation and monitoring on various wastewater treatment plants except factories

(7) Operation and maintenance of treatment plants for leachate from solid waste dumping site

Among the Divisions of DDS , Water Quality Control Division is mainly in charge of the implementation of sewerage system. The organization chart of DDS is shown in Figure 1-2 .

FIGURE 1-1 ORGANIZATION CHART OF PWD

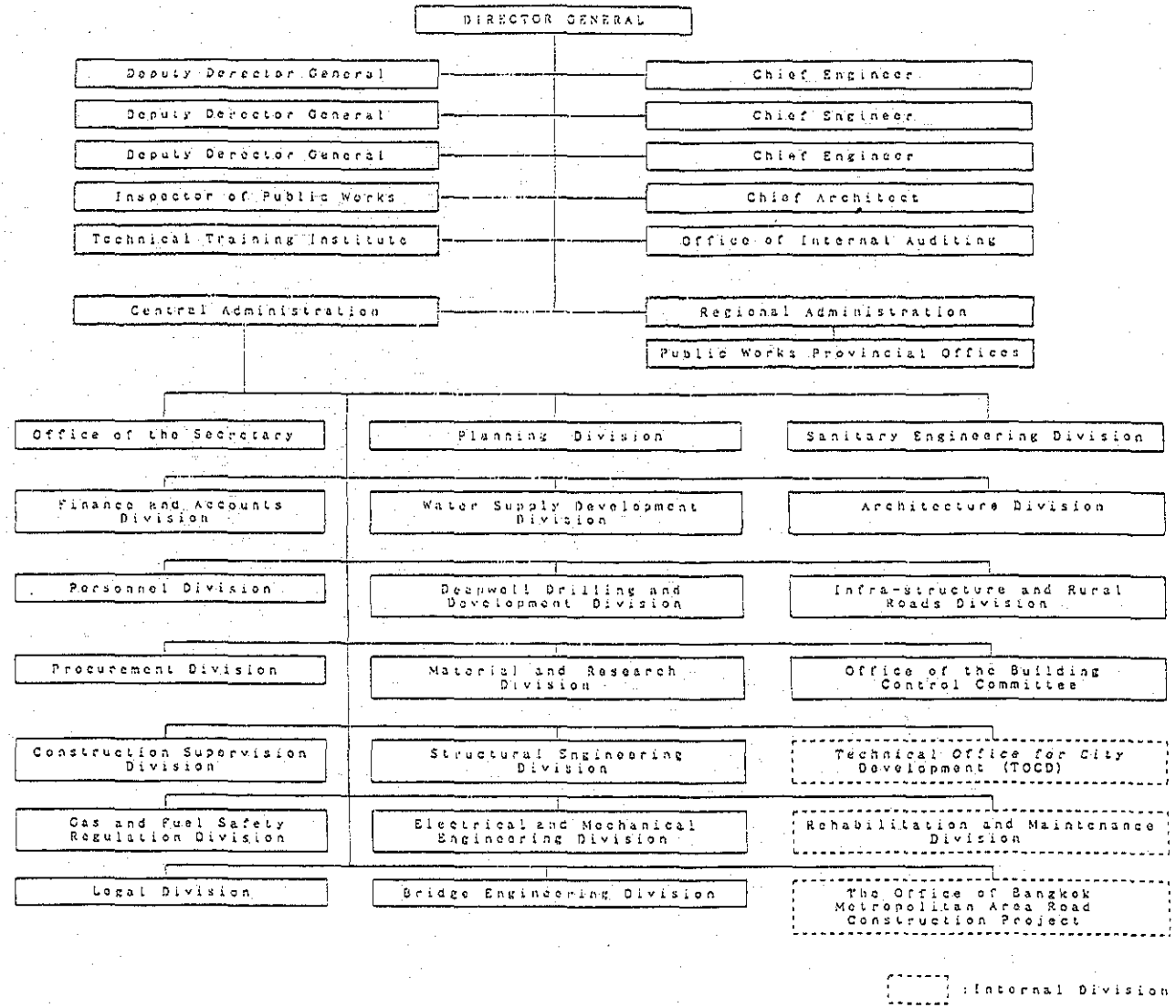
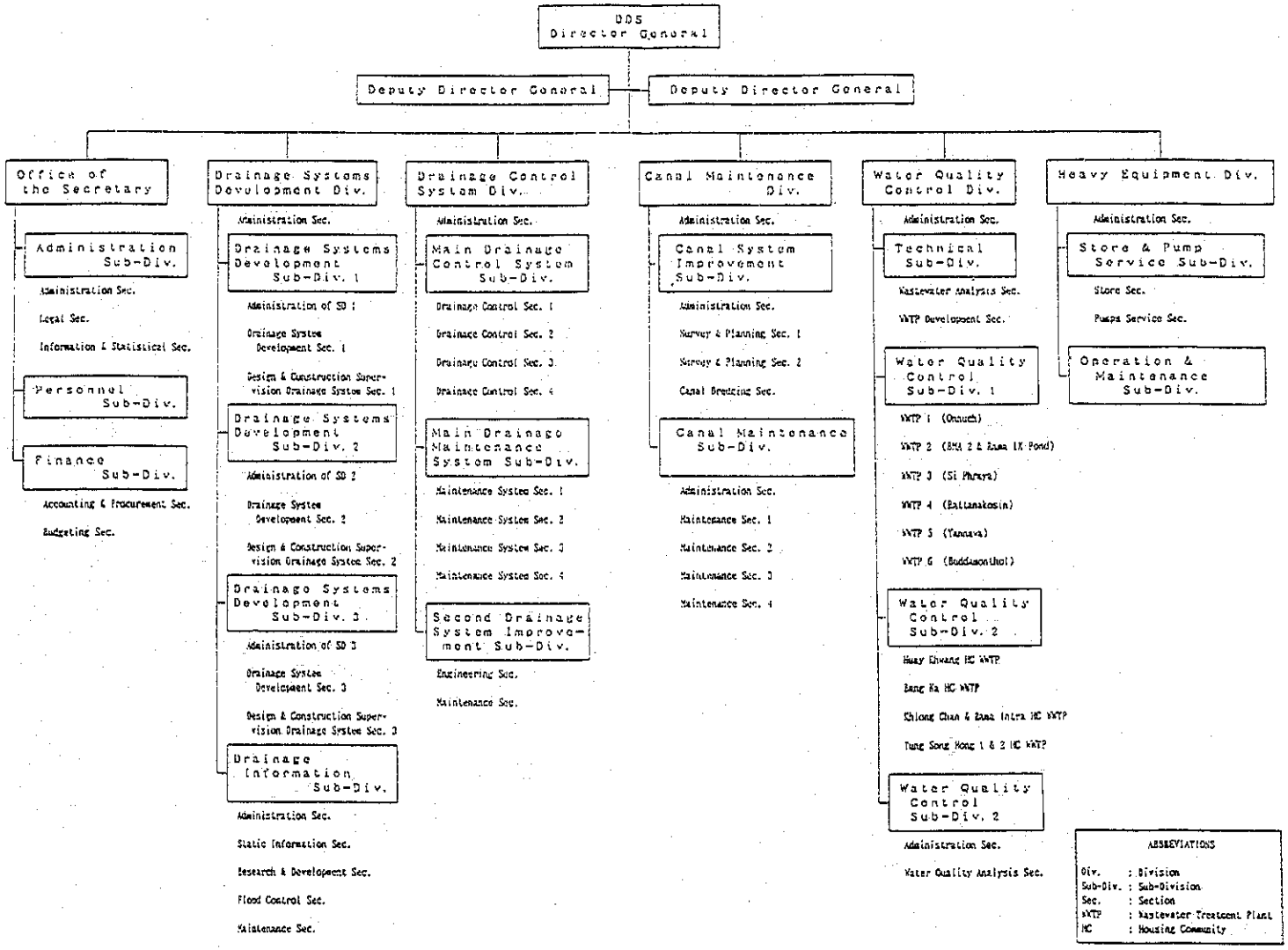


FIGURE 1-2 ORGANIZATION CHART OF DDS/BMA



1.2.2 Implementation Arrangements for Sewage Works

In Thailand , local authorities such as municipalities and sanitary districts (including BMA) are primarily responsible for the sewage works . However , due to the lack of financial affordability and technical capability , central government agencies have been supporting local authorities in both finance and technical works . As far as technical works is concerned , PWD is responsible from planning to construction supervision of sewerage projects in local areas . Local authorities have the responsibility for operation and maintenance .

The implementation arrangements for sewage works is shown in Figure 1-3 .

1.2.3 Current Situation of Sewage Works

(1) Sewage Works in Bangkok

The sewerage projects just started in 1992 , because flood protection had been given higher priority than wastewater treatment in the past decades .

The first sewage treatment plant (Si Phraya sewage treatment plant) started its operation in 1993 .

The on-going sewerage projects in Bangkok comprise six sub-systems . Table 1-1 shows the outline of those projects.

The total service area is 158.3 sq.km with an aggregate service population of about 2.2 million . Service population of each sub-system ranges between 70,000 and 800,000 . The treatment method applied to three of six sub-projects is the modified activated sludge treatment process . The treatment capacity of each six treatment plants is between 30,000 and 350,000 cmd for total treatment needs of 837,000 cmd .

The huge amount of construction cost required will be arranged by BMA supported by the central government . The budget of DDS is shown in Figure 1-4 .

FIGURE 1-3 IMPLEMENTATION ARRANGEMENTS FOR SEWAGE WORKS

Item	Government		
	Nation	Province	Municipality/S.D
Establishment of sewerage plan Decision on the priority projects	- Investigation & planning by PWD - Approval by cabinet meeting 100 %	0 %	- Willingness on participation 0 %
Land acquisition	- Recommendation on location and land size by PWD 0 % 70 % 1/ 60 % 2/ 75 % 3/	0 %	100 % 30 % 1/ 40 % 2/ 25 % 3/
Design & engineering work	Design Committee PWD staff Designing (by consultants) 100 %	Representative 0 %	Representative 0 %
Construction	Advisory Committee PWD staff Supervision work 100 % 70 % 1/ 60 % 2/ 75 % 3/	Representative 0 %	Representative 0 % 30 % 1/ 40 % 2/ 25 % 3/
Staff training	Training Plan by PWD 100 %	0 %	0 %
Operation and Maintenance of facilities	Technical assistance 0 %	0 %	Responsible 100 %

Note: percentage (%) indicates budgetary arrangements
1/ Fifth National Economic and Social Development Plan
2/ Sixth National Economic and Social Development Plan
3/ Seventh National Economic and Social Development Plan (NESDB)

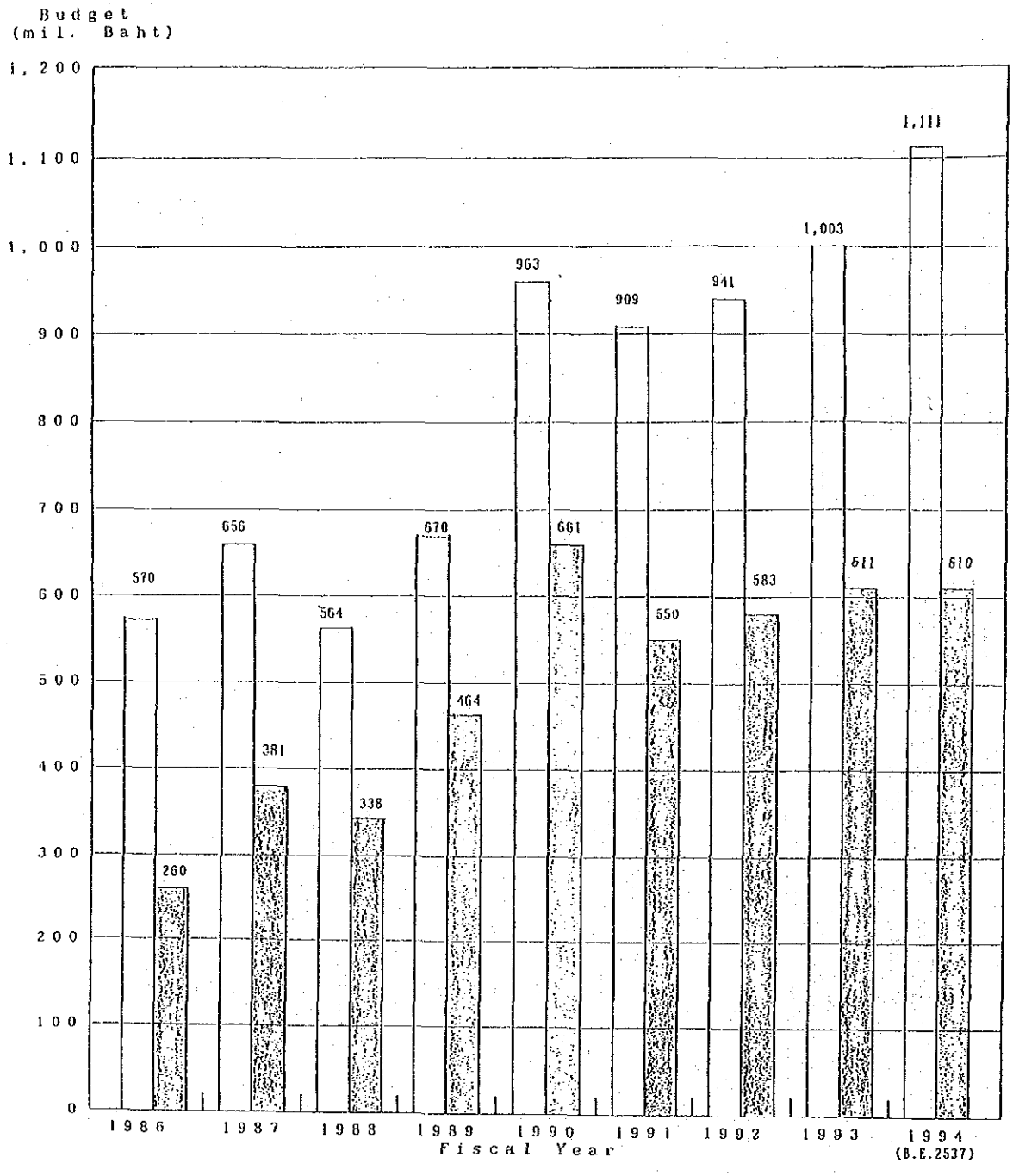
Capital construction cost sharing between central and local government in 5 categories

Traffic	65 : 35	Piped water supply	45 : 55
Drainage	65 : 35	Sewerage system	75 : 25
Solid Waste	70 : 30		

TABLE 1-1 SEWERAGE PROJECTS OF BMA

NO	NAME	SERVICE AREA (km²)	POPULATION (1,000)	TREATMENT PROCESS	CAPACITY (m³/d)	PROJECT COST (Mil. Baht)	CONTRUCTION PERIOD etc.
①	Si Phraya	2.7	70 ~ 100	Contact Stabilization	30,000	460	Sep. 1991 ~ Dec. 1993 (In Operation)
②	Rattanakosin	4.1	120	Activated Sludge	40,000	900	Sep. 1993 ~ 1995
③	Yannawa	28.5	485	Activated Sludge	195,000	4,700	
④	Nong Khaem	44.0	401	Activated Sludge	157,350	3,600	
⑤	Lard Burana	42.0	296	Activated Sludge	65,000	2,800	
⑥	Central Bangkok (Stage-I)	37.0	800	Activated Sludge	350,000	6,000	Nov. 1993 ~ Dec. 1997
	TOTAL	158.3	2,172~ 2,202		837,350	18,460	

FIGURE 1-4 BUDGET OF DDS/BMA



: Total Budget

: Budget for Land and Construction etc.

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(2) Sewage Works in Local Areas (Outside Bangkok)

Public sewerage systems in the local areas of Thailand were started to be constructed in the middle of 1980s . Presently , the sewage works in Thailand is still under the initial stage of development for the improvement of living standard and water pollution control in the public water bodies .

There is a total of 64 sewerage projects in the local areas . Of these , 7 sewage treatment plants are in operation and 12 systems are under construction . Other projects are still under planning or design stage . Table 1-2 and Figure 1-5 indicate the project sites and their location . The capacity of the sewage treatment plants in local areas is small to medium size with a range of 2,200 - 32,000 cmd . The treatment methods include Rotaing Biological Contactor (RBC) (3 projects) , Oxidation Ditch (OD) (6 projects) , Stabilization Pond (SP) (6 projects) , Aerated Lagoon (AL) (1 project) and Combined Fix Film (1 project) .

The classification of sewerage projects is described in Figure 1-6 .

The PWD's budget for sewerage projects is remarkably increasing in the past five years as illustrated in Figure 1 - 7 .

(3) Community plants of National Housing Authority (NHA)

Reference information on the community plants (small-scale sewage treatment plants for housing development) constructed by NHA are shown in Table-3 . Of those 18 plants , the oldest plant is in Huay Khwang constructed in 1975 . The capacity of the treatment plant ranges from 400 to 6,500 cmd . Most of the treatment methods used are activated sludge process (11 plants) . Others are OD (3 plants) , aerated lagoon (AL) (2 plants) and SP (2 plants) .

Those treatment plants located in Bangkok area were or will be transferred to BMA .

TABLE I-2 SEWERAGE PROJECTS IN LOCAL AREAS

(As of March , 1994)

NO.	PROJECT NAME	CONSTRUCTION PERIOD	COST (Mil. B)	TREATMENT CAPACITY (m³/day)	TREATMENT PROCESS	REMARKS
1	Pattaya (Kasem Suwan)	1st : 1984 - 1985 2nd : 1989 - 1991	27.3 31.0	4,000 4,000	RBC RBC	Operated Operated
2	Pattaya (# 17)	1989 - 1991	38.8	5,000	RBC	Operated
3	Patong Beach , Phuket	1st : 1988 2nd : 1990 - 1992	15.5 22.3	2,250 3,000	OD OD	Operated Operated
4	Hua Hin	1st : 1989 - 1991 2nd : 1994 -	43.3 -	4,000 25,000	RBC RBC	Operated D/D
5	Khon Kaen	1988	50.0	25,000	SP	Operated
6	Nakhon Ratchasima	1989	88.5	32,000	SP	Operated
7	Nakhon Pathom	1994 -	250.0	26,000	SP	Under Construction
8	Phuket	1994 -				D/D + Construction (Turn Key)
9	Phanat Nikhom	1992	15.0	2,200	SP	Operated
10	Laem Cha Bang	1994 -	110.0	20,000	OD	Under Construction
11	San Suk , North	1994 -	439.0	14,000	OD	Under Construction
12	San Suk , South	1994 -	380.0	9,000	OD	Under Construction
13	Pattaya (Jomthien Beach)	1992 - 1994	359.0	20,000	Combined Fix Film	Under Construction
14	Chiang Mai	1994 -	200.0	55,000	AL	D/D + Construction
15	Chantaburi	1994 -	195.0	22,000	SP	Under Construction
16	Ubon Ratchathani	1994 -	198.0	20,000	SP	Under Construction
17	Ang Thong	1994 -	180.0	8,500 (4,500)	OD	D/D + Construction
18	Sri Racha	1994 -	215.0	23,000	OD	Under Construction
19	Chong Nek / Ubon	1994 -				Under Construction
20	Chonburi					D/D
21	Nadthaput / Rayong					D/D
22	Rayong					D/D (1993)
23	Ban Pae / Rayong					D/D
24	Nonthaburi					D/D
25	Bang Bua Thong/Nonthaburi					F/S
26	Prakkset / Nonthaburi					M/P (1993)
27	Pathum Thani					D/D
28	Rang Sit / Pathum Thani					M/P + F/S (1993)
29	Chachoeng Sao					F/S , D/D
30	Samut Prakarn					F/S , D/D
31	Samut Sakhon					D/D
32	Chainat					F/S , D/D
33	Sing Buri					F/S
34	Lop Buri					M/P (1993)
35	Sara Buri					F/S , D/D
36	Pa Mok / Ang Thong					M/P (1993)

TABLE I-2 SEWERAGE PROJECTS IN LOCAL AREAS (Cont'd)

NO.	PROJECT NAME	CONSTRUCTION PERIOD	COST (Mil. B)	TREATMENT CAPACITY (m³/day)	TREATMENT PROCESS	REMARKS
37	Ayuttaya					D/D
38	Kanchanaburi					D/D
39	Rachaburi					D/D
40	Suphan Buri					D/D
41	Ban Pong / Rachaburi					D/D
42	Uthong / Suphan Buri					D/D
43	Cha Am / Petchburi					D/D
44	Prachuap Khiri khan					D/D
45	Chumporn					F/S , D/D
46	Surat Thani					D/D
47	Saaui Island					D/D
48	Song Khla					F/S , D/D
49	Had Yai					D/D
50	Pattani					F/S , D/D
51	Kata , Karon / Phuket					D/D
52	Phuket (West)					M/P (1993)
53	Krabi					F/S , D/D
54	Trang					F/S , D/D (1993)
55	Chiang Rai					D/D
56	Payao					F/S , D/D
57	Lampang					F/S
58	Pitsanulok					D/D
59	Pichit					D/D
60	Buriram					D/D
61	Udon Thani					D/D
62	Sakhon Nakhon					D/D
63	Sena					M/P (1993)
64	Potaram / Rachaburi					D/D

NOTE : 1) M/P ··· Master Plan
2) F/S ··· Feasibility Study
3) D/D ··· Detailed Design
4) RBC ··· Rotating Biological Contactor
5) OD ··· Oxidation Ditch
6) SP ··· Stabilization Pond
7) AL ··· Aerated Lagoon

