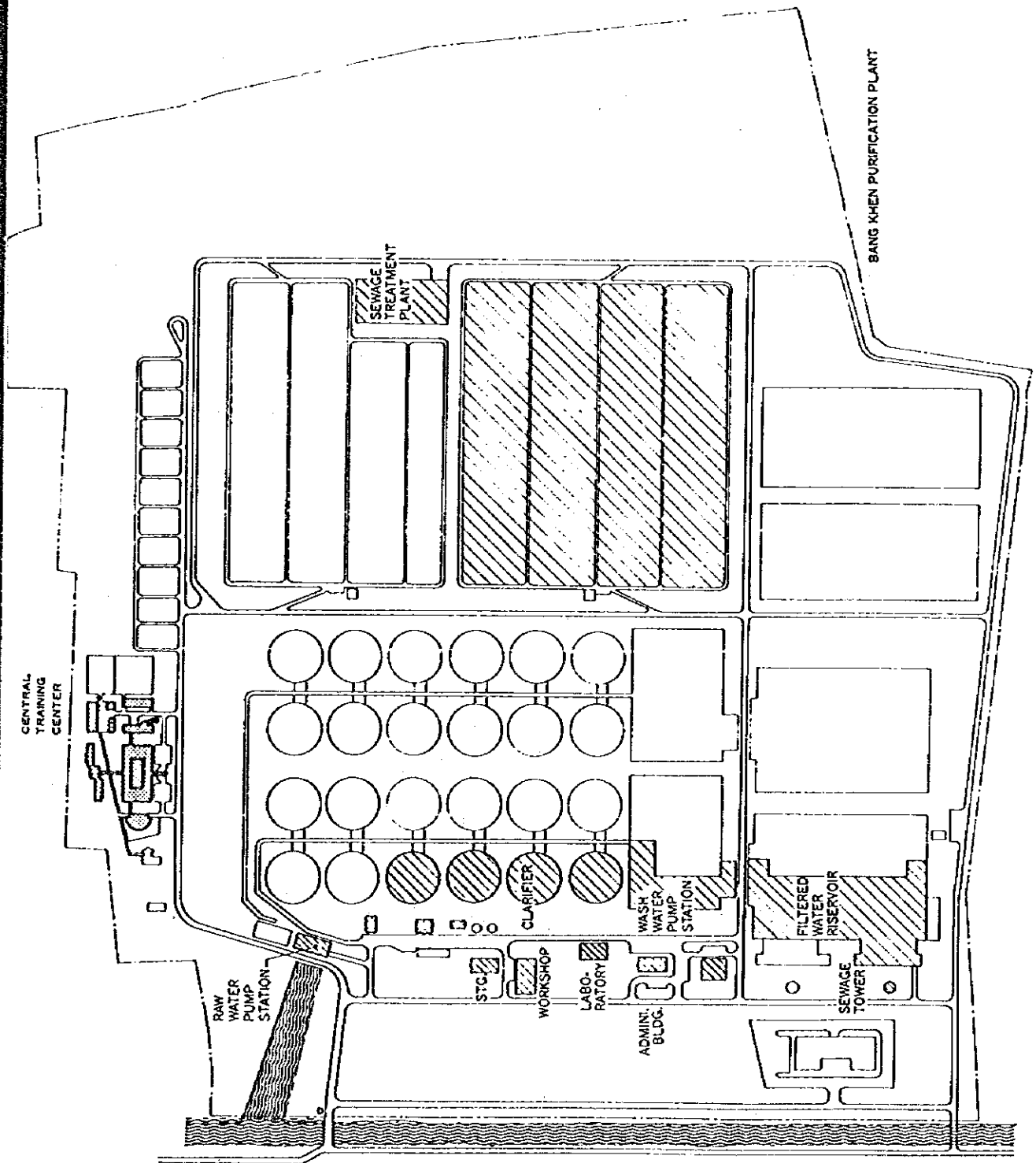


## BASIC DESIGN DRAWINGS

1	CTC	SITE PLAN-1
2	CTC	SITE PLAN-2
3	CTC	1ST FLOOR PLAN
4	CTC	2ND FLOOR PLAN
5	CTC	ELEVATION & SECTION
6	CTC	WATER SUPPLY & DRAINAGE SYSTEM
7	CTC	ELECTRICAL SUPPLY SYSTEM
8	RTC (CHIANG MAI)	SITE PLAN
9	RTC (CHIANG MAI)	FLOOR PLAN
10	RTC (CHIANG MAI)	ELEVATION & SECTION
11	RTC (CHIANG MAI)	WATER SUPPLY, DRAINAGE & ELECTRICAL SUPPLY SYSTEM
12	RTC (KHON KAEN)	SITE PLAN
13	RTC (KHON KAEN)	FLOOR PLAN
14	RTC (KHON KAEN)	ELEVATION & SECTION
15	RTC (KHON KAEN)	WATER SUPPLY, DRAINAGE & ELECTRICAL SUPPLY SYSTEM
16	MINI PURIFICATION PLANT	SECTION
17	MINI PURIFICATION PLANT	FLOW DIAGRAM
18	PUMP OPERATION TRAINING PLANT	LAYOUT OF PUMP PLANT
19	PUMP OPERATION TRAINING PLANT	PUMP CONTROL SYSTEM
20	LEAKAGE SURVEY TRAINING YARD	LAYOUT OF PIPELINES





CENTRAL  
TRAINING  
CENTER

RAW  
WATER  
PUMP  
STATION

SEWAGE  
TREATMENT  
PLANT

STC

WORKSHOP

LABO.  
RATORY

ADMIN.  
BLDG.