FIGURE 1-5 MAJOR PROJECT SITES IN LOCAL AREA

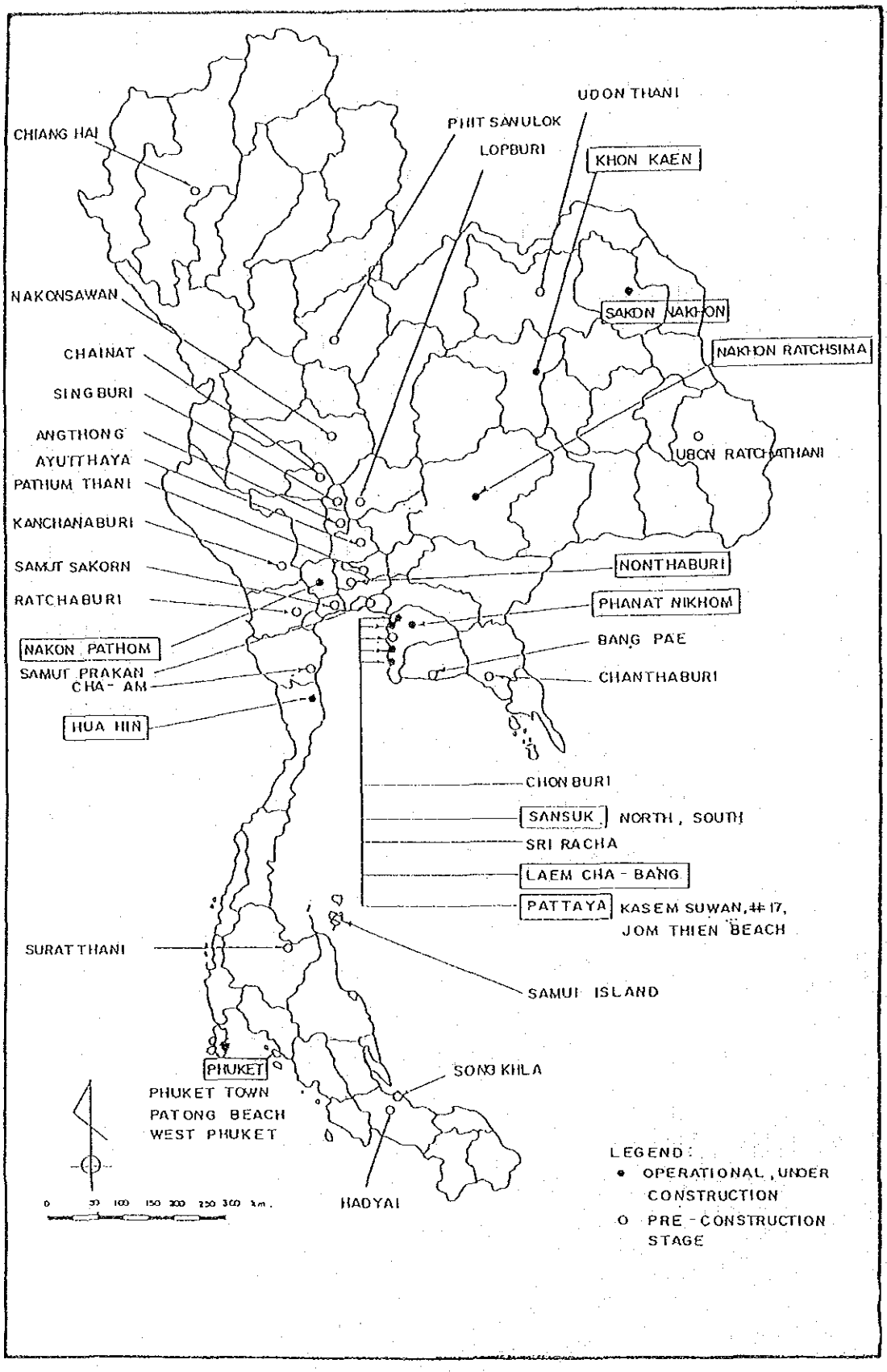
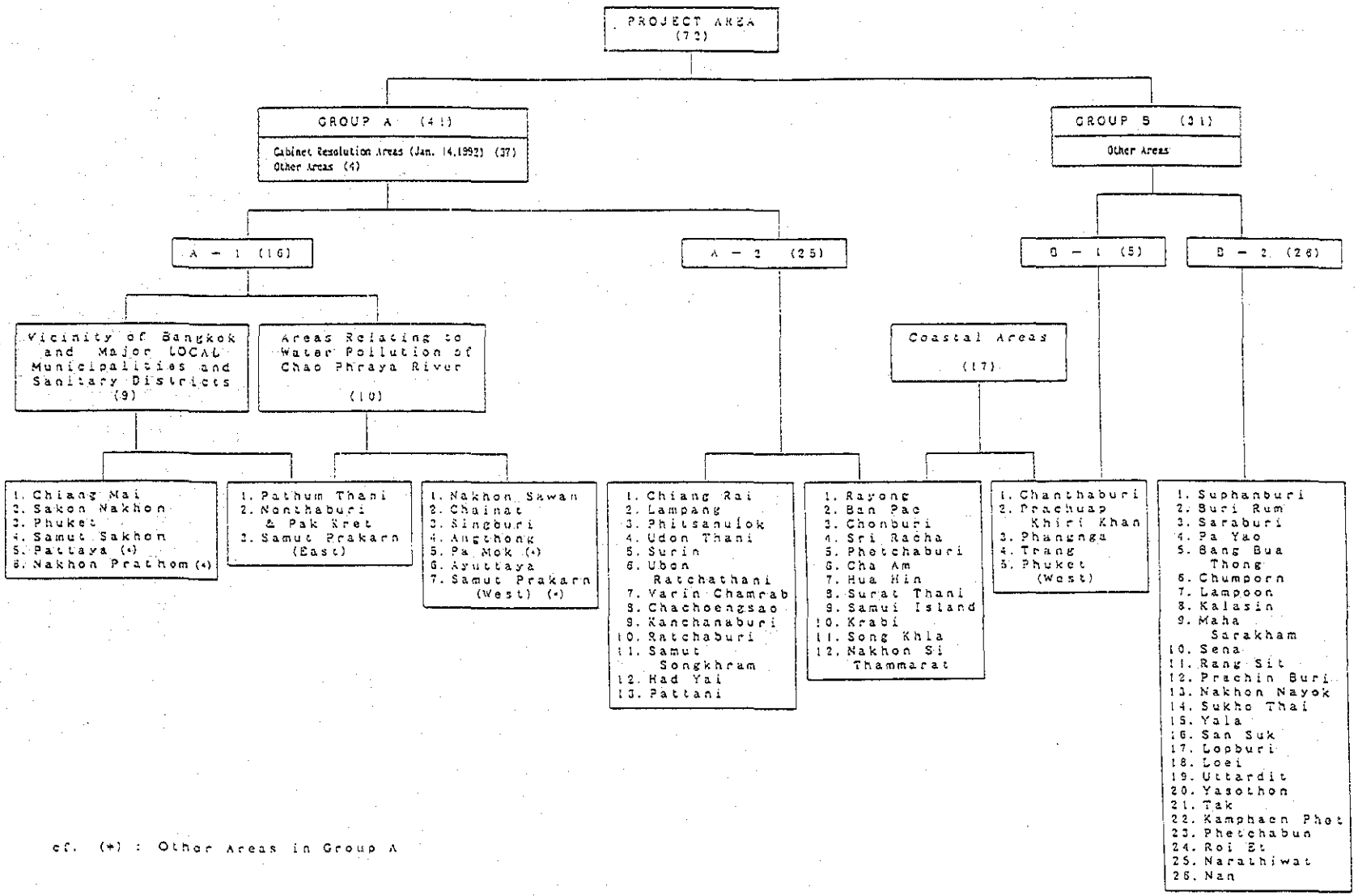
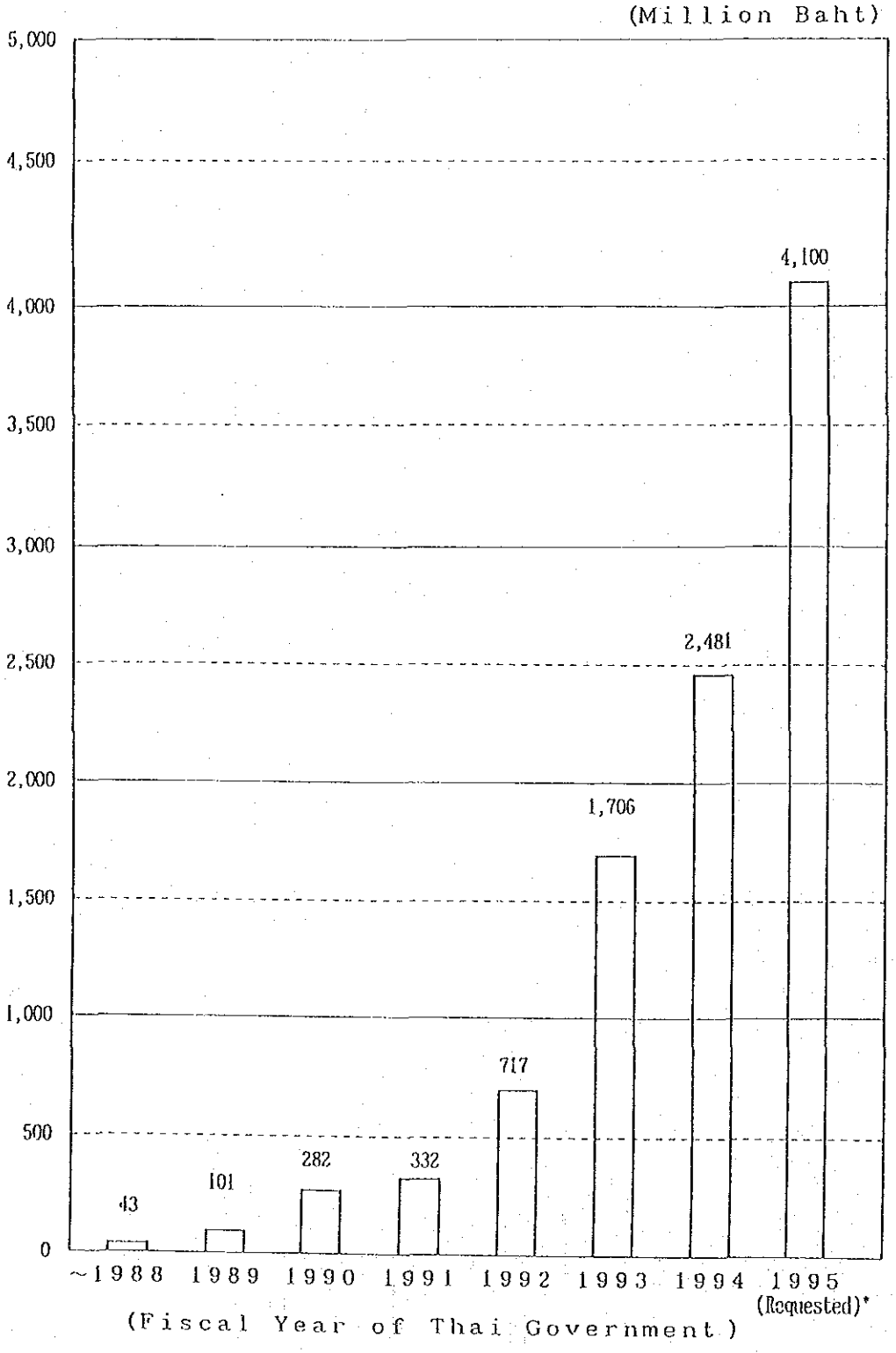


FIGURE 1-6 CLASSIFICATION OF PWD'S SEWERAGE PROJECTS



cf. (*) : Other Areas in Group A

FIGURE 1-7 PWD'S BUDGET FOR SEWERAGE PROJECTS



cf. * : Requested to the Budget Bureau from Ministry of Interior

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1.3 CURRENT SITUATION OF TECHNICAL STAFF

As sewage works in Thailand started only about ten years ago , the number of technical staff in the field of sewerage engineering is still quite limited . Although there are several government agencies involved in water pollution control and wastewater treatment , PWD and BMA are main implementing agencies for sewerage system . Therefore , most technical staff in the field of sewerage engineering are working in these two agencies .

Because both the number of projects and budget of sewerage projects of PWD are remarkably increasing , PWD has been trying to employ new staff and fill many vacant positions for technical staff . However , it is very difficult to do so , due to the big difference of salary between governmental and private sectors .

Current number of technical staff of PWD and BMA are shown below .

(1) Technical Staff of PWD (SED,EMD,MRD)

TABLE 1-3 TECHNICAL STAFF OF PWD

	Engineer	Scientist	Technician	
Civil Sanitary	25	---	27	SED
Mechanical Electrical	10 11	--- ---	--- ---	EMD
Chemical Biological	---	11	7	MRD *

cf. * :Water Analysis Sub-Div.

(2) Technical Staff of BMA (DDS)

TABLE 1-4 TECHNICAL STAFF OF DDS/BMA

	Engineer	Scientist	Technician
Civil Sanitary	51	14	45
Mechanical	1	---	28
Electrical	---	---	32
Chemical Biological	---	20	---

1.4 EDUCATION RELATING TO ENVIRONMENTAL STUDY

In order to increase the number of technical staff relating to sewage works , together with the training , the education in high school , technical colledge , university and higher level is also very important .

In Thailand , the job positions are classified as the following ;

TABLE 1-5 EDUCATION AND JOB POSITION

Educational Background	Job Position
University or higher level	Engineer , Scientist
Technical colledge	Technician
High school	Technician

1.4.1 Vocational Education

Vocational education in Thailand started in 1898 , and later in 1941 , Department of Vocational Education was established under the Ministry of Education . The program of vocational education was re-organized to put emphasis on agricultural , industrial and commercial field in 1960 and has improved by the assistance from foreign countries and increasing budget .

In 1975 , Institute of Technical and Vocational Education (ITVE) was established for higher vocational education .
As a result of rapid economic growth , vocational education program is requested to cover various fields and upgrade the level of program .

The fields included in vocational education program are as follows ;

1) Industrial : Automobile , machinery , welding , construction , ship etc.

2) Agricultural

3) Handicraft

4) Business : Accounting , secretary , hotel management etc.

5) Others

The outline of the courses are shown in Table 1-6 .

As of April , 1991 , there are 40 vocational colledges and 7 technical colledges and 46 agricultural colledges in Thailand .

In addition , there are 26 ITVEs for higher education in 1991 . There are also 312 private vocational schools under the control of Private Education Commission of the Ministry of Education in 1991 .

TABLE 1-6 OUTLINE OF THE COURSES FOR VOCATIONAL EDUCATION

COURSE	PERIOD (Years)	QUALIFICATION	NUMBER OF STUDENTS (1990)
PVC	3	Graduated junior high school	40,590
PVS	2	Finished PVC	14,922
PVT	2	Graduated senior high school	3,913
TOTAL			59,425

Note : 1) PVC ···· Primary Vocational Course
2) PVS ···· Secondary Vocational Course
3) PVT ···· Technical Vocational Course

1.4.2 University or higher level

Chulalongkorn University was established as the first university in Thailand in 1916 . The number of universities was 9 as of 1965 , and increased to 17 national universities and 26 private universities in 1991 .

The number of universities which have the department relating to environmental/sanitary study is very limited in Thailand . Those are Chulalongkorn University , Khon Kaen University , Chiang Mai University , Asian Institute of Technology (AIT) , Kasesart University , Prince of Songkhla University and Mahidol University . The number of students is also very small and not more than 200 per year .

The outline of major universities are summerised in Table 1-7 .

Table 1-7 OUTTLINE OF DEPARTMENT RELATING TO ENVIRONMENTAL STUDY OF MAJOR UNIVERSITIES IN THAILAND

Unversity	Chulalongkorn	Khon Kaen	Chiang Mai	AIT
Faculty	Fac.of Eng.	Fac.of Eng.	Fac. of Eng.	---
Department	Env. Eng.	Env. Eng.	Env. Eng.	Env. Eng.
Year of Establishment	1953	1983	1980	1964
No. of Student				
Bachelor	20	20 - 22	30	---
Master	20			35
Doctor	--	--	--	7 - 8
No. of Staff				
Professor	1	0	0	1
Associate Prof.	6	2	1	5
Lecturer	7	4	7	2
Assistant etc.	1	3		
Total	15	9	8	8

1.5 CURRENT SITUATION OF TRAINING PROGRAM

PWD is the major technical organization in the Ministry of In -terior (MOI) . PWD is responsible for the planning , design and implementation of the architectual and engineering works within its own department and other governmental agencies . It also acts as the technical consultant to the MOI and other Ministries as well as to local authorities in the whole kingdom .

As a result of remarkable economic growth , PWD's assignment or duties have been rapidly increasing . In order to carry out increasing number of projects , the necessity of staff training has been strongly recognized .

Therefore , PWD established Technical Training Institute (TTI) and has been promoting the staff training in recent years .

As the necessity for the training is increasing , PWD decided to expand the existing training center in FY 1991 . The new buildings are expected to be complete by the end of 1995 .

1.5.1 Organization

The organization chart of existing TTI is shown in Figure 2-2 (Chapter 2).

1.5.2 Training Program

(1) Outline of the training program

1) Budget about 2,000,000 Baht in FY 1993

2) Training courses

The training courses of PWD are devided into three groups as the following ;

a) Technician Courses

i) Period : 1 month

ii) Number of participants : 40 persons / course
iii)Place : TTI

iv) Number of courses : 4

- Bridge and dam
- Road
- Building
- Sanitation

v) Content of the courses

- Theory
- Practice (Laboratory)
- Practice (field) and site visit

b) Administrator , engineer courses

i) Period : 3 - 15 days
ii) Number of participants: 20 - 60 persons / course
iii)Place : Meeting room of PWD
iv) Number of courses : 6 (Regular:5 , Special:1)

- Directors of high level
- Directors of middle level
- Administration
- Lecturers
- Orientation for new officers
- Operation and maintenance of sewage treatment plant (Special course)

c) Seminars

i) Period : 2 - 5 days
ii) Number of participants : 150 - 180 persons
ii) Place : not fixed
iii)Number of courses : 3

- Gas and fuel safty regulation
- PWD's activities
- Deep well drilling and development

3) Others

Certificate will be issued to participants who complete training courese .

(2) Training courses relating to sewage works

Among the training courses of PWD , courses relating to sewage works are Sanitation Course and Operation and Maintenance of Sewage Treatment Plants Course .

The outline of those courses are as follows ;
1)Sanitation Course

a) Objectives

- To improve the knowledge , ability and experiences of technicians
- To convert MOI's technicians of other fields to technicians of sanitary field

b) Qualifications

- Civil technician , draftsman , mechanic
- Working experience : 2 - 15 years

or

- Those who the Director General assigns

c) Period 30 days

d) Number of participants 40 persons

e) Training method

Lecture , practice (Laboratory and field) , discussion , etc.

f) Lecturers

i) PWD staff : Sanitary Engineering Div.
Water Supply Development Div.
Deep Well Drilling Div.
Material and Research Div.

ii)Others : Outside lecturers

g) Curriculum

See Table 1-8 .

2) Operation and Maintenance of Sewage Treatment Plants Course

a) Objectives

To improve the ability of the staff working in sewage treatment plants so that they can understand the treatment process , control the treatment system properly and give advice to other staff .

b) Participants

41 persons

i) PWD staff

- Sanitary Engineering Div. : 6
- Material and Research Div. : 2
- Provincial PWD offices : 16

ii)Staff of local authorities : 21

c) Period

11 days

d) Training method

Lecture , discussion , AV equipment practice (laboratory and field) , site visit

e) Lecturers

i) PWD staff
ii) Others : Outside lectures

f) Curriculum

See Table 1- 9 .

1.5.3 Construction Plan of Training Center

(1) Location and Area

1) Address : Phahon Yo Thin Rd. , Pratunam Pa-In , Ayuttaya Province

45 km to the noth from PWD Headquarters
See Figure 1-8 .

2) Area : 68 rai (10.88 ha)
See Figure 1-9 .

(2) Budget

Table 1-10 Budget of TTI Expansion

TFY	Budget (Mil.B)	Remarks
1991	16.45	Improvement of existing buildings
1992	4.0	
1993	22.54	
1994	44.0	
1995	44.135	
Total	133.125	

cf. TFY : Fiscal year of Thai Government

(3) Outline of TTI Buildings

1) Administration Building : RC , 2 stories
Total area : 1,182 sq.m
2) Recreation Building : RC , 1 story
Total area : 832 sq.m
3) Lecture Building : RC , 4 stories
Total area : 4,226 sq.m
4) Accommodation Building : RC , 4 stories
Total area : 4,848 sq.m
5) Main Building (existing) : RC , 2 stories
Total area : 894 sq.m
6) Annex (existing) : RC , 2 stories
Total area : 316 sq.m

(4) Construction Schedule

Construction schedule of new TTI buildings is ahown in Figure 1-10 .

(5) Details of the New and Existing Buildings of TTI

Details of the new and existing buildings of TTI are shown in Table 2-4 ~ Table 2-7 and Table 2-7A and Table 2-7-B . Plan of the TTI buildings are also shown in Figure 2-5 ~ Figure 2-14 .

TABLE 1-8 CURRICULUM OF SANITARY COURSE

No.	SUBJECT	PERIOD (HOUR)			
		THEORY	PRACTICAL (LAB)	PRACTICAL (FIELD)	TOTAL
1	Introduction to sanitation	1	-	-	1
2	Survey	5	-	-	5
3	Introduction to science relating to water and wastewater	6	-	-	6
4	Hydrology - Introduction, surface water, underground water	3	3	3	9
5	Hydraulics - Introduction, orifice, notch and weir, pipe, open drainage, Pumping	6	3	-	9
6	Water supply - The estimation of water requirement, water quality and standard, sludge processing, filter	9	3	-	12

TABLE 1-8 CURRICULUM OF SANITARY COURSE

(Cont' d)

No.	SUBJECT	PERIOD (HOUR)			
		THEORY	PRACTICAL (LAB)	PRACTICAL (FIELD)	TOTAL
7	Drainage				18
	7.1 Introduction to drainage and flood protection	6	-	-	6
	7.2 Data analysis for design	6	-	-	6
	7.3 Detail drawing	3	-	-	3
	7.4 Construction and inspection	2	-	-	2
	7.5 Maintenance	1	-	-	1
8	Domestic wastewater treatment	24	-	12	36
	8.1 Basic theory of wastewater treatment	3	-	-	3
	8.2 Data analysis for design	3	-	-	3
	8.3 Wastewater treatment plant design	12	-	-	12
	8.4 Construction and inspection techinque	2	4	-	6

TABLE 1-8 CURRICULUM OF SANITARY COURSE

(Cont'd)

No	SUBJECT	PERIOD (HOUR)			
		THEORY	PRACTICAL (LAB)	PRACTICAL (FIELD)	TOTAL
	8.5 Operation of wastewater treatment Plant	3	4	-	7
	8.6 Maintenance	1	4	-	5
9	Sanitation in building	9	3	-	12
10	Solid waste management	6	-	-	6
11	Cost estimating	6	-	-	6
	TOTAL	93	12	15	120

TABLE 1-9

CURRICULUM OF OPERATION AND MAINTENANCE OF WASTEWATER TREATMENT PLANT COURSE

NO.	SUBJECT	PERIOD (DAYS)
1	Opening	0.5
	1.1 Opening Ceremony	
	1.2 Orientation	
2	Basic theory of wastewater treatement	0.5
	2.1 Physical treatment	
	2.2 Biological treatment	
3	Factors relating to the operation and maintenance of wastewater treatment plants	0.5
4	Laboratory	1.5
	4.1 Theory	
	4.2 Practice	

TABLE 1-9

CURRICULUM OF OPERATION AND MAINTENANCE OF WASTEWATER TREATMENT PLANT COURSE

(Cont'd)

NO	SUBJECT	PERIOD (DAYS)
5	Wastewater treatment process	4.5
	5.1 Activated sludge process (Conventional activated sludge, extended aeration, oxidation ditch)	2.0
	5.2 Fied flim biological treatment process (Trickling filter, rotating biological contactor, combined fixed film activated Sludge)	1.0
	5.3 Pond process (Stabilization pond, aerated lagoon)	1.0
	5.4 Sludge treatment (Aerobic treatment, Anaerobic treatment, drying bed)	0.5
6	Site visit	1.0
7	Countermeasures of operational problems and trouble shooting techniques	0.5
8	Training, monitoring, and reporting	0.5

TABLE 1-9

CURRICULUM OF OPERATION AND MAINTENANCE OF WASTEWATER TREATMENT PLANT COURSE

(Cont'd)

NO.	SUBJECT	PERIOD (DAYS)
9	Panel discussion	0.5
10	Closing ceremony	0.5
Total		10.5

FIGURE 1-8 LOCATION OF TCSW AND TTI

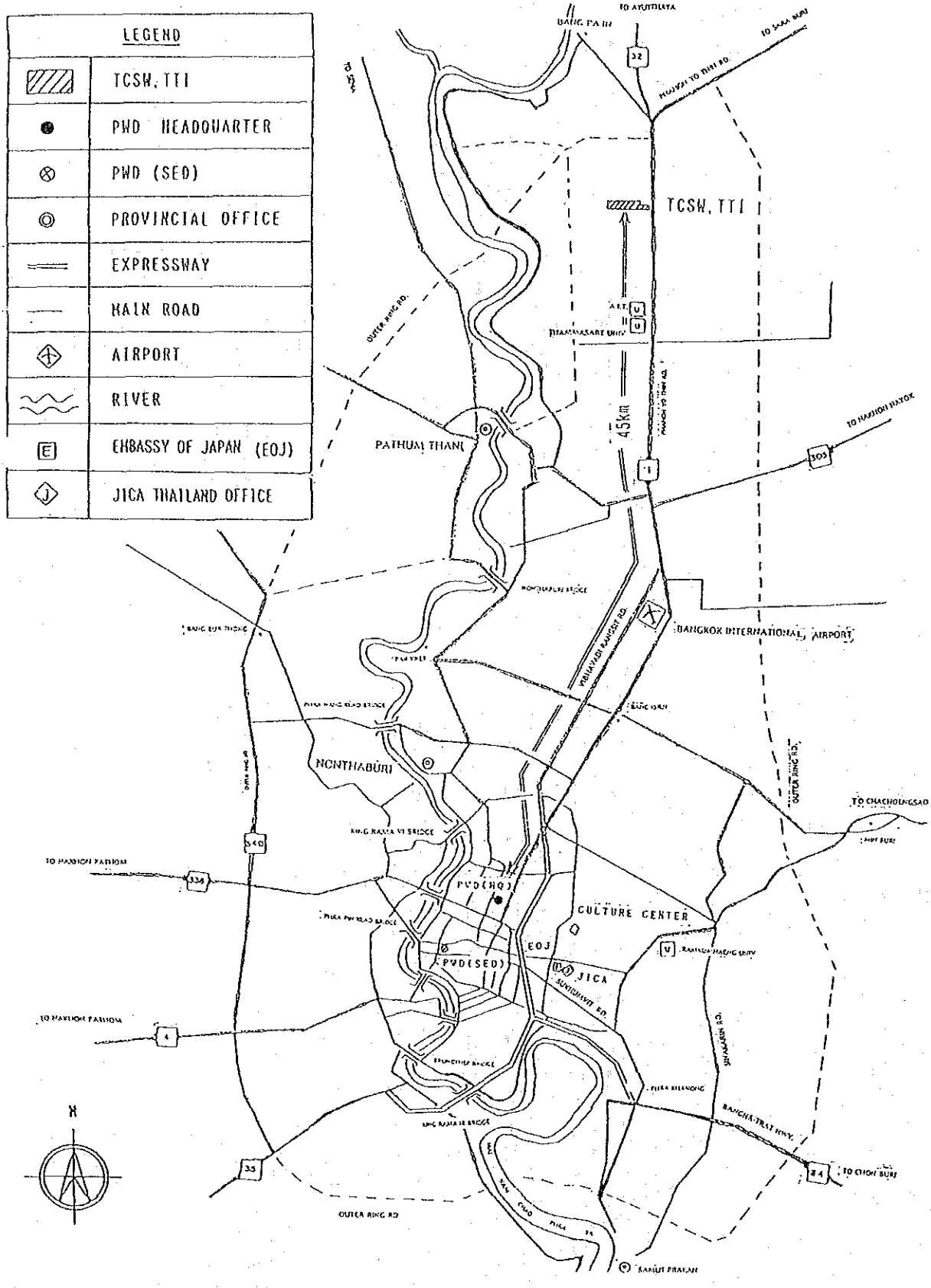
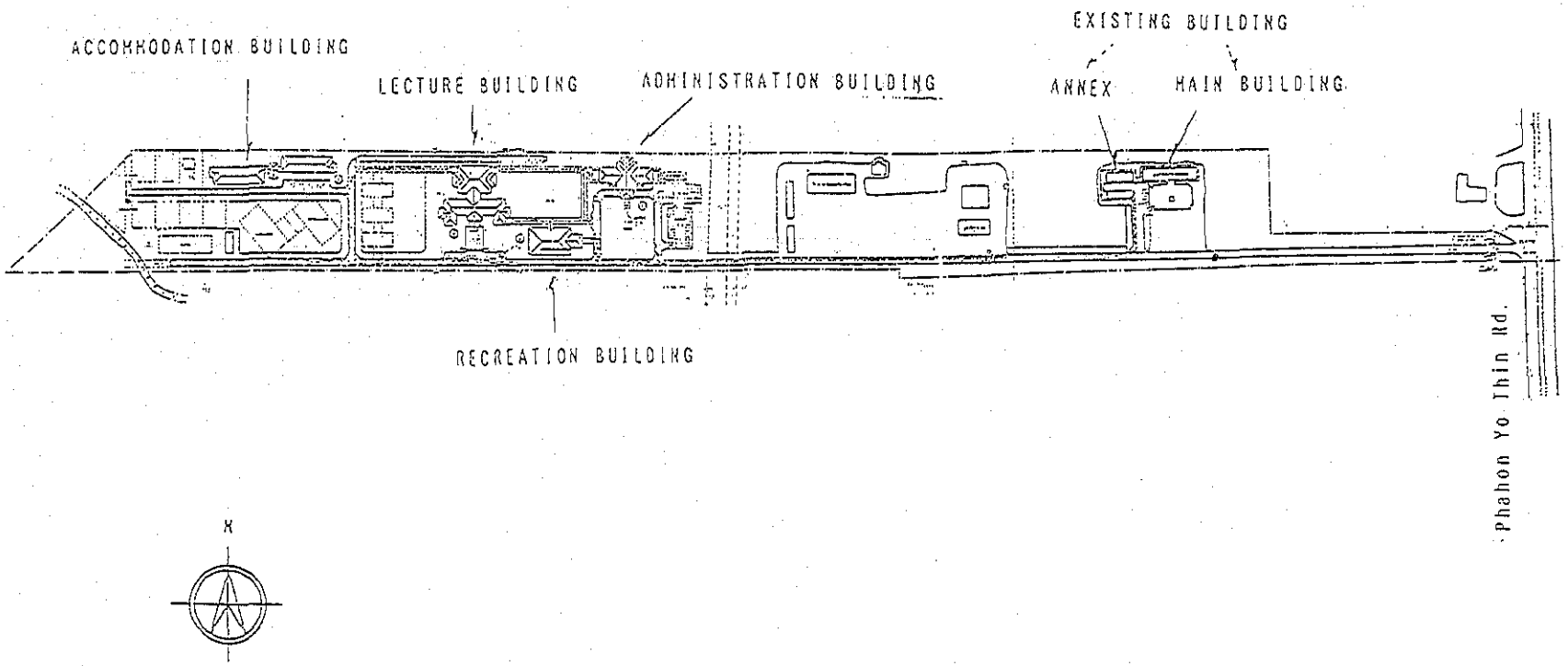
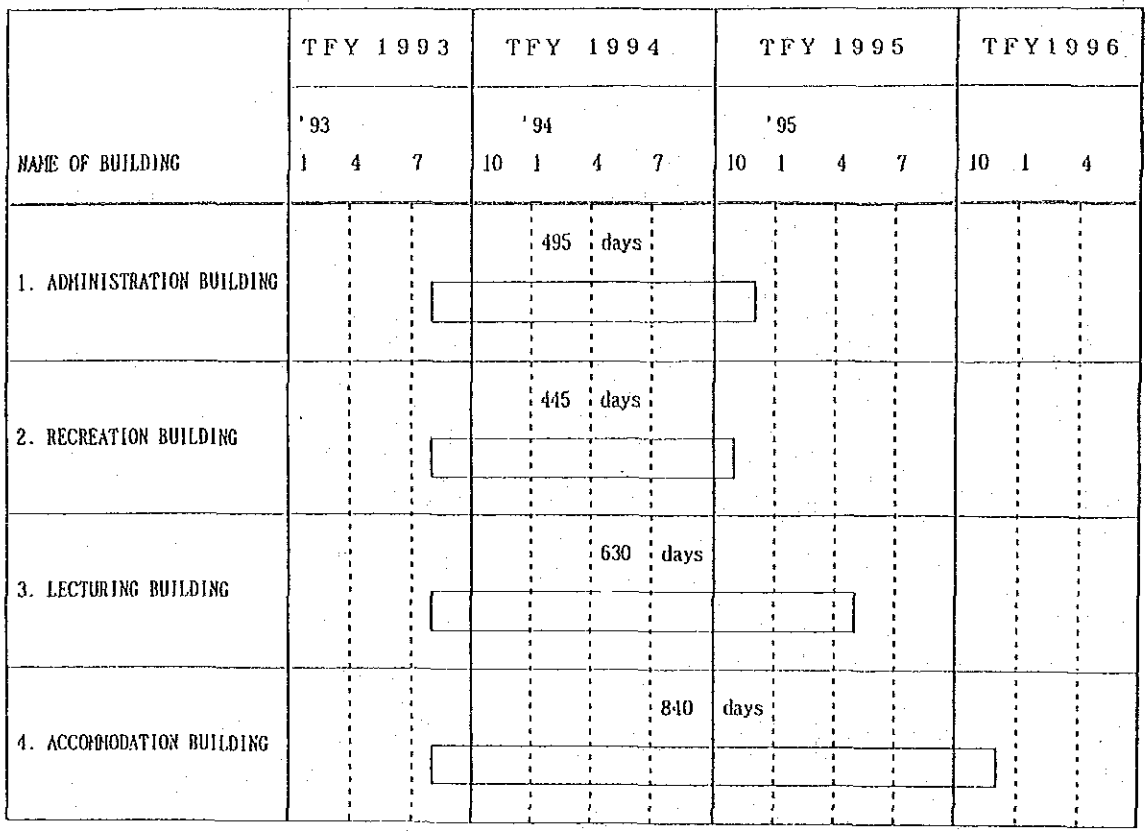


FIGURE 1-9 LAYOUT OF TTI



TOTAL AREA : 68 RAI (10.88 ha)

FIGURE 1-10 CONSTRUCTION SCHEDULE OF TTI



cf. TFY : Fiscal year of Thai government

CHAPTER 2. CONTENTS OF THE PROJECT

2.1 OBJECTIVES

The objectives of the project are to tranfer the sewage works technology to Thailand and to develop TCSW through the following activities.

(1) Tranfer of the sewage works technology through training of personnel in PWD, BMA, and local authorities.

(2) Preparation of technology transter through provision of practice of research and development on the apporiate technology for Thailand.

(3) Preparation of technology transter through establishment of data-base on sewage works in Thailand.

2.2 TERMS OF COOPERATION

The terms of cooperation of the Project is for five years (from 1995 to 2000.) THe implementation date will be settled in the Record of Discussions.

2.3 ORGANIZATION STRUCTURE OF TRAINING CENTER FOR SEWAGE WORKS

2.3.1 ORGANIZATION CHART

Technical Training Institute (TTI) is a Division of PWD, under the Ministry of Interior. Currently, there are three Sub-Divisions, namely Management Sub-Division, Training Administration Sub-Division, and Technical Group Sub-Division. TCSW will be as an additional Sub-Division of TTI. Organization chart for TCSW is shown in Figure 2-1.

As shown in Figure 2-1, two committees, Board of Institute and Institutional Committee, exist to promote TTI : Board of Institute is chaired by Minister of MOI, and Institutional Committee is chaired by permanent secretary of MOI. Members list of these committees are shown in Tables 2-1 and 2-2. In addition to these committees, Steering Committee will be set to promote TCSW.

TCSW will have a director, and will consist of four sections; Training Section 1, Training Section 2, Adminstration Section, and BMA branch center. Training Section 1 will be responsible for the training courses mainly on planning and designing. Training Section 2 will be responsible for the training courses mainly on operations and maintenance. Adminstration Section will be responsible for adminstration work to promote TCSW and training courses. In order to conduct on-the-job training, TCSW will have BMA branch center in Sri Phraya Sewage Treatment Plant, where the actual training concerning operations and maintenance of sewage treatment will be carried out.

2.3.2 COOPERATION BETWEEN PWD AND BMA

Although PWD is directly responsible for TCSW, cooperation with BMA is necessary, as explained in Section 2.3.1, to conduct on-the-job training for which BMA branch center will be utilized as a site including lecturers as part-time counterparts.

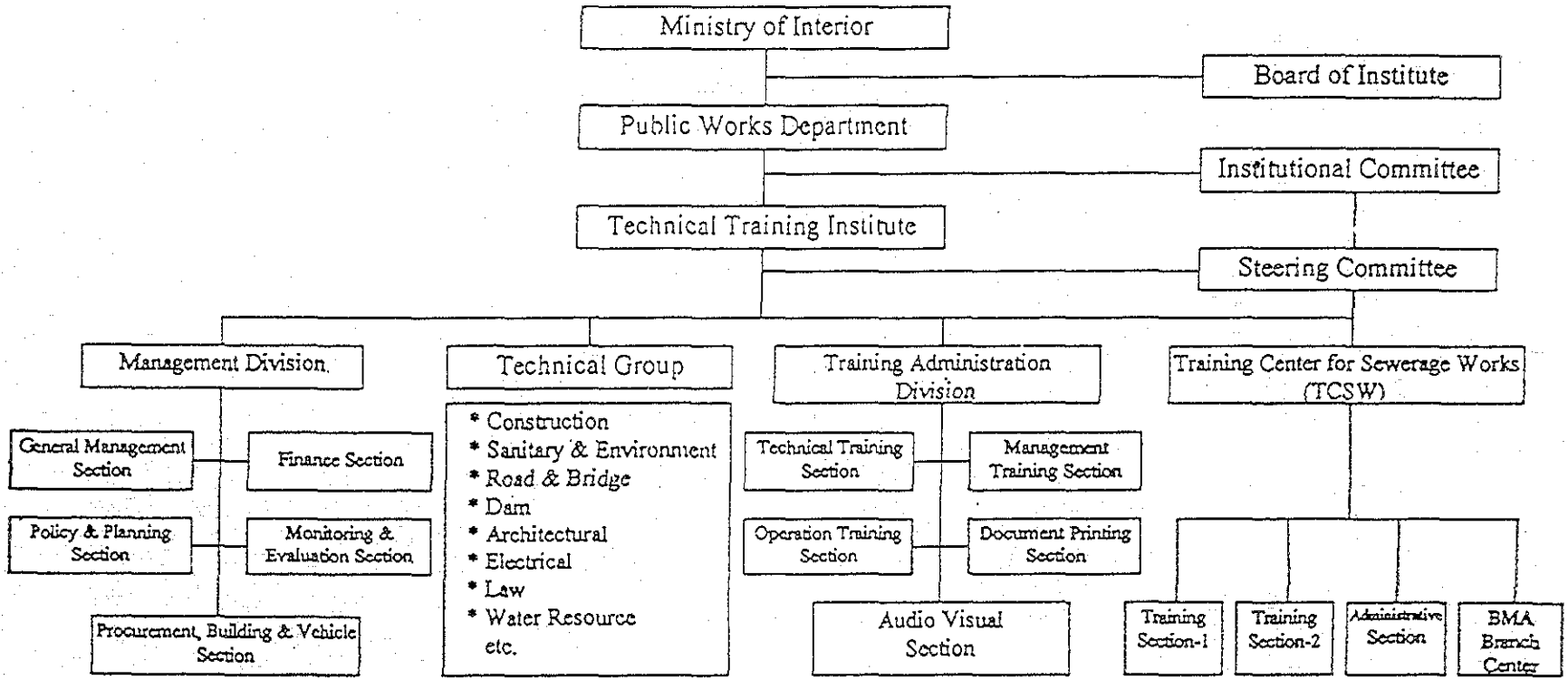
Because TCSW is a national project, all sectors involving sewage works should get together to promote TCSW. In Thailand, PWD has responsibility to help local authorities, except BMA, by preparing sewerage plan, design and construction of sewerage facilities. BMA is responsible for its own sewage works. Thus, these two sectors should work together to proceed TCSW successfully.

To promote TCSW with cooperation between PWD and BMA, representatives of BMA will join the Steering Committee.

Concerning training programs, as described in 2.4.1 and 2.4.2, BMA branch center will be utilized as on-the job training center. Operation and Maintenance course requires on-the-job training ; therefore, trainees of Operations and Maintenance course will spend most of the time in BMA branch center. Also, trainees of Water Quality Analysis will visit BMA branch center to take sewage samples.