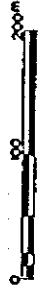
CLARIFIER

WASH.  
WATER  
PUMP  
STATION

SEWAGE  
TOWER

FILTERED  
WATER  
RESERVOIR

BANG KHEN PURIFICATION PLANT

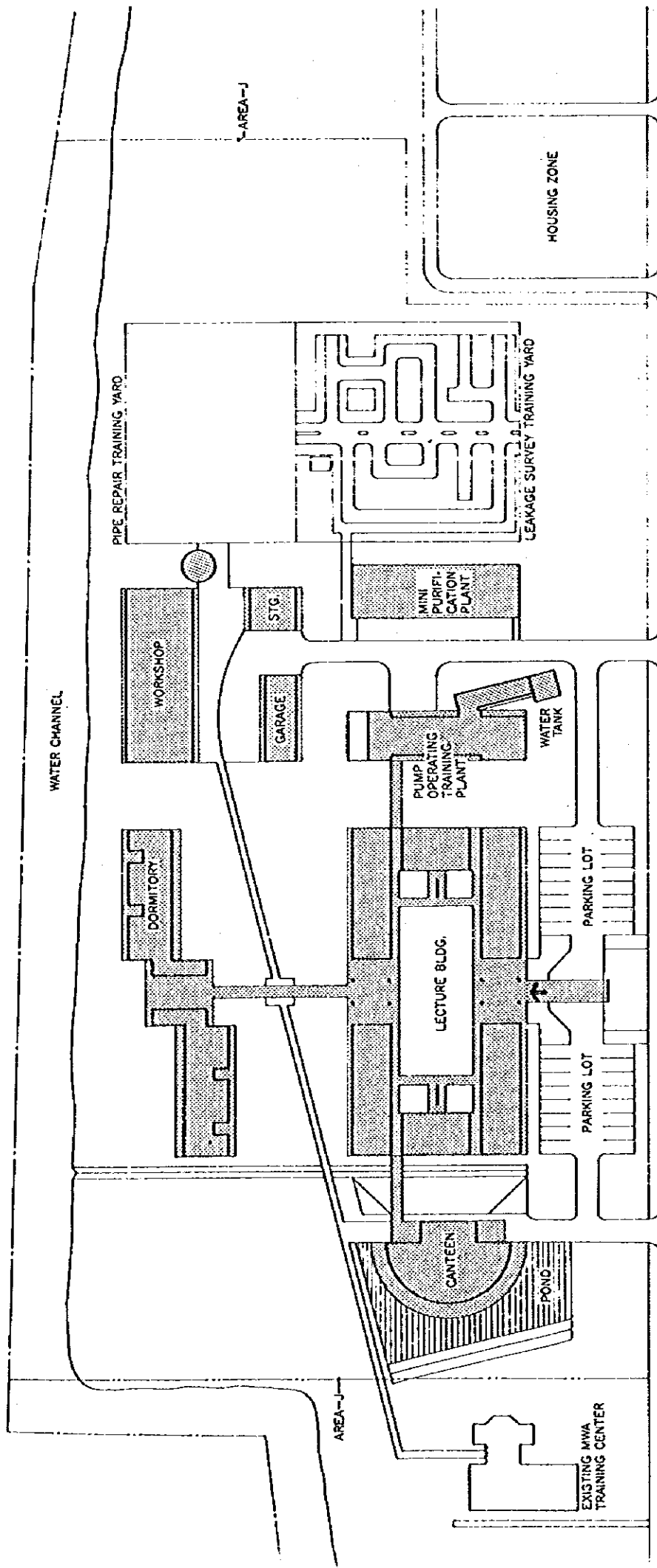


01

SITE PLAN-1

CENTRAL TRAINING CENTER

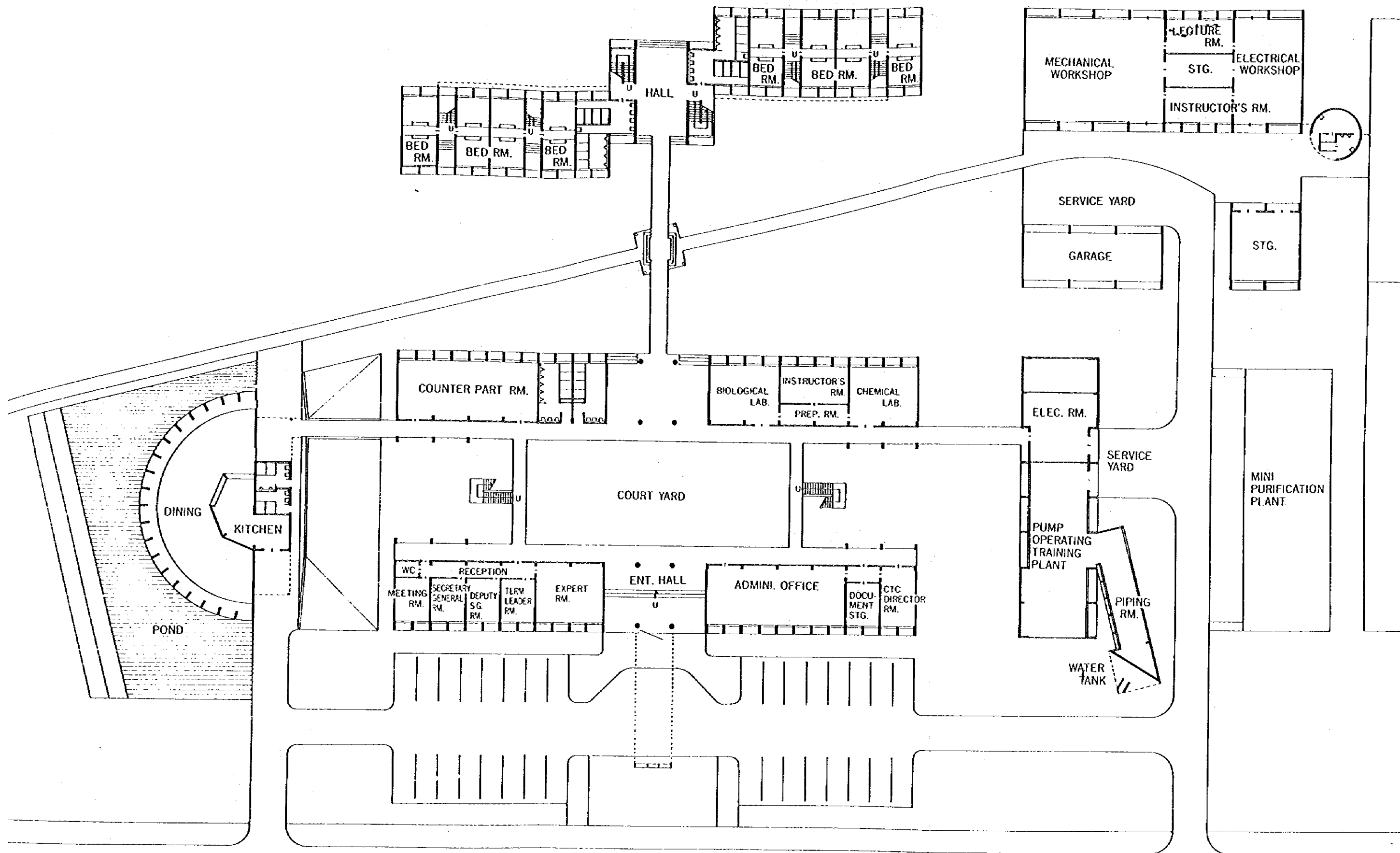




02

SITE PLAN-2

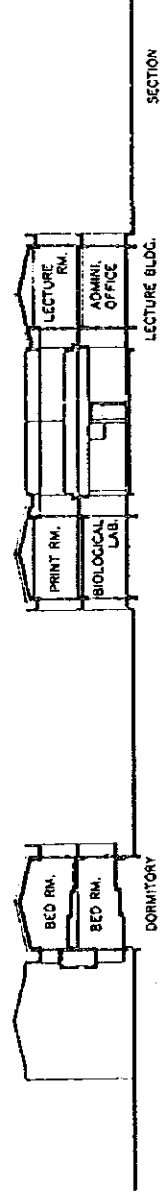