FIGURE 2-1

ORGANIZATION CHART OF TCSW



MINISTRY OF INTERIOR

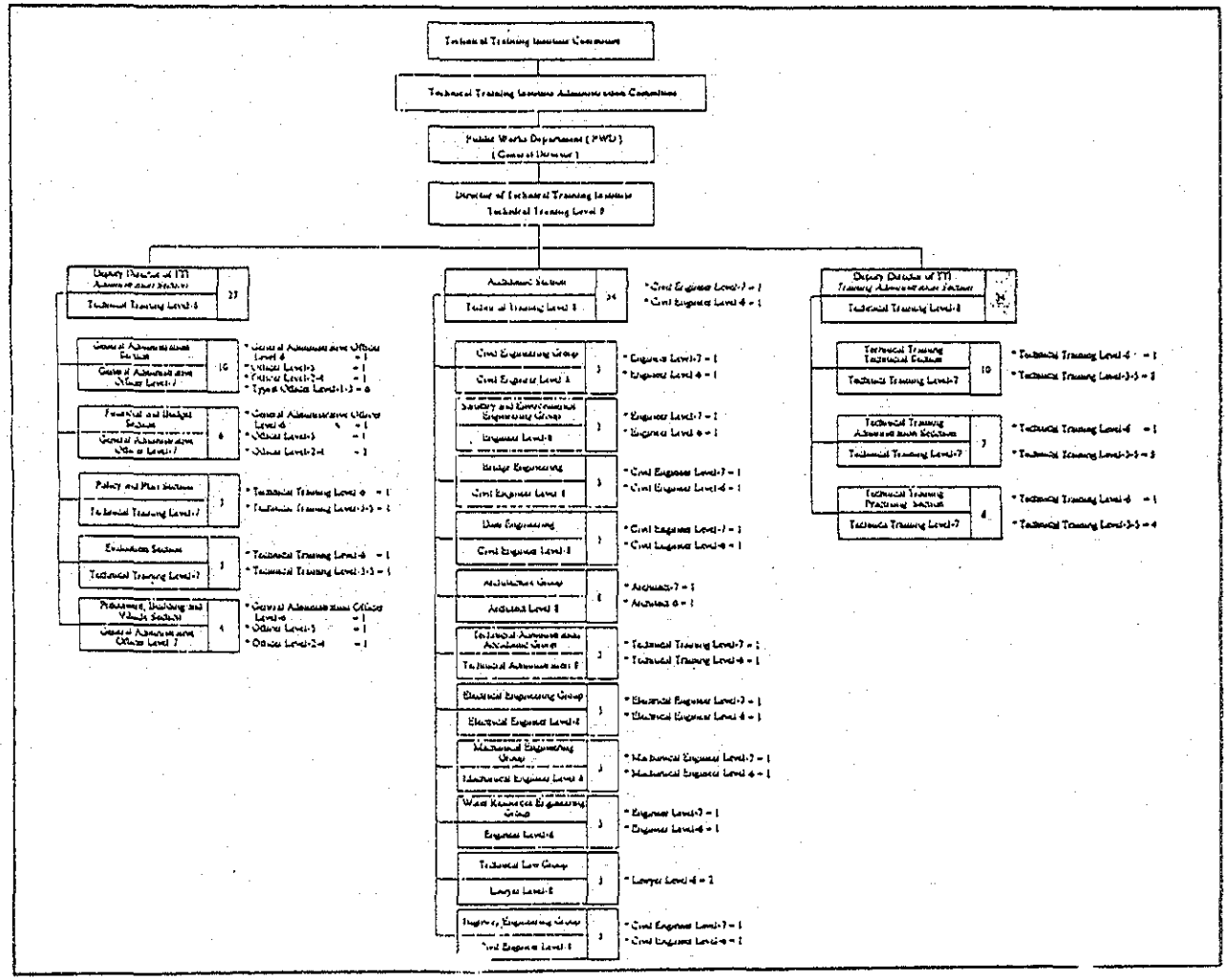


TABLE 2.1 COMMITTEE OF TTI (Board of Institute)

1.	Ministry of MOI	President
2.	Permanent Sectary of MOI	Vice-President
3.	The secretariat of the Civil Service Commission or Representation	Committee
4.	The Secretariat Office of the National Economic and Social Development Board	Committee
5.	Director of Budget Bureau	Committee
6.	Deputy Permanent Secretaries of Policy and Planning	Committee
7.	Director General of Department of Local Administration	Committee
8.	Director General of DIEC	Committee
9.	Director-General of Department of Town and City Planning	Committee
10.	Dean of Faculty of Engineering of Chulalongkorn University	Committee
11.	Dean of Faculty of Architecture of Chulalongkorn University	Committee
12.	Dean of Department of Vocational Commission	Committee
13.	Dean of Departmrnt of Development Community	Committee
14.	Director-General of Office of Acclerated Rural Department	Committee
15.	Experts (not over than 5 persons)	Committee
16.	Director-General of PWD	Committee and Secretary
17.	Deputy Director-General of PWD	Committee and Assistant Secretary
18.	Director of TTI	Committee and Assistant Secretary

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TABLE 2-2 COMMITTEE OF TTI (Institutional Committee)

1.	Permanent Secretary of MOI	President
2.	Director General of PWD	Vice-President
3.	Deputy Director General, Department of Local Administration	Committee
4.	Deputy Director-General, Department Town and City Planning	Committee
5.	Deputy Director General of PWD	Committee
6.	Chief Engineer of PWD	Committee
7.	Chief Architect of PWD	Committee
8.	Chief Engineer of Accelerated Rural Development	Committee
9.	Representative of Civil Service Commission	Committee
10.	Deputy Director General, Department of Highways	Committee
11.	Representative of Budget Bureau	Committee
12.	Deputy Director General, Royal Irrigation Department	Committee
13.	Deputy Director General, Community Development Department	Committee
14.	Director General of Damrong Rachanuparb Institute of MOI	Committee
15.	Director of TTI	Committee
16.	Deputy Director of TTI	Committee

2.3.3 STEERING COMMITTEE

To make proper operation of TCSW, Steering Committee will be set. The steering Committee will be chaired by Director-General of PWD and will have 11 members as shown below ;

1. Director-General of PWD	Chairman
2. Deputy Director-General Department of Local Administration	Committee
3. Minister of National Municipal League of Thailand	Committee
4. Representative from Department of Technical and Economic Cooperation Department	Committee
5. Repersentative from the Budget Bureau	Committee
6. Director-General of Department of Drainage and Sewerage (DDS) of BMA	Committee
7. Director of Water Quality Control Division, DDS/BMA	Committee
8. Director of Dhamrong-Rajanuparb Institute	Committee
9. Director of Sanitary Engineering Division/PWD	Committee
10. Director of TTI	Committee/ Secretary
11. Deputy-Director of TTI	Committee/ Assistant Secretary

The Steering Committee issues its policy about activities of TCSW. The Chairman of the Steering Committee is responsible for implementation of the project.

2.3.4 STAFF

TCSW will have a Director of Level 8. Administration Section will have a chief and 2-3 personnel to do administrative work and secretarial work. Two training sections will have at least 7 staff ; Civil Engineer, Sanitary Engineer, Mechanical Engineer, Electrical Engineer, Chemist, Biologist, and Economist (or Social

Scientist). These staff will be also counterparts to JICA experts. In addition, BMA branch center will have 2-3 personnel, who will be also counterparts to JICA experts.

2.3.5 COUNTERPARTS

The counterparts for JICA Project Leader should be the chairman of the Steering Committee, i.e. Director-General of PWD, and Director of TTI. The counterparts for JICA Coordinator should be Director of TCSW. Staff of two training sections in TCSW will be basically full-time counterparts for JICA experts, while staff of BMA branch center will be part-time counterparts.

2.4 PROGRAM OF TRAINING

2.4.1 TRAINING COURSES

The demand of sewage system in Thailand has been in creased in recent environmental deterioration carsed by rapid economic growth of the country. To protect such deterioration, Thai government has intensively invested to construct sewerage facilities and will continue to promote sewerage project all over Thailand.

Although the demand and necessity for sewage works are strongly requested, technology of sewage works is quite new to Thailand. The public Works Department (PWD) has responsibility to help local authorities, except BMA, by preparing sewerage plan, design and construction of sewerage facilities. Local authorities are responsible for operations and maintenance of sewerage facilities. PWD, and local authorities, including BMA, are suffering from lack of well-experienced engineers in this field.

The tranfer of sewage works technology isplanned through intensive training. For planning, designing, construction, and operations and maintenance of sewerage facilities, Civil Engineer, Sanitary Engineering, Mechanical Engineering, Electric Engineering,

Biology, Chemistry, and Economics, are necessary. To cope with the shortage of approprite engineers for sewage works, this training program intens to convert engineers, scientists, and technicians in the field of other than sewage works to those with appropriate knowledge and technique for sewage works.

The programs are composed of the basic technology for sewage works. To implement the programs, training courses are arranged which are divided into seven courses as shown below.

1. PLANNING AND DESIGN 1:

This course provides knowledge of planning and design on sewers. This course is appropriate for civil and/or sanitary engineers/ technicians.

2. PLANNING AND DESIGN 2:

This course provides knowledge of planning and design on sewage treatment plant and pumping station . This course is appropriate for civil and/or sanitary engineers/technicians.

3. PLANNING AND DESIGN 3:

This course provides knowledge of planning, design, and construction suprevision on mechanical and electrical facilities in sewage treatment plant and pumping station. This course is appropriate for mechanical and electrical engineers/technicians.

4. CONSTRUCTION SUPERVISION

This course provides knowledge of construction supervision on sewerage facilities. This course is appopriate for civil engineers/ technicians.

5. OPERATIONS AND MAINTENANCE (BASIC)

This course provides basic knowledge of operations and maintenance of sewerage facilities. This course is appropriate for engineers/technicians who work or will work on operations and maintenance of sewerage facilities.

6. OPERATIONS AND MAINTENANCE (ADVANCED)

This course provides knowledge of operations and maintenance of sewerage facilities, especially rather complex system, such as conventional activated sludge process and RBC. Prerequisite : Operations and Maintenance (Basic).

7. WATER QUALITY ANALYSIS (BASIC)

This course provides basic knowledge of water quality analysis for sewage works. This course is appropriate for technicians and scientists who work or will work on water quality analysis at sewage treatment plant.

8. WATER QUALITY ANALYSIS (ADVANCED)

This course provides knowledge of water quality analysis for sewage works. Trainees will obtain how to operate high-technology analyzer, such as G.C. Prerequisite : Water Quality Analysis (Basic).

9. MANGEMENT OF SEWAGE WORKS

This course provides knowledge of management.of sewage works. This course is appropiate for non-engineering personnel.

Main subjects of each training courses are shown below.

1. PLANNING AND DESIGN 1 (SEWERS)
   1) Basic Planning of Sewerage Facilities
   2) Basic Knowledge of Stormwater Drainage
   3) Hydraulics for Sewerage Facilities
   4) Design of Sewers
   5) Basic Knowledge and Practice of Survay
   6) Design Practice

2. PLANNING AND DESIGN 2 (SEWAGE TREATMENT PLANT AND PUMPING STATION)
   1) Basic Planning of Sewerage Facilities
   2) Principle of Sewage Treatment
   3) Design of sewage Treatment Plant and Pumping Station

4) Hydraulics for Sewerage Facilities

5) Design Practice

3) PLANNING AND DESIGN 3 (FOR MECHANICAL/ELECTRICAL STAFF)

1) Basic Planning of Sewerage Facilities

2) Principle of Sewage Treatment

3) Machinery for Sewage Treatment

4) Electric Apparatus for Sewage Treatment

5) Pumping Station

6) Construction Supervision

7) Design Practice

4. CONSTRUCTION SUPERVISION

1) Principle of Sewerage Treatment

2) Basic Knowledge and Practice of Survey

3) Construction Planning

4) Construction Mangement

5) Quality Control

6) Inspection

5. OPERATION AND MAINTENANCE (BASIC)

1) Principle of Sewage Treatment (Basic)

2) Operations and Maintenance of Sewerage Facilities (Basic)

3) Practice of O/M of Pumps

4) Practice of O/M of Machnery for Sewage Treatment (Basic)

5) Practice of O/M of Electric Apparatus for Sewage Treatment (Basic)

6) On-the- Job Training

6. OPERATION AND MAINTENANCE (ADVANCED)

1) Principle of Sewage Treatment

2) Operations and Maintenance of Sewerage Facilities (Advanced)

3) Practice of O/M of Machinery for Sewage Treatment (Advanced)

4) Practice of O/M of Electric Apparatus for Sewage Treatment (Advanced)

5) Water Quality Management

6) On-the-Job Training

7. WATER QUALITY ANALYSIS (BASIC)

1) Priciple of Sewage Treatment (Basic)
2) Outline of Water Quality Analysis (Basic)
3) Practice of Water Quality Analysis (Basic)

8. WATER QUALITY ANALYSIS (ADVANCED)

1) Principle of Sewage Treatment (Advanced)
2) Outline of Water Quality Analysis (Advanced)
3) Practice of Water Quality Analysis (Advanced)
4) Biology for Sewage Treatment
5) Water Quality Management

9. MANAGEMENT OF SEWAGE WORKS

1) Outline of Sewerage Facilities
2) Laws and Regulations on Sewage Works
3) Outline of Economics
4) Cost of Operation and Maintenance of Sewerage Facilities
5) Financing for Sewage Works

Training Duration and number of trainees are shown below

Name of Course	Duration of Training	Number of Trainees	Number of Courses/yr	Total Number of Trainees/yr	Trainees from
PLANNING AND DESIGN 1	3 weeks	20	1	20	PWD BMA
PLANNING AND DESIGN 2	3 weeks	20	1	20	PWD BMA
PLANNING AND DESIGN 3	3 weeks	20	1	20	PWD BMA
CONSTRUCTION SUPERVISION	3 weeks	20	2	40	PWD BMA
OPERATION AND MAINTENANCE (BASIC)	4 weeks	20	6	120	Local BMA
OPERATION AND MAINTENANCE (ADVANCED)	4 weeks	20	3	60	Local BMA
WATER QUALITY ANALYSIS (BASIC)	3 WEEKS	20	1	20	PWD Local BMA
WATER QUALITY ANALYSIS (ADVANCED)	3 weeks	10	1	10	PWD Local BMA
FINANCE FOR SEWERAGE WORKS	2 weeks	15	2	30	PWD BMA Local

Note : Planning and Design 2, Operation and Maintenance (Basic), and Water Quality Analysis (Basic) will start from the second year. Other courses will start from the third year.

The number of trainees are calculated based on the data shown in Table 2-3.

TABLE 2-3 EXPECTED TRAINEES

A. CONSTRUCTION PLAN TREATMENT PLANT

FY	1995	1996	1997	1998	1999	2000	TOTAL
PWD	16	3	4	17	6	6	52
BMA	8	5	1	2			16
TOTAL	24	8	9	19	6	6	72
ACCUMULATION	24	32	41	60	66	72	

B. NUMBER OF POSSIBLE TRAINEES

FY	1995	1996	1997	1998	1999	2000	TOTAL
CIVIL/SANITARY ENG.	20	7	8	21	10	10	76
CIVIL TECH.	52	13	16	55	22	22	180
SANITARY TECH, SCI.	27	10	8	25	9	9	88
MECHANICAL ENG.	20	7	8	21	10	10	76
MECHNICAL TECH.	54	56	39	60	21	21	251
ELECTRICAL ENG.	20	7	8	21	10	10	76
ELECTRICAL TECH.	38	30	21	46	13	13	161
OFFICE PERSONNEL.	20	7	8	21	10	10	76
TOTAL	251	137	116	270	105	105	984

C. NUMBER OF TRAINEES IN EACH COURSE

FY	1995	1996	1997	1998	1999	TOTAL
PLANNING AND DESIGN 1	0	0	20	20	20	60
PLANNING AND DESIGN 2	0	20	20	20	20	80
PLANNING AND DESIGN 3	0	0	20	20	20	60
CONSTRUCTION SUPERVISION	0	0	40	40	40	120
OPERATIONS AND MAINTENANCE (BASIC)	0	120	120	120	120	480
OPERATIONS AND MAINTENANCE (ADVANCED)	0	0	60	60	60	180
WATER QUALITY ANALYSIS (BASIC)	0	20	20	20	20	80
WATER QUALITY ANALYSIS (ADVANCED)	0	0	10	10	10	30
MANAGEMENT SEWAGE WORKS	0	0	30	30	30	90
TOTAL	0	160	340	340	340	1180

2.4.2 IMPLEMENTATION OF TRAINING COURSES

a) Applicants for trainees

The applicants will be screened by the TCSW and the host office. Priority of the applicants selection should be from their related responsibilities to the present job. Training is supported to fulfill their deficiencies as efficiently and effectively as possible.

b) Preparation of Educational Materials

The educational materials such as textbooks will be prepared by the trainers under the guidance of JICA experts.

c) Budget Sources of Each Training Courses

Budget sources of each training courses will mainly come from TCSW and the other budget will be on the trainee's office.

2.4.3 TRAINING OF THAI COUNTERPARTS IN JAPAN

According to the counterparts training system based on the Projects-type Technical Cooperation program, the training staff of TCSW should be further trained in Japan in order to upgrade the curriculum and to improve techniques. It is expected that they will undertake intensive training courses in Japan and take study tours with emphasis on specialized fields of sewage works. Such intensive courses and/or educational tours should need approximately 2-4 months to accomplish. It is anticipated that these fellows will help to improve training activities in TCSW upon their return to Thailand.

At present, JICA provides group training courses in Japan. Among many group training courses, appropriate courses for counterparts of the project are as follows :

Couses		Duration
1.	SEWAGE WORKS ENGINEERING	3 months
2.	DOMESTIC WASTE WATER TREATMENT TECHNIQUE	4 months
3.	SEWERAGE TECHNOLOGY FOR STROMWATER	3 months
4.	OPERATION AND MAINTENANCE FOR SEWERAGE FACILITIES	2 months

3-5 perons per will be sent to Japan to attend JICA group training courses in Japan.

2.5 PRE-RESEARCH AND DATA-BASE

2.5.1 PRE-REARCH

At present, design of sewerage facilities is based on the data from books and materials published in foreign countries. In order to have sewerage facilities appropriate for Thailand not for foreign countries, it is necessary to do research work because of the difference of temperature, climate, and environmental. Basically, research work ; is necessary to promote in the Project ; however, at first, this Project will focus on personnel training because the lack of sewerage personnel is very severe. Thus, this project will deal with pre-research which is to start research work. Which proceeding the research work, the results will be published as textbooks in TCSW. Moreover, the results will be utilized to improve our design work for sewerage facilities in Thailand.

Objectives of pre-research are summarized as following :

1) to obtain sewerage technology appropriate for Thailand.
2) to obtain parameters and values of the parameters appropriate to design and to operate sewage treatment plant in Thailand.

2.5.2 DATA-BASE

This data-base is intended to accumulate design and O/M information. First, accumlation of design data is necessary to improve quaity of design. This data-base will collect all the design data on sewerage facilities. Second accumlation of operations and maintenance data is necessary to operate sewerage facilities : however, there are no idea available at the beginning of the operation. Thus, this data-base will provide information to personnel who will operate sewerage facilities. Also, if some problem is found, operator can get necessary data to solve the problemfrom this data-base. Last based on this data-base, textbooks will be revised.

The objects with which this data-base will deal are as follows :

1) Reports on M/P, F/S, and D/D of every sewage treatment plant and pumping station
2) Drawings of every sewage treatment plant and pumping station
3) Operational data, such as flowrate and electric comsumtion
4) Water quality data, such as BOD, DO and SS

2.6 SITE FOR TRAINING

2.6.1 TTI HEADQUARTERS

As described in Chapter 2.3, TCSW has two sites, 1) TTI headquarters 2) BMA branch office in Sri Phraya Wastewater Treatment Plant. In this section, TTI site is described.

At present, TTI is preparing new building for expansion of its own training course and TCSW. Its location is shown in Figure 2-3. TCSW is a sub-division of TTI ; thus, TCSW headquarters will be located in TTI. The spaces exclusively provided for TCSW are as follows ;

1. The 2nd floor of Administration Building (excluding Director's room) is for main office.

2. The 1st floor of Lecture Building is for laboratory and model equipment room.
3. The 3rd floor of Lecture Building is for teaching rooms.

These locations are shown in Figure 2.5 through 2.12. Also each area of above is shown in Tables 2.4 through 2.7

TCSW's office will be located on the second floor of administration Building. This office area consists of two offices, two lecturer's rooms, a meeting room, a library, and others. Library, recreation room, and lecturer's room can be also used as office, if necessary.

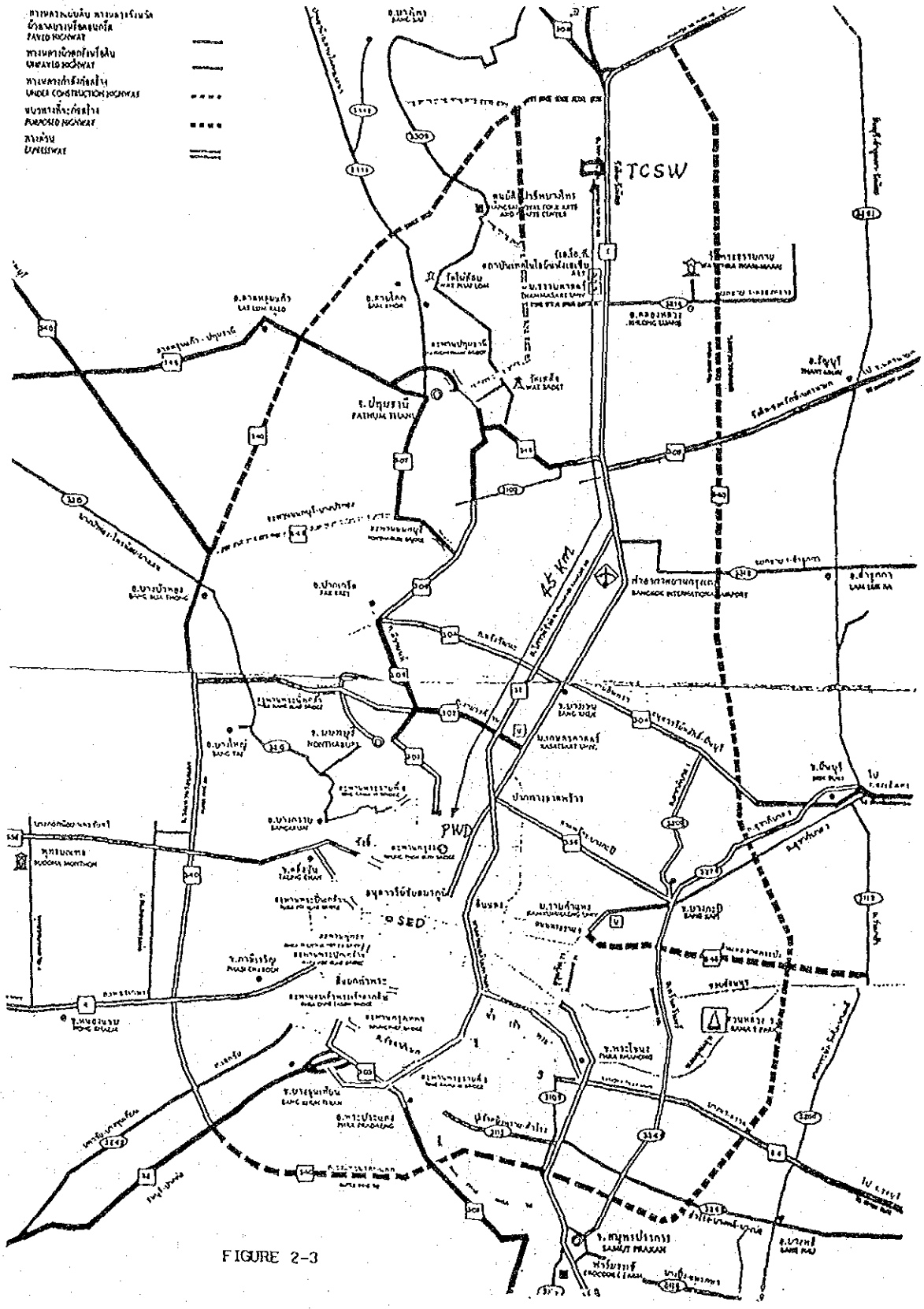
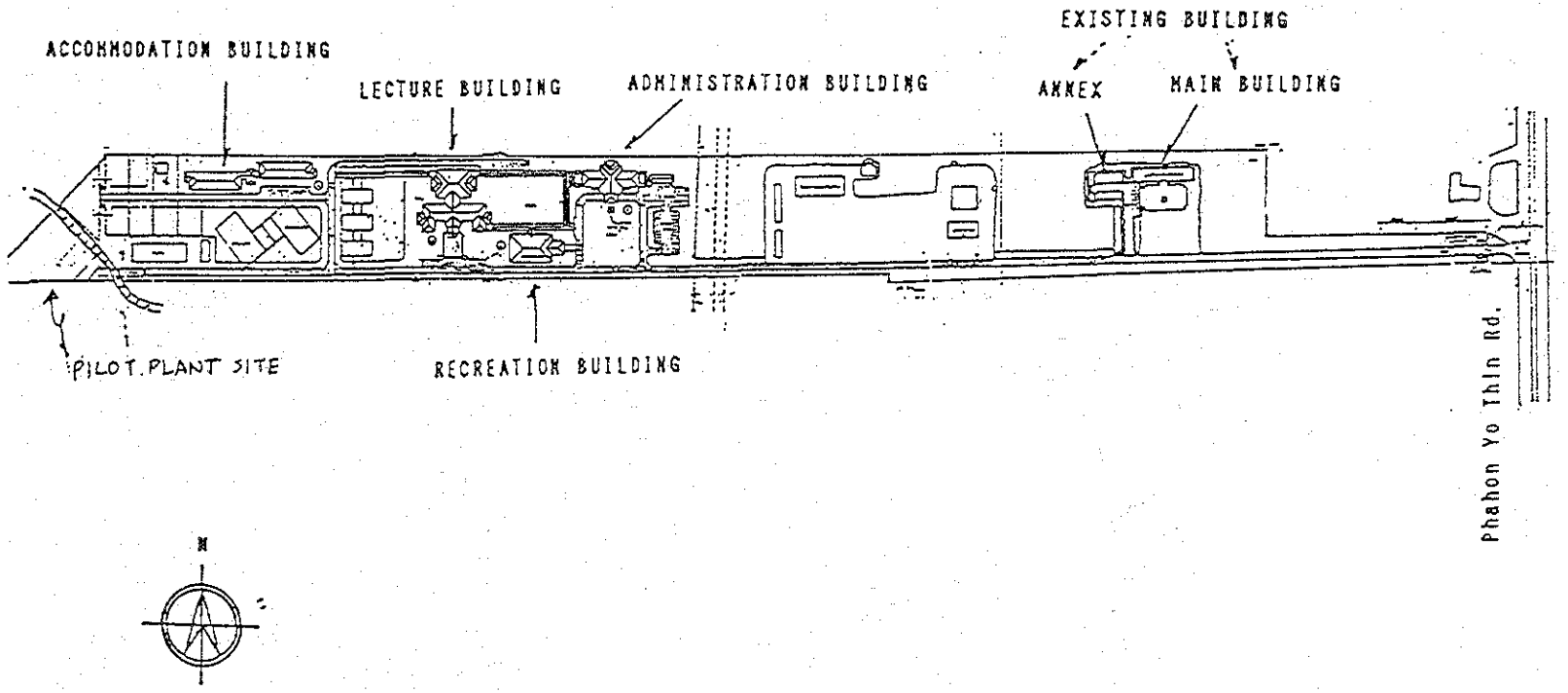


FIGURE 2-3

FIG. 2-4 LAYOUT OF TTI



TOTAL AREA : 68 RAI (10.88 ha)

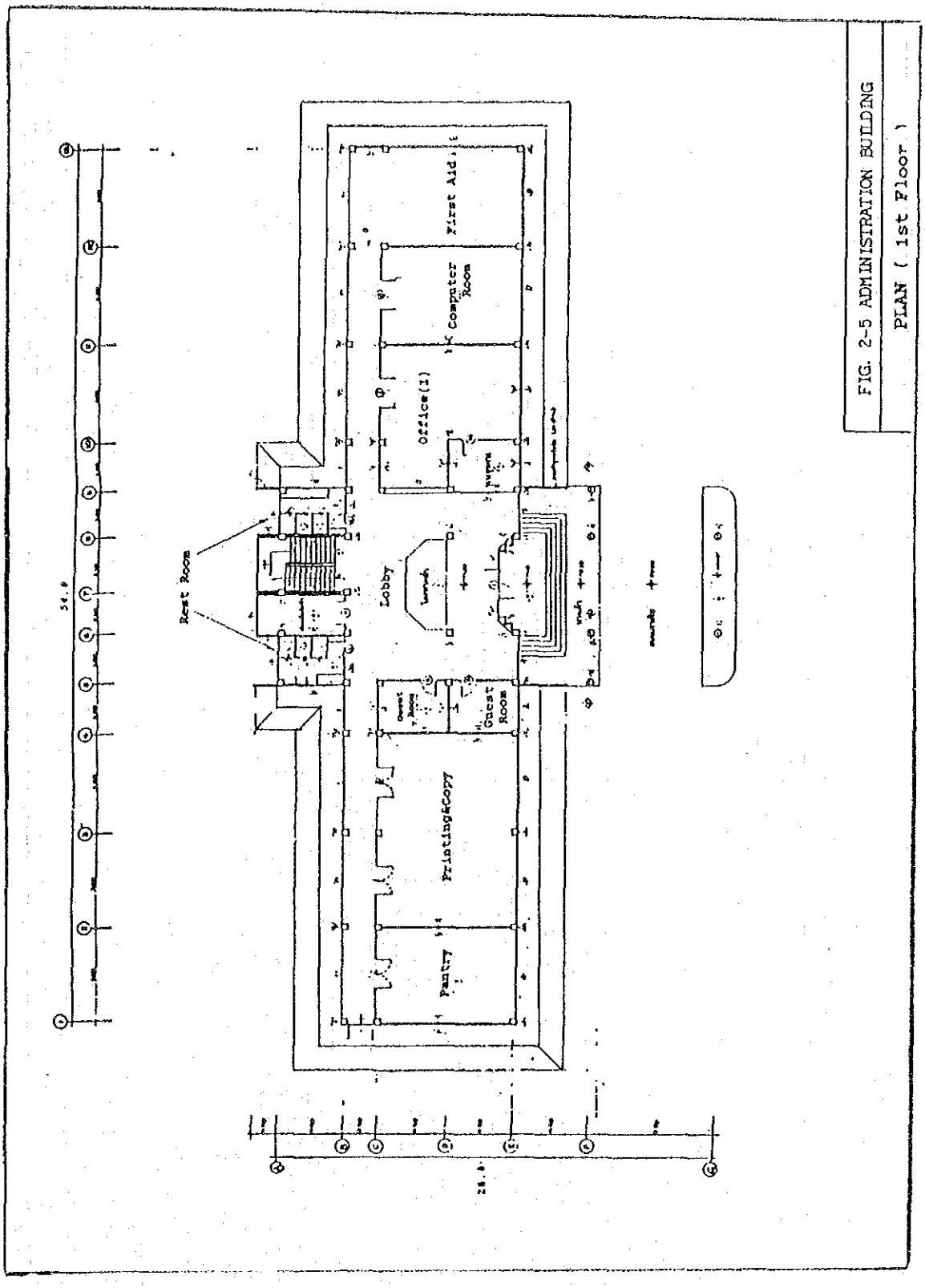


FIG. 2-5 ADMINISTRATION BUILDING

PLAN (1st Floor)

58

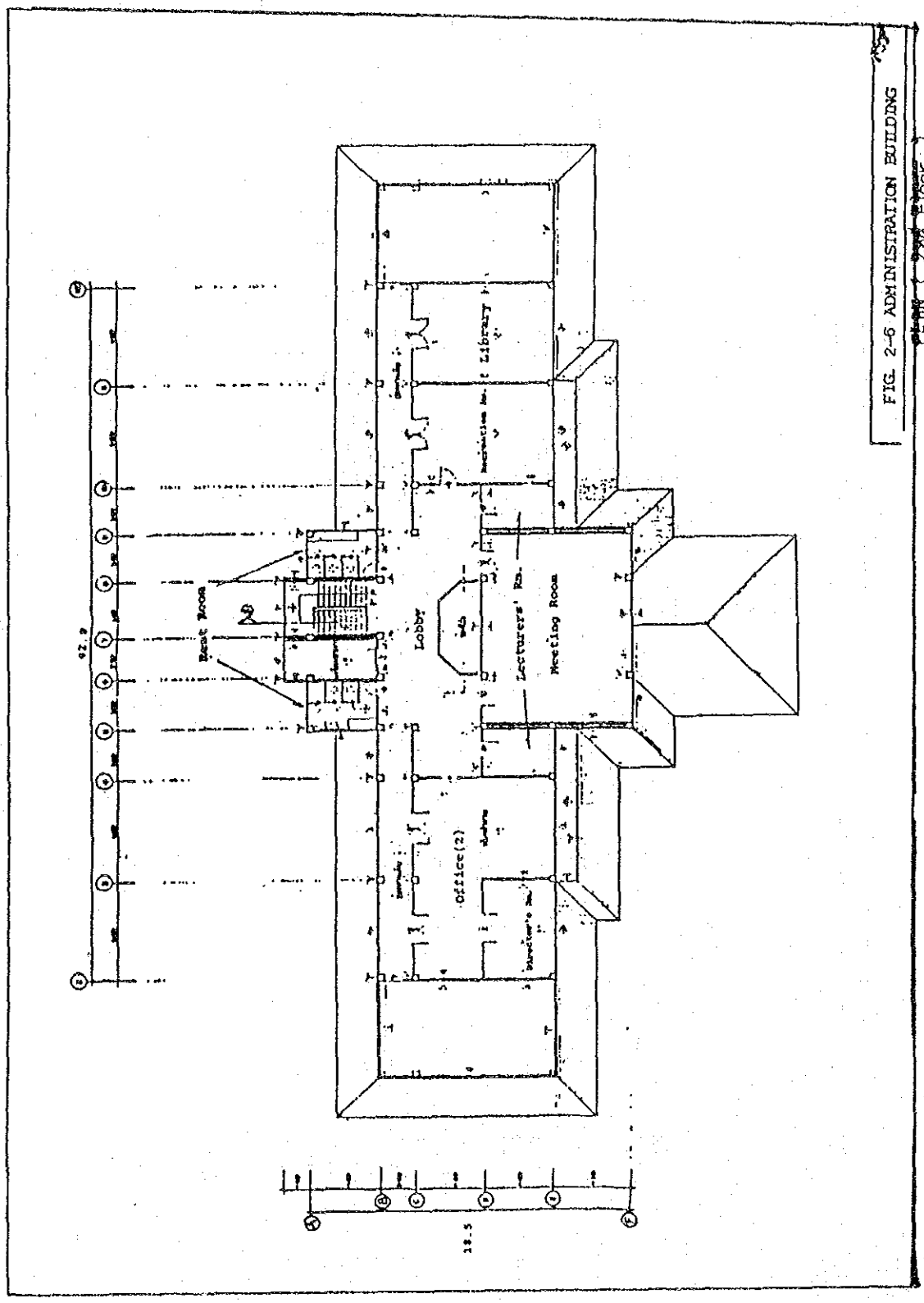


FIG. 2-6 ADMINISTRATION BUILDING

57

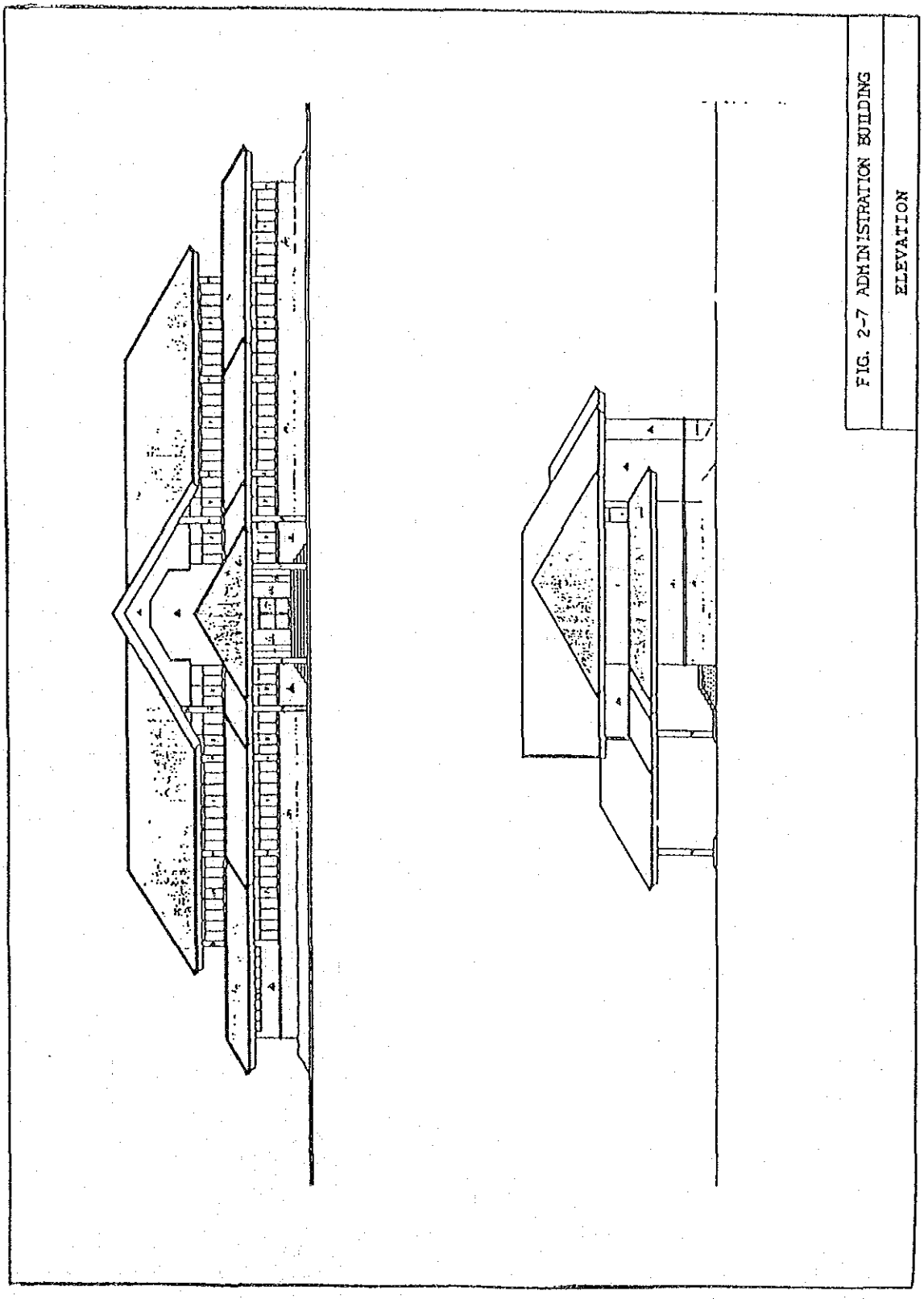
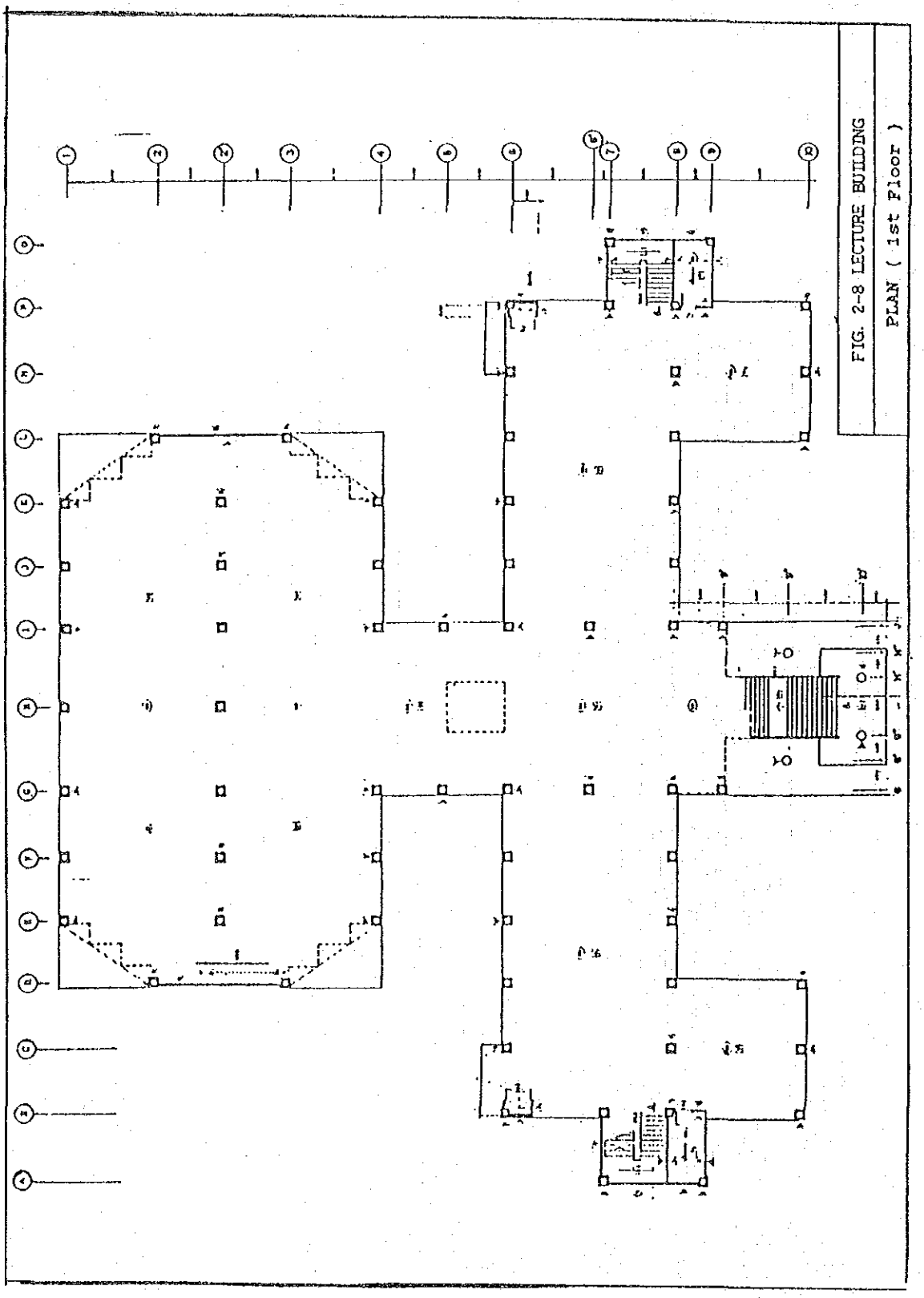