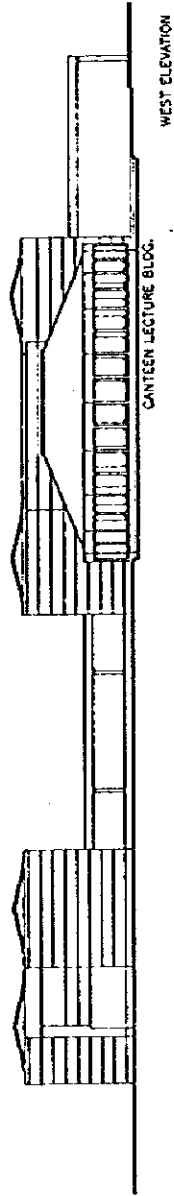
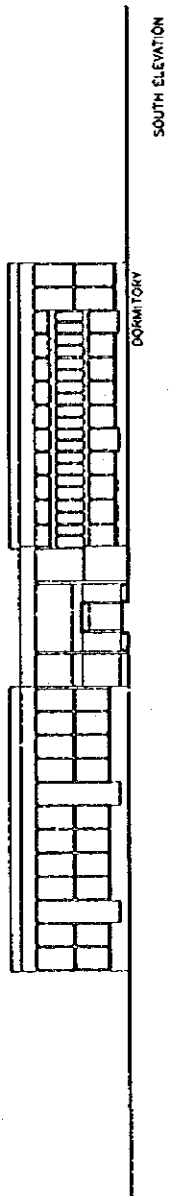
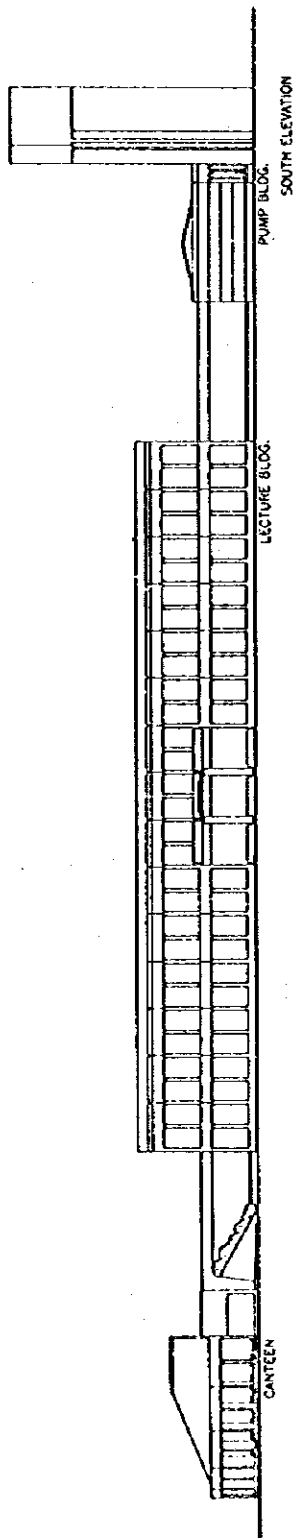
CENTRAL TRAINING CENTER