FIG. 2-7 ADMINISTRATION BUILDING
ELEVATION



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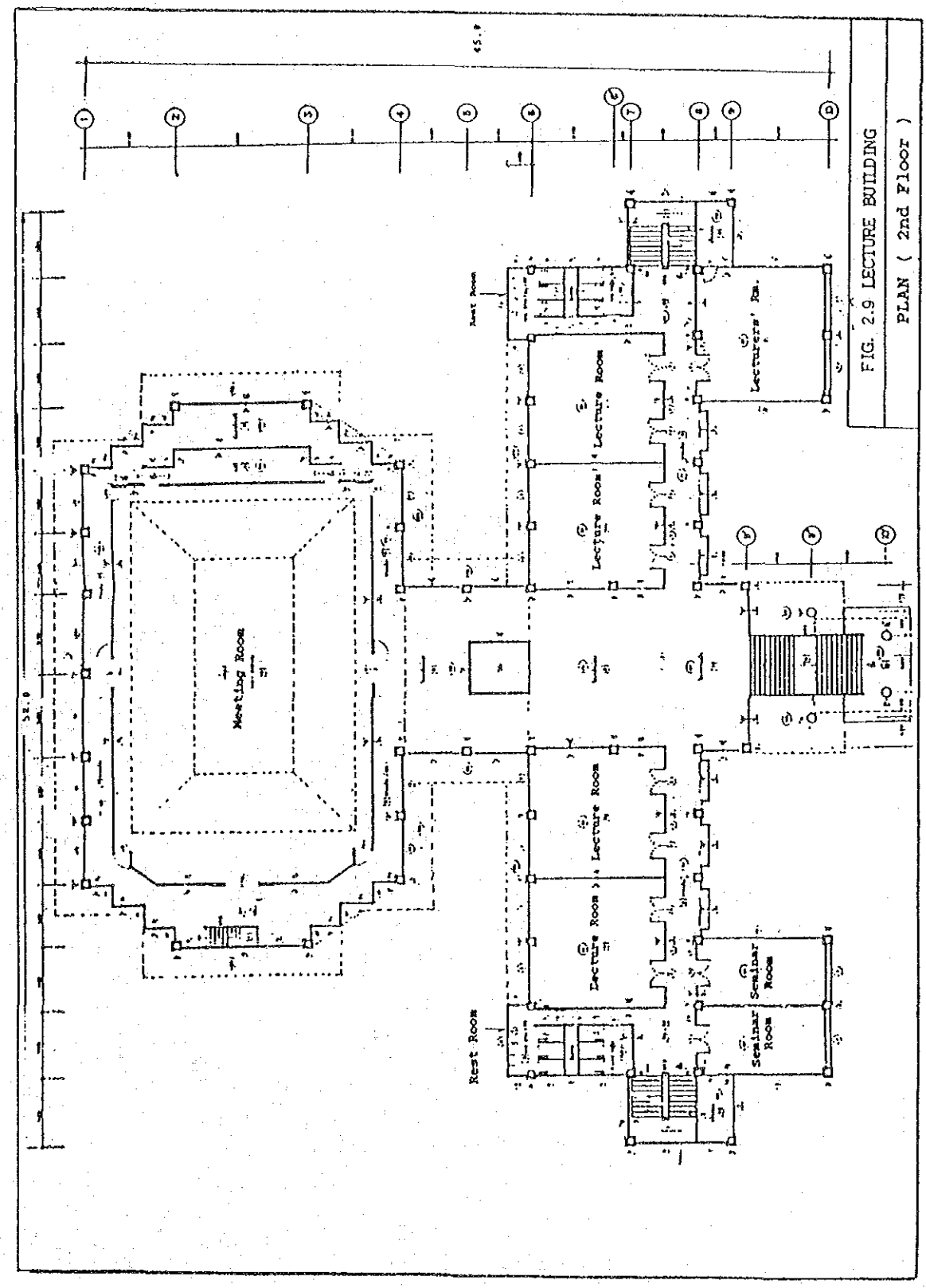
FIG. 2.9 LECTURE BUILDING
PLAN (2nd Floor)
Meeting Room
Lecture Room
Lecture Room
Lecturers' Rm.
Lecture Room
Lecture Room
Seminar Room
Seminar Room
Rest Room
Rest Room

62

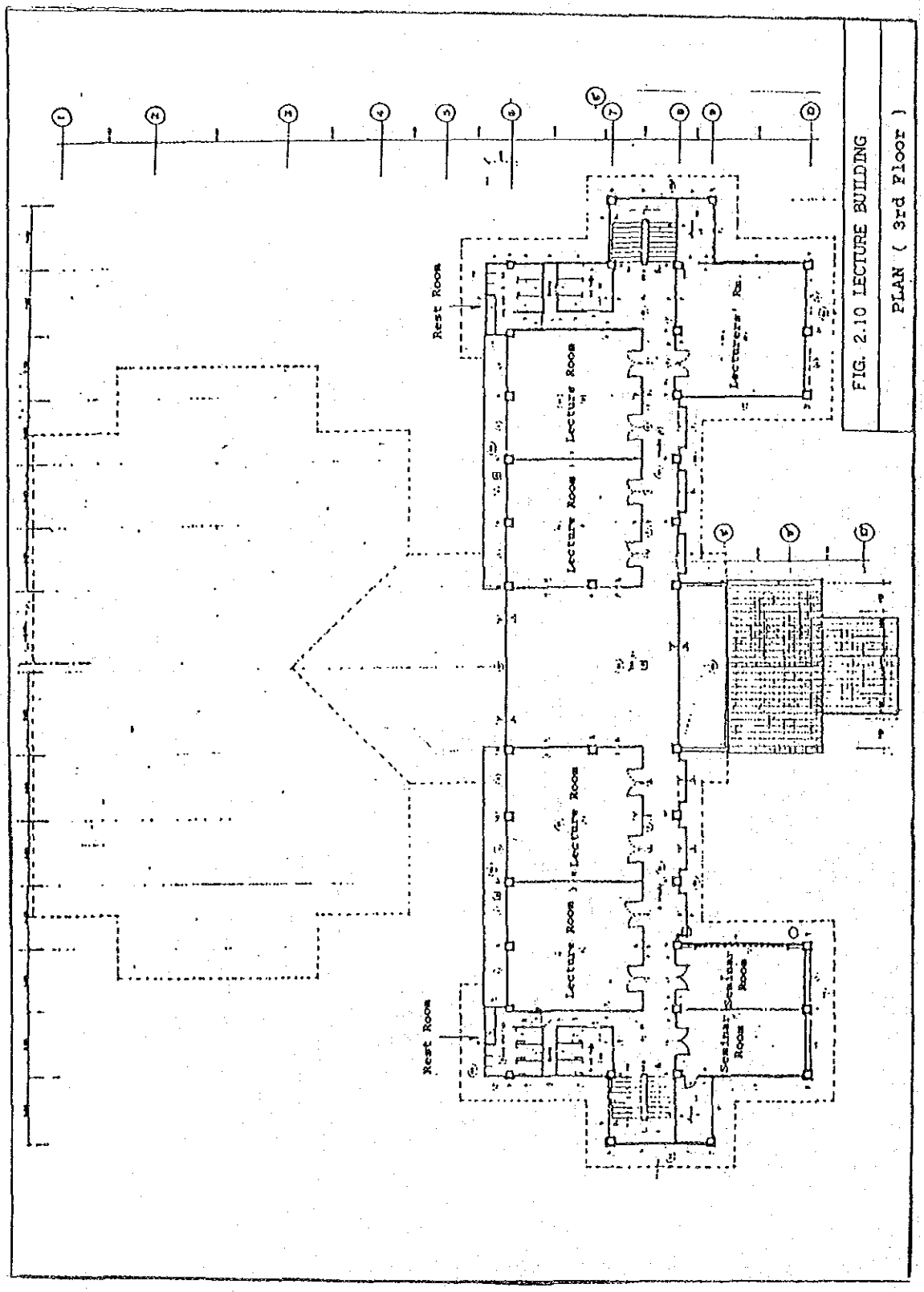
FIG. 2.10 LECTURE BUILDING
PLAN (3rd Floor)
Rest Room
Lecture Room
Lecture Room
Lecturer Rm.
Lecture Room
Lecture Room
Lecture Room
Seminar Room
Seminar Room
Rest Room

63

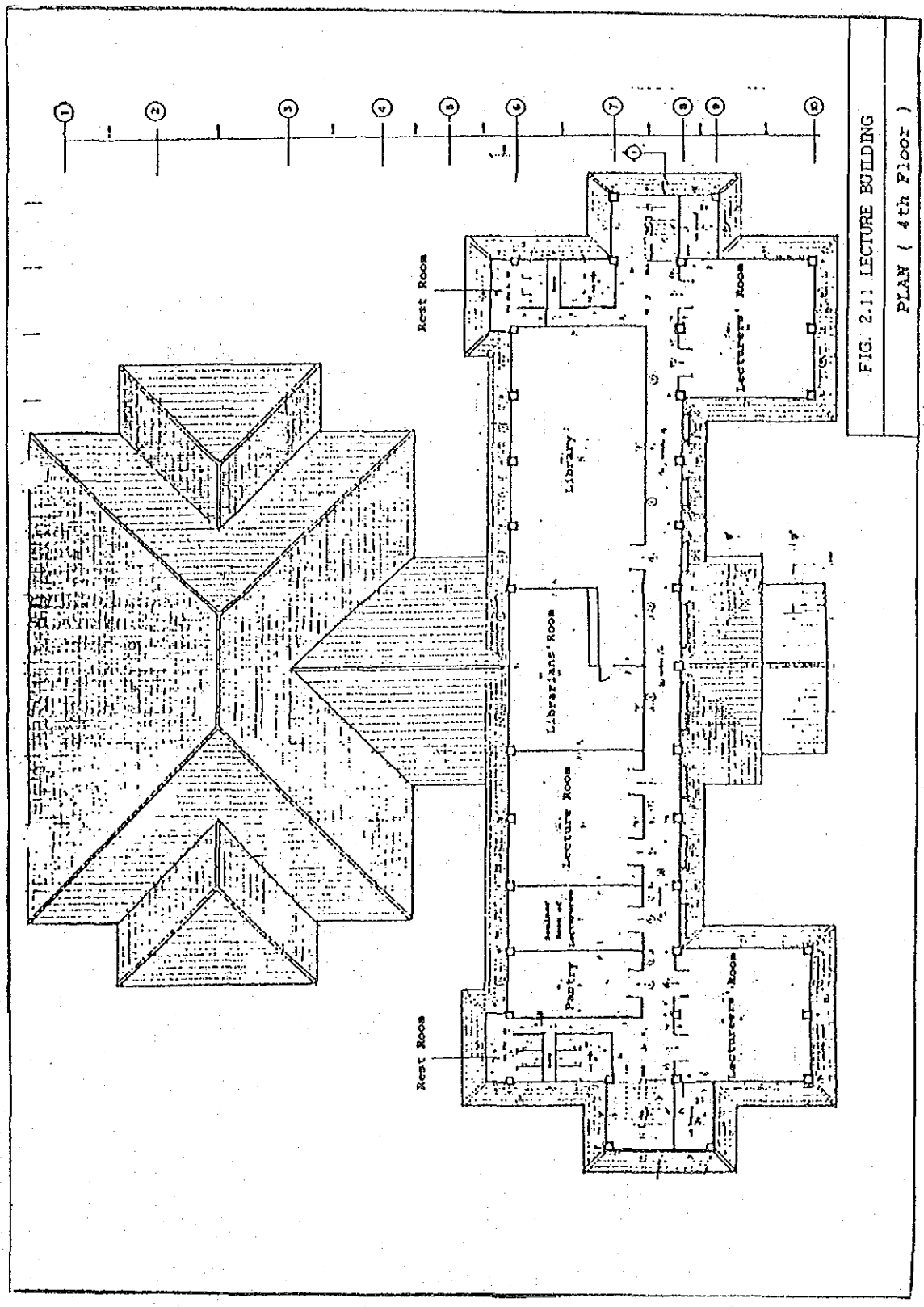
FIG. 2.11 LECTURE BUILDING
PLAN (4th Floor)
Rest Room
Library
Librarians' Room
Lecture Room
Pantry
Rest Room

64

FIG. 2-12 LECTURE BUILDING
ELEVATION

TABLE 2-4 ADMINISTRATION BUILDING

	Name of Room	Area (sq.m)	Number of Rooms
1st FL.	Lobby	120	1
	Office (1)	72	1
	Guest Room	12	2
	Computer Room	40	1
	Printing & Copy	96	1
	First Aid	48	1
	Pantry	48	1
	Rest Room	12	2
	Others	179	
	Sub-total	651	
2nd FL.	* Lobby	72	1
	Director's Room	24	1
	* Office (2)	72	1
	* Lecturers' Room	12	2
	* Meeting Room	114	1
	* Recreation Room	48	1
	* Library	48	1
	* Rest room	12	2
	* Others	105	
	* Sub-total	531	
TOTAL		1,182	

(TCSW 507)

* provided to TCSW

TABLE 2-5 RECREATION BUILDING

	Name of Room	Area (sq.m)	Number of Rooms
1st FL.	Hall	294	1
	Kitchen	18	2
	Storage	12	1
	Rest Room	15	1
	Maintenance	12	1
	Others	463	
TOTAL		832	

TABLE 2-6 LECTURE BUILDING

	Name of Room	Area (sq.m)	Number of Rooms
* 1st FL.		1,425	
2nd FL.	Meeting Room	416	1
	Lecture Room	64	4
	Seminar Room	32	2
	Lecturers' Room	64	1
	Rest Room	23	2
	Others	579	
	Sub-total	1,425	
* 3rd FL.	Lecture Room	64	4
	Seminar Room	32	2
	Lecturers' Room	64	1
	Rest Room	23	2
	Others	258	
	Sub-total	688	
4th FL.	Lecture Room	64	1
	Library	143	1
	Librarians'Room	65	1
	Lecturers' Room	64	2
	Seminar Room of Lectureres	32	1
	Pantry	32	1
	Rest Room	23	2
	Others	178	
	Sub-total	688	
TOTAL		4,226	

(TCSW 2.113)

* Provided to TCSW

TABLE 2-7 ACCOMMODATION BUILDING

	Name of Room	Area (sq.m)	Number of Rooms
1st Fl.	Lobby	105	1
	Recreation Room	149	1
	Laundry	119	1
	Rest Room	25	1
	Others	814	
	Sub-total	1,212	
2nd FL.	Dormitory *1	60	9
	Lecturer's		
	Dormitory *2	30	6
	Storage Room	20	1
	Others	472	
	Sub-total	1,212	
3rd FL.	Dormitory *1	60	12
	Storage Room	20	1
	Others	472	
	Sub-total	1,212	
4th FL.	Dormitory *1	60	12
	Stroage Room	20	1
	Others	472	
	Sub-total	1,212	
TOTAL		4,848	

cf. *1.....4 persons/room, *2.....2 persons/room

TABLE 2-7A MAIN BUILDING (EXISTING)

	Name of Room	Area (sq.m)	Number of Rooms
1st FL.	Office	28	1
	Lecture Room	56	2
	Lecturer's Rm	28	1
	Canteen	112	1
	Rest Room	28	1
	Others	139	
	Sub-total	447	
2nd FL.	Dormitory	28	10
	Rest Room	28	1
	Others	139	
	Sub-total	447	
Total		894	

cf. Dormitory ···for the participants
4 persons/room

TABLE 2-7B ANNEX (EXISTING)

	Name of Room	Area (sq.m)	Number of Rooms
1st FL.	Print & copy	22	1
	Storage	22	1
	Dormitory	22	2
	Rest Room	22	1
	Others	63	
	Sub-total	173	
2nd FL.	Dormitory	22	4
	Others	55	
	Sub-total	143	
Total		316	

cf. Dormitory ···for Lecturers and PWD staff
2 persons/room

Laboratory will be located on the first floor of Lecture Building, and has enough space of 1,425 m In this space, demonstration equipments such as pupms etc. will be exhibited.

Lecture rooms will be located on all of the third floor of Lecture Building. On this floor, there are four lecture rooms, two seminar rooms, one lecturer's room. One of the lecture rooms will be allotted as practice room for drawing.

The Sewage Treatment Pilot Plants will be constructed in the training center. As a pilot plant site, space at west end of TTI is allocated. In this area, pilot plants of sewage treatment processes, such as aerated lagoon, stabilization pond, and oxidation ditch, will be constructed to be utilized as practical training for trainees to be familiarized for themselves with variety of training.

2.6.2 BMA BRANCH OFFICE

BMA Branch is prepared in the building of Si Phraya Wastewater Treatment Plant operated by BMA. This branch is mainly used as the site for on-the-job training. Main part of training for Operations and Maintenance course and a part of Waste Quality Control course will be hold here

(1) Location (Figure 2-13)

SI PHRAYA WASTEWATER TREATMENT PLANT
Si Phraya Road
Bangkok
10500

(2) Outline of the branch

BMA branch is on the 6th floor in the building and consists of the staff room a lecture room, a laboratory and a practice room. The layout is shown by Figure 2-14.

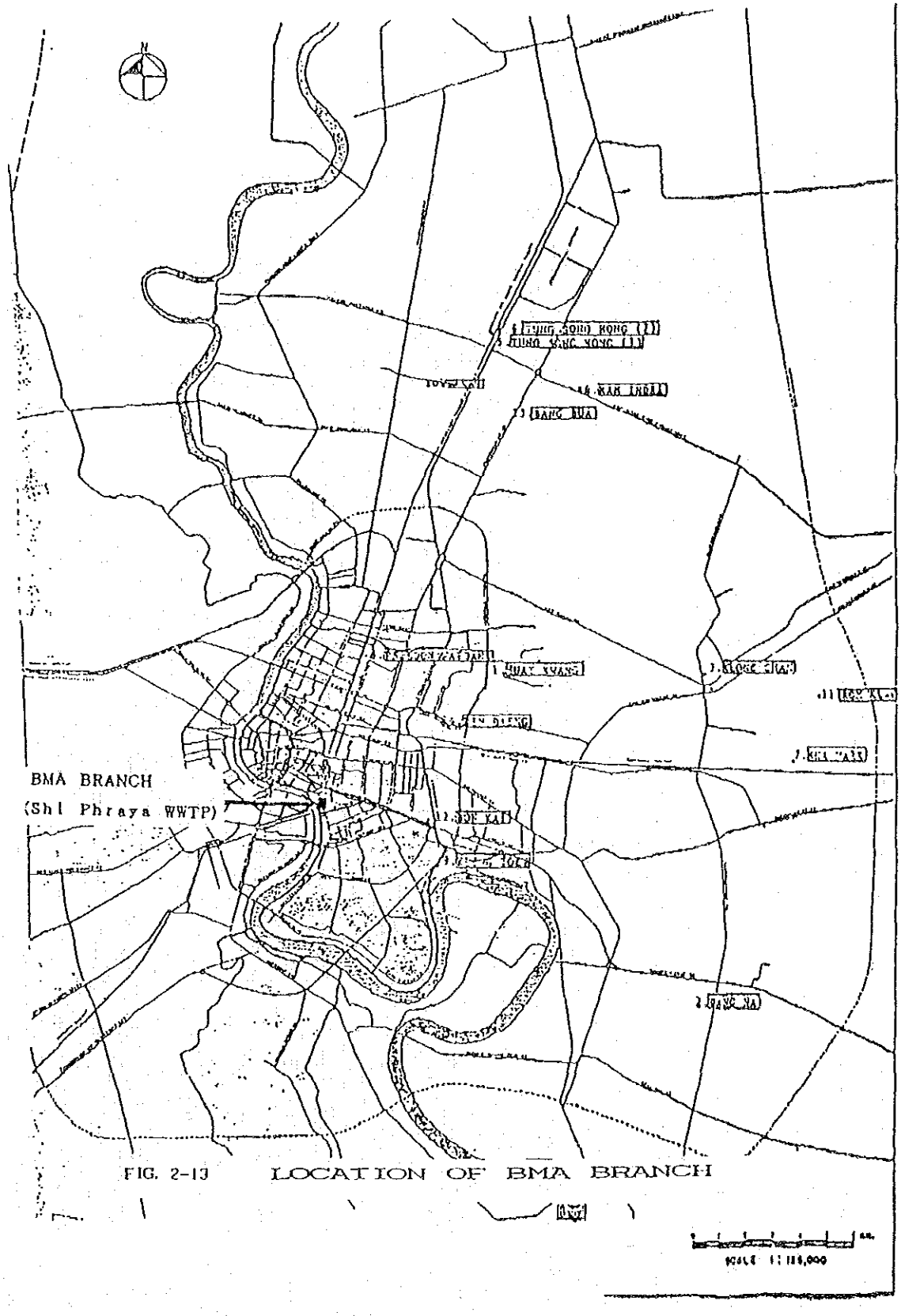

FIG. 2-13 LOCATION OF BMA BRANCH

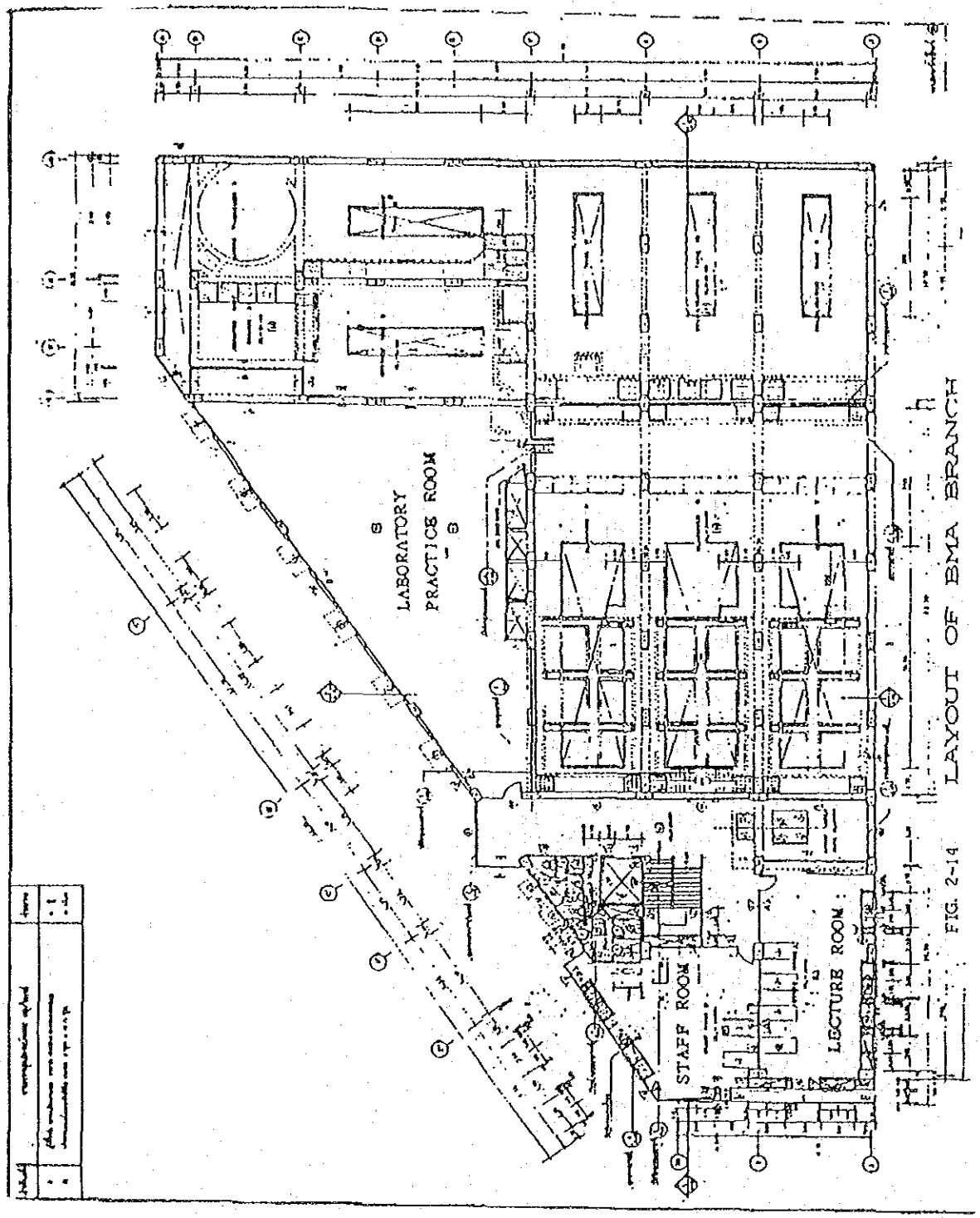

FIG. 2-14 LAYOUT OF BMA BRANCH

Floor	Name of Room		Area	
6th Floor	Staff Room	65 m²	Branch Chief Room Staff Room Expert Room	15 m² 35 m² 15 m²
	Lecture Room			70 m²
	Laboratory and Practice Room	200 m²	Labotatory Practice Room	70 m² 130 m²
	TOTAL			335 m²

(3) Other Space for training

BMA will arrange training space besides BMA Branch. These are available for Water Quality Analysis, Operations and Maintenance training. Those are located in Huay Kwang WWTP and Bang Na WWPT. (Located is shown in Figure 2-13)

Outline is as follows ;

1. Huay Kwang WWTP

Treatment process of this plant is conventional activated suldge process. Trainees can be trained for operations on conventional activated sludge process.

Location : Prachasungkok Rd. Huay KWang,
Bangkok. 10400

Facility : Laboratory and PRactice Room

2. Bang Na WWTP

This plant has oxidation ditch process. Trainees can be trained for operations on oxidation ditch process.

2.7 PROJECT IMPLEMENTATION

2.7.1 IMPLEMENTATION SCHEDULE

Table 2-8 shows the annual work plan to implement the project. The following activities are considered for the work area.

Revision of the texbook formation sall be mainly finished in the third year. In the fifth year, the last year of the Project, preparation of research and data-base shall be started and concluded.

Along with this schedule, necessary training eqipment will be provided by JICA.

2.7.2 DISPATCH OF JICA EXPERTS

Table 2-9-A shows the schedule of dispatch of JICA experts.

(1) Long Term Experts

As long term experts, a Project Leader, Civil Engineer, Sanitary Engineer, Mechanical Engineer, Electric Engineer, Chemist (or Bioligist) and Coordinator will be dispatched. The duties of Project leader and Coordinator are to summarize and manage the project, and to give advice to the Thai side. The duties of experts on each field are to conduct training courses and preparation of research and data-base, and to arrange training materials.

It takes long time to implement all of the experts duties described above. For example, usually it takes above one year to make

one textbook ; two month for outline and contents, four months for English draft, two month for evaluation and discussion, and four months for translation into Thai. Also, to have one training course needs at least three month ; one month for preparation (revision of material, etc.), one month for training course, and one month for evaluation. Therefore, total of seven long term experts shall be dispatched for five years.

TABLE 2-8 Project Implementation Schedule

Annual Work Plan

Project Year / Project Activities	1st year	2nd year	3rd year	4th year	5th year
1. Review of the Plan and Preparation for TCSW	———				
2. Curriculum Planning		———			
3. Texbook Formation	———	———	———	———	———
4. Staff Training	———	———	———	———	
5. Training		———	———	———	
6. Pre-Reserch and Data Base Preparation					———

1) Review of the plan and preparation for TCSW
2) Curriculum formation
3) Texbook formation
4) Staff training

In the first year, review of the plan and preparation of TCSW shall be completed. Then, curriculum planning and textbook formation shall be started.

In the second year, revision of the curriculum shall be completed and a part of training program, namely Planning and Design 2, Operation and Maintenance (Basic), and Water Quality Analysis (Basic), shall be strated.

In the third year, remaining courses shall be started.

TABEL 2-9 A DISPATCH OF EXPERTS

Project Period	1st year	2nd year	3rd year	4th year	5th year
1. Expert Assignment Schedule (Long term expert)					
1) Project Leader (60)					
2) Civil Engineer (60)					
3) Sanitary Engineer (60)					
4) Chemist (or Biologist) (60)					
5) Mechanical Engineer (60)					
6) Electric Engineer (60)					
7) Coordinator (60)					
(Short term expert)					
8) Biologist (12) (or Chemist)		—	—	—	—
9) Economist (12)		—	—	—	—

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TABLE 2-9 B Related Courses for each Expert

(1) Long Term Experts	Related Courses	Number of Courses per year
(1) Long Term Experts		
Civil Engineer	P.D.1 (1), P.D.2 (1), P.D.3 (1), C.S. (2), Management(2)	7
Sanitary Engineer	P.D.1 (1), P.D.2 (1), P.D. 3 (1) O/M (9), W.Q.A (2)	14
Chemist	O/M (9), W.Q.A (2)	11
Mechanical Engineer	P.D.3 (1), O/M (9)	10
Electric Engineer	P.D. 3 (1), O/M (9)	10
(2) Short Term Experts		
Biologist	W.Q.A (2)	2
Economist	Management (2)	2

Note : P.D. = Planning and Design
C.S. = Construction Supervision
O/M = Operations and Maintenance
W.Q.A = Water Quality Analysis
Management = Management of Sewage Works
Figure in parenthesis shows the number of courses per year.

(2) Short Term Experts

As short term experts, Biologist (or Chemist) and Economist will be dispateched for four times, in three month for each time. The duties of each short term experts are to develop the training courses and to arrange the training materials. The second year of the project, experts will arrange training materials. From the third year, experts will have training courses.

2.8 INVESTMENT PLAN

2.8.1 JAPANESE SIDE

(1) Provision of Equipment

Neeessary equipment to be used in each training courses and preparation of research and data base will be provided by JICA. The list of training equipment is shown in Table 2-10.

(2) Other assistance

Necessary local costs of technical exchange programs with TCSW will be also provided by JICA, as well as expenses for dispatch of Japanese experts to Thailand and for training of counterparts in Japan

2.8.2 THAI SIDE

A part of the local costs for technical exchange program with ICSW shall be born by Thai side.

(1) Preparation for Facilities

PWD and BMA shall prepare the facilities for TCSW to JICA experts and to install the equipment that will be provoded

from JICA. The facilities including Administration Building shall be prepared before JICA experts are dispatched.

(2) Provision of the Budget for TCSW

PWD and BMA shall secure budget for the operation cost of facilities during the training period.

PWD and BMA shall secure budget for expenditure of training programs.

TABLE 2-10 NECESSARY EQUIPMENT FOR TCSW

G. TOTAL 511,264
(Thousand yen)

	PWD	BMA	TOTAL	U. PRICE	PRICE
1. AUDIO EQUIPMENT				TOTAL	19,640
* FOR LECTURE ROOMS					
1) Microphone and Speaker	3	1	4	595	2,378
2) VTR and Projector	3	1	4	3,010	12,040
3) OHP	3	1	4	232	928
4) Slide Projector	3	1	4	152	608
* FOR MEETING ROOM					
1) Simultaneous Interpretation	1		1	3,491	3,491
2) Microphones	5		5	18	90
3) Speakers	1		1	24	24
4) Amplifier	1		1	80	80
2. EQUIPMENT FOR PRACTICE				TOTAL	30,462
1) Drawing Equipment	25		25	20	500
2) Surveying Equipment	10		10	609	6,092
3) Pump	1		1	5,270	5,270
4) Surface Aerator	1		1	2,500	2,500
5) Blower & Diffuser	1		1	5,400	5,400
6) Belt-press Dehydrater	1		1	3,620	3,620
7) Measuring Equipment	1		1	3,630	3,630
8) Control Circuit	1		1	3,450	3,450
3. EQUIPMENT FOR WATER QUALITY ANALYSIS				TOTAL	216,050
1) LABORATORY FURNITURE & FACILITIES				SUB TOTAL	76,200
* Center Tables	10	5	15	1,500	22,500
* Side Table	10	5	15	200	3,000
* Balance Table	4	4	8	300	2,400
* Sink	4	2	6	300	1,800
* Hume Hood	4	2	6	3,000	18,000
* Exhaust Gas Washer	2	1	3	5,000	15,000
* Storage Cabinet	4	2	6	400	2,400
* Bottle Cabinet	2	1	3	300	900
* Drying Shelf	4	2	6	500	3,000
* Laboratory Chair	40	20	60	20	1,200
* Waste Fluid Treatment Apparatus	1	1	2	2,500	5,000
* Others(Case, Cart, Work Table, etc.)			1	1,000	1,000
2) LABORATORY INSTRUMENT				SUB TOTAL	40,950
* Ultrasonic Cleaner	2	1	3	1,800	5,400
* Refrigerator(L)	2	1	3	300	900
* Refrigerator(M)	2	2	4	100	400
* Water Purifier	2	1	3	1,500	4,500

* Drying Oven	4	2	6	400	2,400
* Low Temp. Incubator	4	2	6	1,000	6,000
* Incubator	2	1	3	500	1,500
* Drying Sterilizer	2	1	3	400	1,200
* Autoclave	2	1	3	500	1,500
* Water Bath	2	2	4	400	1,600
* Muffle Furnace	2	2	4	700	2,800
* Distillation Equipment	2	1	3	600	1,800
* Vacuum Pump	2	2	4	150	600
* Hot Plate	2	1	3	150	450
* Centrifuge	2	2	4	500	2,000
* Shaker	5	2	7	300	2,100
* Evapolator	5	2	7	200	1,400
* Disiccator	5	3	8	300	2,400
* Others(Mixer, Stirrer, Heater, Pump)			1	2,000	2,000
3) ANALYTICAL EQUIPMENT				SUB TOTAL	88,900
* pH Meter	10	10	20	200	4,000
* DO Meter	10	10	20	600	12,000
* Spectrophtometer	2	1	3	2,000	6,000
* A.A. Photometer	2	1	3	10,000	30,000
* Analytical Balance	4	4	8	300	2,400
* Balance	4	4	8	200	1,600
* Moisture Balance	4	4	8	250	2,000
* Microscope(with VTR)	2	1	3	3,500	10,500
* Ion Chromatgraph	2	1	3	4,000	12,000
* Gas Chromatgraph	2	0	2	3,000	6,000
* Recorder	4	4	8	300	2,400
4) GLASSWARE			1		10,000
4. DEMONSTRATION PLANT				TOTAL	100,000
1) Oxidation Ditch	1				
2) Aerated Lagoon	1				
3) Stabilization Pond	1				
4) RBC	1				
5. EQUIPMENT FOR FORMATION TEACHING MATERIAL				TOTAL	28,416
1) Video Camera	4	1	5	100	500
2) Camera	4	1	5	100	500
3) Personal Computer and Printer	4	1	5	683	3,416
4) Personal Computer and Slide Projector	2	1	3	8,000	24,000
6. TEXTBOOK FORMATION					30,000
7. BOOKS					10,000
8. DATA BASE	1		1		43,000

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9. SUPPLEMENTARY EQUIPMENT					19,860
1) Copy Machine	2	1	3	500	1,500
2) Color Copy Machine	1	1	2	3,840	7,680
3) Facsimile	1	1	2	340	680
4) Others			1		10,000
10. VEHICLES				TOTAL	13,836
1) Mini Bus (25seats)	1		1	6,800	6,800
2) Micro Bus (12seats)	2		2	2,448	4,896
3) Van	1		1	2,140	2,140

PCMワークショップアンケート結果

December 12, 1994
PWD Phanfa

QUESTIONNAIRE ON PCM WORKSHOP FOR TRAINING CENTER FOR SEWAGE WORKS PROJECT

For the improvement of the quality of future PCM workshops, your frank comments and suggestions would be very much appreciated.

Please answer to each question by circling on the five-point scale:
1: Very poor 2: Poor 3: Fair 4: Good 5: Very good

1. To what extent did you find PCM Method useful for project planning?

1	2	3	4	5
	2人	1人	11人	8人

Comments:
- プロジェクトのコンセプト形成時には非常に有用。ただしもっと時間が必要（1人）
- 評価の観点からはよい手法である。ただし参加者は慎重に選定すべき（1人）
- 考えを体系化できて良い（1人）
- 議論の結果をまとめるのに一定のフレームワークが与えられるので良い（1人）

2. Was the moderator's instruction clear?

1	2	3	4	5
		4人	8人	10人

Comments:
- もう少しゆっくり話して欲しかった（1人）

3. Did the materials used by the moderator help your understanding on PCM?

1	2	3	4	5
		4人	9人	8人

Comments:
- 例をもっと多く提示して欲しかった（1人）

4. Was the time appropriately allocated?

1	2	3	4	5
	5人	8人	8人	1人

Comments:
- 配分はOK（1人）
- 時間が短すぎた（6人）
- 最低3日間は必要（1人）

Any further suggestions or comments:
- プロジェクトのタイプを決めるのには有用。
- 初心者には例示の多いマニュアルが必要。

The Primary Survey
for
The Project of Training Center for Sewage Works
in the Kingdom of Thailand

prepared by
Macro Consultants Co., Ltd.

November 1994

TABLE OF CONTENT

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SECTORAL SURVEY #3 : PLAN OF SEWERAGE WATER TREATMENT FACILITIES

SECTORAL SURVEY #4 : TRAINING AND RESEARCH INSTITUTIONS CONCERNING SEWERAGE TREATMENT AND RELATED FIELDS

SECTORAL SURVEY#1 : MANAGEMENT ORGANIZATION, ADMINISTRATION, BUDGET, REGULATION

1. Organization or Ministries which are responsible for sewage works

Organizations involving in sewage works can be catagoried to four types: policy planning, designing and constructing, operating, and regulating. Some organizations have more than one role as Bangkok Metropolitan Administration (BMA). BMA are responsible in designing and constructing, operating and regulating. Details of each organization are described below

1.1 Bangkok Metropolitan Administration (BMA)

The BMA takes care of an area of 1,572 square kilometers. The area can be classified into 3 groups as follows:

- high dense urban,
- medium dense suburban and,
- rural.

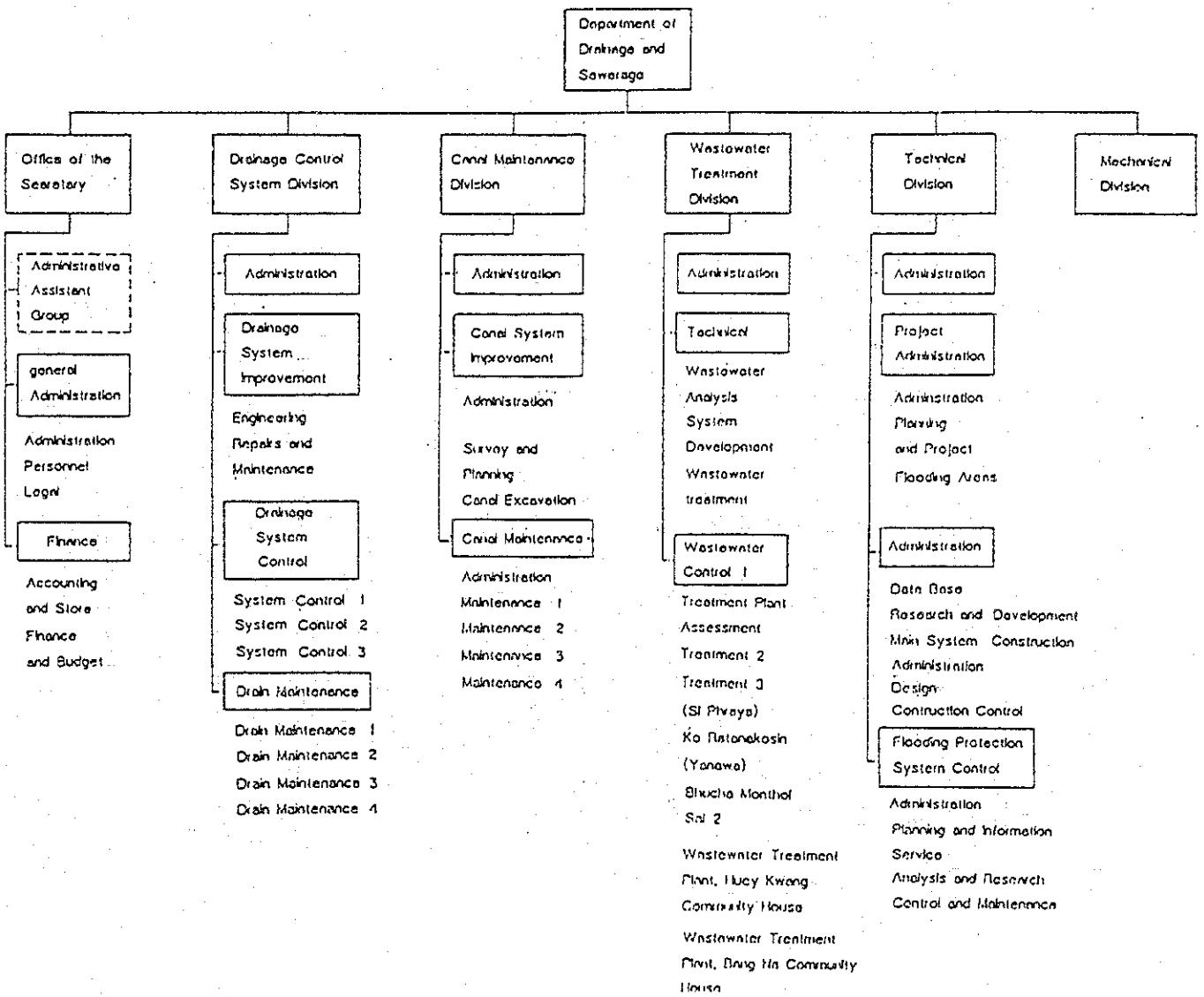
The Drainage Bureau of the BMA is the responsible agency.
There are 6 divisions responsible for various activities namely:

- Drainage control system
- Khlong maintenance
- Wastewater control
- Mechanical center
- Technical
- Secretariat

These divisions are further sub-divided into a number of area activities as shown in Figure 1-1

Figure 1-1

present BMA Organizational Management for Wastwater Treatment



1.2 Municipalities

In each Municipality, the wastewater and drainage works are under the Sanitary Engineering Division. This division, previously with the Engineering Division, has just been established recently as a result of an attempt to adjust to the aggravating situation of the wastewater problems. The division is sub-divided into 4 section, Wastewater, Solid Waste, Finance, and Administration. The organization is shown in Figure 1-2

1.3 Sanitary District

A Sanitary District is a local organization looking after small semi - dense urban centers in Amphoe area. In a Sanitary District, Drainage Unit looks after wastewater work. The division is divided into two sub-sections : the Engineering Section and the Sanitation and Public Health Section. Details are as shown in Figure 1-3

At present, both municipalities and sanitary districts are incapable to design and construct wastewater treatment plant by themselves because of lacking of both technical knowledge and money. Furthermore, they also lack of operation and maintenance personel. To cope with those difficulties,Public Works Department is in charge of designing and constructing the treatment plant and train their staffsfor sewage works

1.4 Provincial Administrative Organization (PAO)

The Governor in each province is the chief executive and responsible for both general management and as the representative of all local government orgnaizations. The organizational structure in the province is as shown in Figure 1-4

Figure 1-2
Newly Revised Wastewater Treatment of Municipalities (92)

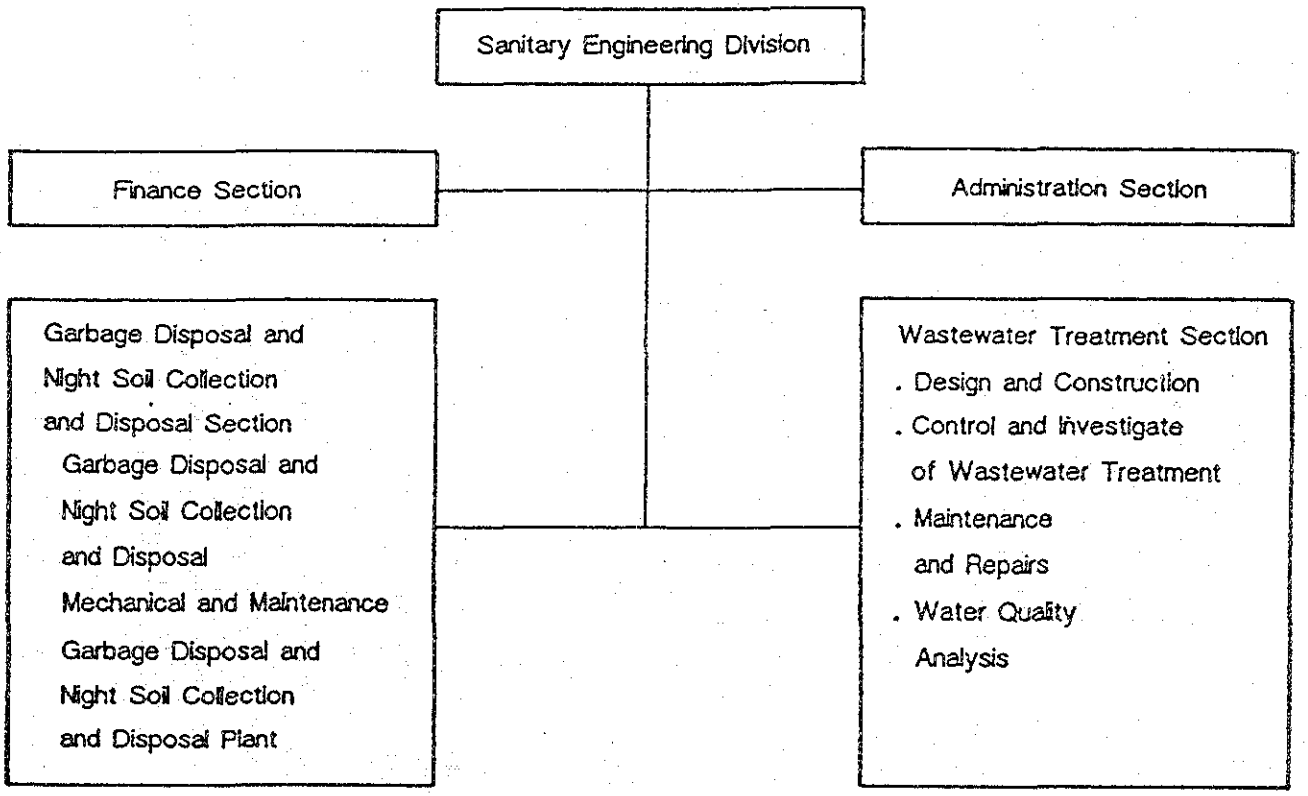


Figure 1-3

Unit Management of Sanitary Districts

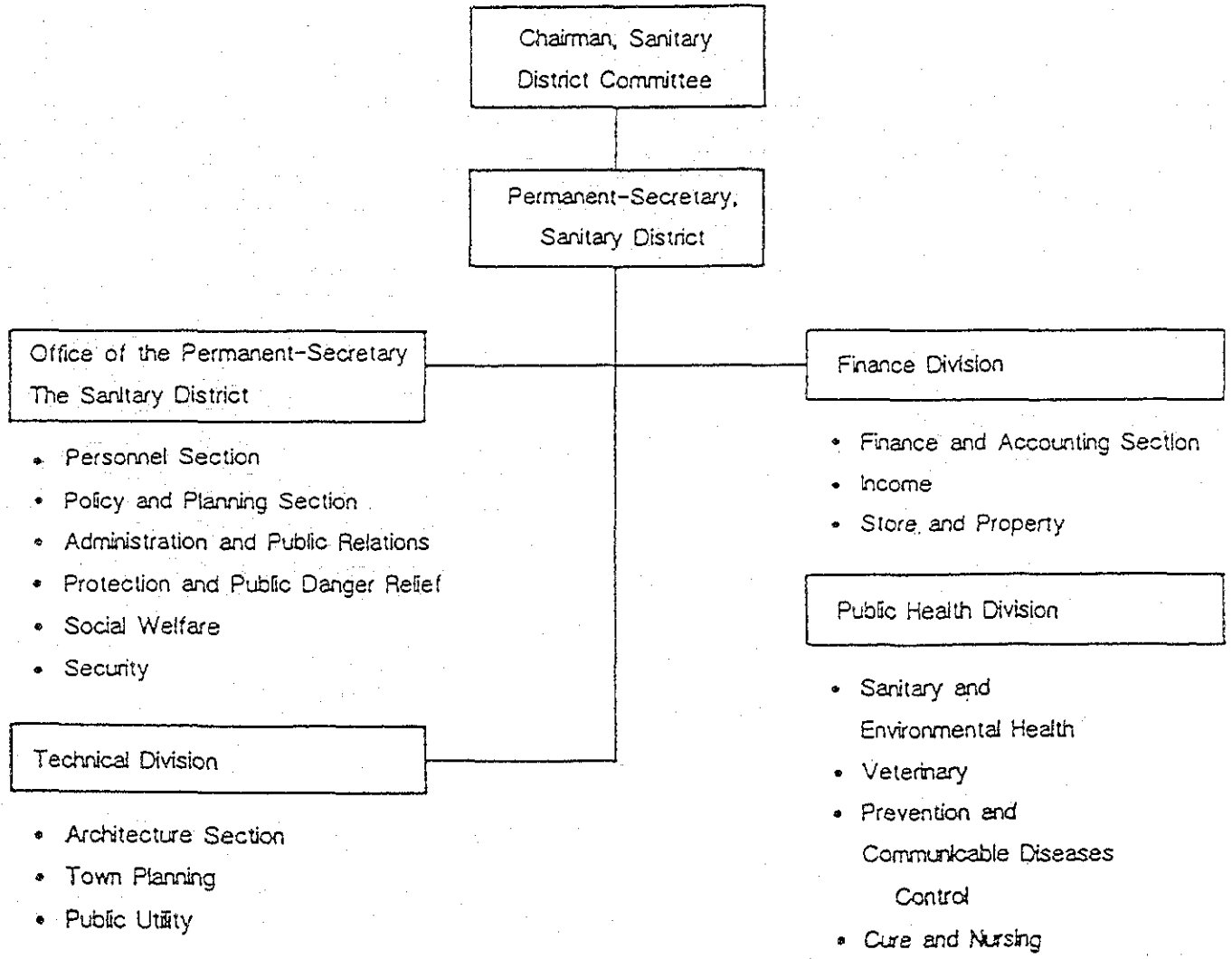
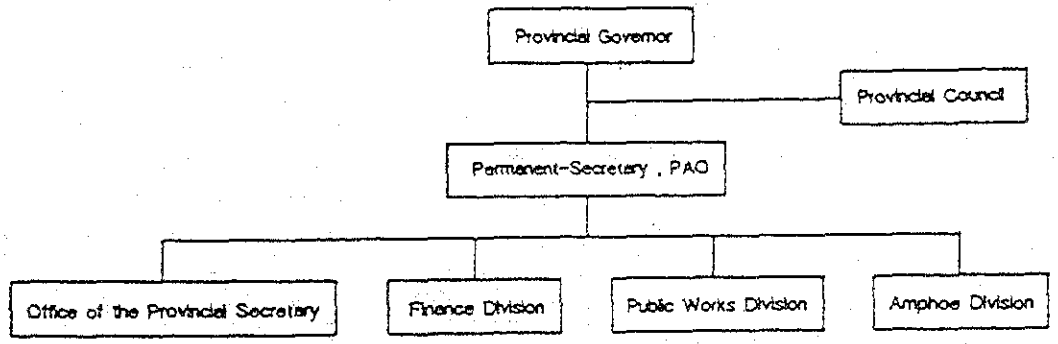


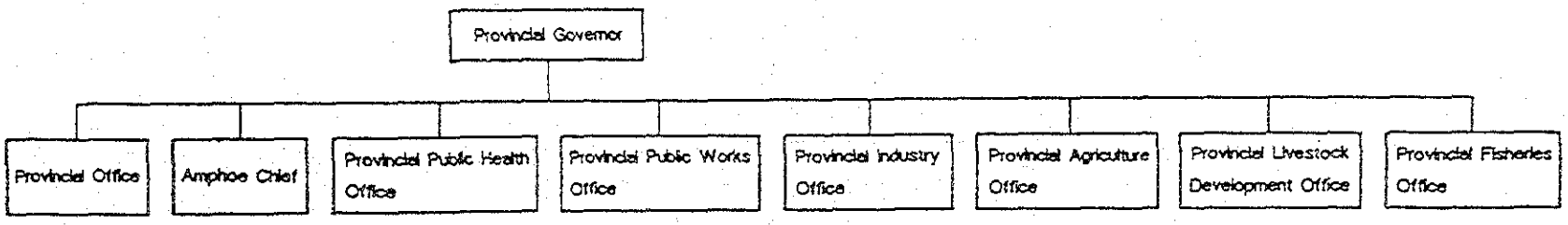
Figure 1-4

Two Responsible Roles of Provincial Governor

A. Provincial Governor as a Representative of Provincial Administrative Organization



B. Provincial Governor as a Representative of Local Governmental Organization



Most of the area under PAO responsibility are in agriculture, but a sizeable portions are presently developed into real estates, and industry which the trends are sharply upward, These developments enhanced a new source of wastewater pollution. The agricultural activities both the livestock or aquaculture and modern technology of cultivation have also released various types of wastewater into natural water sources. All of these contribute to the aggravating environmental problems and cause serious public disturbances.

The 4 forms of governmental organizations are all under the direction of the central government who lays down policy, set up standard, control and assist the development of strength both directly and indirectly.

1.5 National Economic and Social Development Board (NESDB)

NESDB is the central economic planning agency of Thailand and it is under the office of the prime Minister. The NESDB's methodology in drawing up environmental plans and policies includes, in addition to internal studies and analysis , consultation and coordination with other governmental agencies, working groups/committees (inter-agency on otherwise), the academy and other consultants/experts. Aside from its planning tasks, the NESDB screens/evaluates and monitors plans and projects of sectorial agencies.

1.6 The National Environmental Board (NEB)

The NEB is a national body performing the following functions in improving environmental conditions in the country which are:

- Laying down policy,
- Operating guideline

- National environmental conservation plan, and
- Setting up standard.

The NEB actsas the main agency in providing guidance on environmental issues to the government and acts as a coordinator among agencies concerned. Another important duty of NEB is to provide suggestions on improvements of environmental standards and codes of practice to various executing agencies.

The NEB was previously chaired by a Deputy Prime Minister, but presently the Prime Minister is the chairman, according to newly promulgated legislation.

This change has a spicific purpose to enhance the executing authority of the "NEB" Board from heads of government offices such as the Minister of Science, Technology and Environment, the Secretary of the NEB, Director of The Budget Bureau, and from selected laureate from public and private sectors. The Permanent Secretary of the Science, Technology and Environment acts as a board members and the secretary of the board.

1.7 The office of the National Environment Board (ONEB)

Formerly, the Office of the National Environment Board (ONEB) was a secretariat office and technical advisor body for the NEB. The ONEB functions as the operating body of the NEB, i.e. all the activities concerning environmental issues in the country were

executed by ONEB and the results or conclusion and suggestions were then forwarded to the Board of the NEB for final consideration. These duties include:

- Data collection and information
- Data analysis and conclusion
- Preparation of drafted standard,
- Suggestions on measure to alleviate environmental problems,
- Environmetal assessment and analysis of environmental impacts on major national projects,

In B.E. 2532, the new law on environmental protections has been promulgated until the intention to reinforce the effectiveness of all environmental control practice. Under the new legislation the former ONEB has been reorganized into 3 new executing departments, They are:

(1) The Office of Environmental Policy and Planning (OEPP)
(2) The Pollution Control Department (PCD)
(3) The Environmental Quality Promotion Department (EPQD)

The OEPP has direct responsibilities on the followings:

- Laying down policy and planning on environmental promotion,
- Coordination for the planning of environment quality management,
- Coordination for international cooperation , and

- Provincial cooperation within the country,
- Managenment of the environmental fund,
- Assessment of environmental impact and monitoring major projects,
- Preparation of reports on environmental situations,

The PCD has main activities on the following:

- Planning for the management and control of environment quality.
- Protections of environment and correction of pollution problems.
- Development of working format and methodology for management of pollutions control.
- Inspection and monitoring pollution situations.

The EQPD main responsibility is on the promotional and public relation activities. These include:

- Promotion and public education on environmental aspects.
- Preparation of information system.
- Training of governmental and private sector.

1.8 The Ministry of Interior (MOI)

There are now 2 departments in the MOI responsible for the wastewater management, the Public Works Department (PWD) and the Department of Local Administration (DOLA).

The MOI itself has full legislative authority to direct and control the Bangkok Metropolitan Administration.

The PWD functions as an engineering agency responsible for design, budgeting and construction of wastewater facilities in all urban centers nationwide. At present, with the limited capability PWD cannot cope with the amount of works in all urban centers. The PWD now schedules these needs (construction of wastewater treatment facilities) according to theirs priority and the budget allocated by the central government. All the wastewater works in PWD is performed by the Sanitary Engineering Division.

The DOLA acts as a supporting agency in promoting the decentralization of authority to local government bodies in carrying out the wastewater treatment project in the communities and in major tourism centers. Environmental improvement projects such as wastewater management are initiated by local governments and DOLA supports are provided through divisions within DOLA : the Local Administration Division, the Provincial and Tambon Division, the Local Finance Division and the office for Urban Development. The Governor in each province acts as the local representative of the MOI in controlling local governments.

1.9 The Ministry of Industry (MI)

The MI has the Department of Industrial Works (DIW) in dealing with industrial wastewater problems. The DIW itself has 3 divisions, solely responsible for environmental works: the Industrial Environment Division, the Industrial Inspection Division, and the Office for Hazardous Waste Disposal. The DIW is the main agency for controlling of industrial wastes.

The DIW, according to its legislative power, enforces strict control and penalizes industries that do not conform with regulations on pollution control. The MI sets up a condition and control of industries in the initial stage by laying down requlations on effluent standards for industries. Since 1982 (B.E.2525) the MI has issued 4 regulations followed by 3 codes of practice for the regions around Bangkok Metropolitan. For the Bangkok Metropolitan area the MI monitors and controls all industries through its special unit within the Ministry.

The MI also provides assistance, apart from monitoring and controlling, to industries on environmental improvement, ie., the planning to establish another hazardous waste disposal center and the first disposal center is in Sa Mae Dam in Bang Khun Thian area. The MI also plans to build central wastewater treatment facilities for 4 major industrial zones: Rangsit area, Suksawad Road area, Thepharak Road area and Puchao Saming Phrai area in Samut Prakarn.

1.10 The Ministry of Public Health (MPH)

The Environmental Health Division (EHD) in the Department of Health (DH) in the MPH is in charge of the monitoring water quality in natural water sources and has direct responsibility as a watchdog agency on general sanitation situations and environment degradations in the country.

The EHD currently proposes that all of the public and private hospitals do provide wastewater treatment and infected waste incineration plants, and that all hospitals do separate infected

solid waste from general garbage and must have proper disposal facilities. The EHD support comes in the form of providing engineering designs of the facilities. For private hospital, a new ligislation is being put into effect to force all the hospitals to have their own wastewater treatment plants.

1.11 Other Agencies

Besides the previous mentioned governmental agencies directly involved in the support of environmental development and conservation, which are the Commission for Controlling of Real Estate Development, the National Housing Authority, the Harbour Department, and etc.

2. Source of Revenue to construct sewage treatment facilities

The revenue to construct sewage treatment facilities come from government and local authorities. The financing of sewage treatment project in Bangkok area and Provincial area is different. For Bangkok area, the sewage treatment projects are managed by BMA and BMA can ask for governmental subsidy on the Project by project basic. Most of BMA projects received 75% of total budget from government as a subsidy and the other 25% will be BMA's budget.

For Provincial area, the sewage treatment projects can be managed by PWD or by local authorities. If the projects are managed by PWD, it will be fully financed by the government through PWD budget. In case that local authorities want to manage their own sewage treatment

project, they can apply for governmental subsidy or government loan from Ministry of Science. The projects in provincial area are rarely financed through Ministry of Science because the local authorities is technically incapable to manage the project and the Ministry of Science do not have knowledgeble and experienced engineers to assist the local authorities. Consequently, the local authorities prefer to received projects financing through PWD.

3. List of names of Laws, regulations and environmental standards concerning sewage works.

3.1 Laws Involving Control, Prevention and Solution of Wastewater Pollution

From our study and analysis, the following are the important laws directly involved with control, prevention and solution of wastewater pollution. Since B.E. 2534 almost of such laws have been modified or amended to directly control, preven and solve only problem of wastewater.

3.1.1 Canal Maintenance Act of Ratanakosin Era 121

This Act was provided for canal maintenance and usage. The person who drops garbage into or causes damage to the canal will be punished.

3.1.2 Internal Water Navigation Act of B.E 2456

This Act was provided for control of internal water navigation and the 14th Amendment of this Act was incurred in B.E. 2535.

Building construction over the public waterway will be prohibited except obtaining permission from the Harbor Department, and the owner of such building will pay the high fees for the said permission. Any person who throws something or causes damage to the waterway will be puhnished.

3.1.3 Fishery Act of B.E.2490

This Act was provided for fishing control and water animal conservation. Any person who drops toxic object into the fishing resource or uses electricity or explosive for fishing will be prohibited and punished. From th end of B.E.2534, the prawn farmer will register for his farm to the fishery official and the prawn farmer who has more than 50 rais for his farm will provide wastewater treatment not less than 10% of total farm area and its biochemical oxygen demand not more than 10 mg./l.

3.1.4 National Executive Council Announcement No 286 (B.E.2515)

This Act was provided for land allocation control. The land allocation Control Board has duly power to issue the regulation involving land allocation. The drainage system and wastewater treatment system will be constructed in such land by the applicant for land allocation license under the Regulation Involving Land Allocation B.E. 2535 dated August 17,1993.

3.1.5 Building Control Act of B.E. 2522

This Act was provided for building construction control and authorized the Interior Minister and the local official to issue the Ministerial Regulation and local regulation respectively to control building construction alteration, removal, mobilization and usage. Under the Ministerial Regulation No.3 (B.E.2535) dated February 14,1993, the high building or special huge building will have drainage system and wastewater treatment system.

3.1.6 Bangkok Metropolis Regulation on drainage Control B.E.2534

This Regulation was provided for drainage from buildings into drainage pipes and public water resources, and the building to be constructed will have drainage system and wastewater system.

3.1.7 Public Cleanliness and Orderliness Act of B.E.2535

This Act was provided for control public cleanliness and orderliness in the boundaries of Municipalities, Sanitary Districts, Bangkok Metropolis and Pattaya City. Any Provincial Administrative Organization will be applied with this Act by issuance of Notification of Interior Ministry. Any person who drops garbage or takes a piss in public place will be penalized

3.1.8 Public Health Act of B.E.2535

This Act was provided for public health control such as nuisance, dangerous activities to health, etc. The Person who desires to establish market will obtain permission from the local official and also have drainage system.

3.1.9 Factory Act of B.E.2535

This Act was provided for control of factory establish and operation and not enforced with the government factory for national security and safety benefit. The Minister of Industry has power to issue the Ministerial Regulation and Notification to govern any or all types of factory to comply with. The factory owner will show wastewater treatment process which does not cause damage or nuisance to the people, and will maintain drainage system in accordance with the rules procedures and conditions as specified in the Ministerial Regulations and Notifications. Architect or engineer who works in the factory and responsible in the work illegally performed may be liable in civil and crimial case and his professional license may be withdrawn.

3.1.10 National Environment Control and Promotion Act of B.E.2535

This Act was provided for environmental control and promotion including support of people participation in maintenance of environmental quality. It specified the powers and duties of National Environment Board, Pollution

Control Committee and Environmental Fund Committee involving control, prevention and solution of wastewater.

In addition to the mentioned laws, there were another laws indirectly involvedd with the control, prevention and solution of wastewater, such as, Civil and Commercial Code, Disease Act of B.E. 2477, Private Irrigation Act of B.E. 2482, Royal Irrigation Act of B.R.2485, Animal Disease Act of B.E.2499, Penal Code, Animal Food Quality Control Act of B.E. 2505, Petroleum Act of B.E. 2514, Fertilizer Act of B.E. 2518, City Planning Act of B.E. of B.E. 2518, Toxic Material Act of B.E. 2535, etc.

3.2 Effluent Standards

Numerous standards, have been decreed in Thailand for the purpose of environmental quality management. Summarized hereunder are the standards, pertinent to water quality management.

3.2.1 Industrial Effluent

Table 1 - 1 presents the standards set for industrial effluents, and the applicable penalty for non-compliance. Other regulations relevant toindustrial water pollution control are shown in Tables 1-2 to 1-4