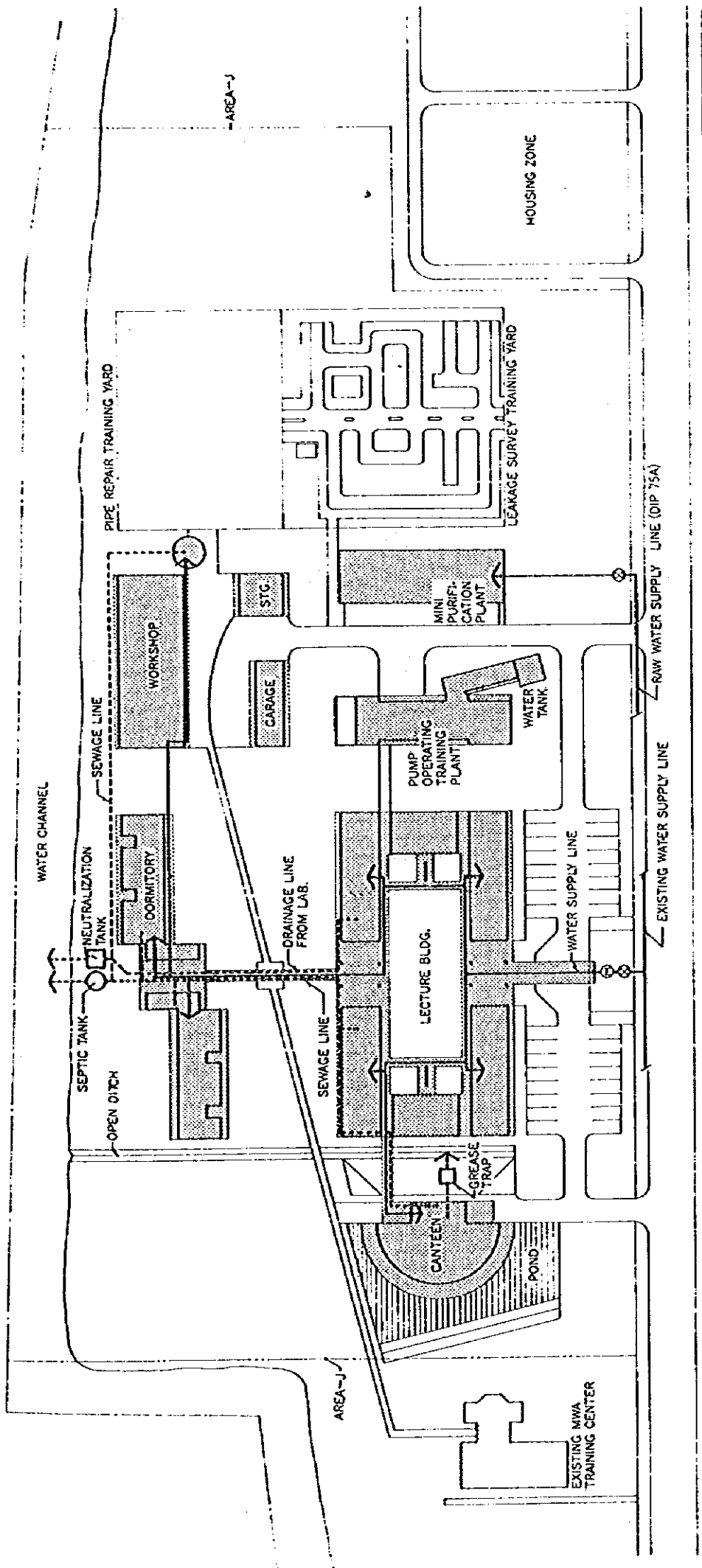


CENTRAL TRAINING CENSER

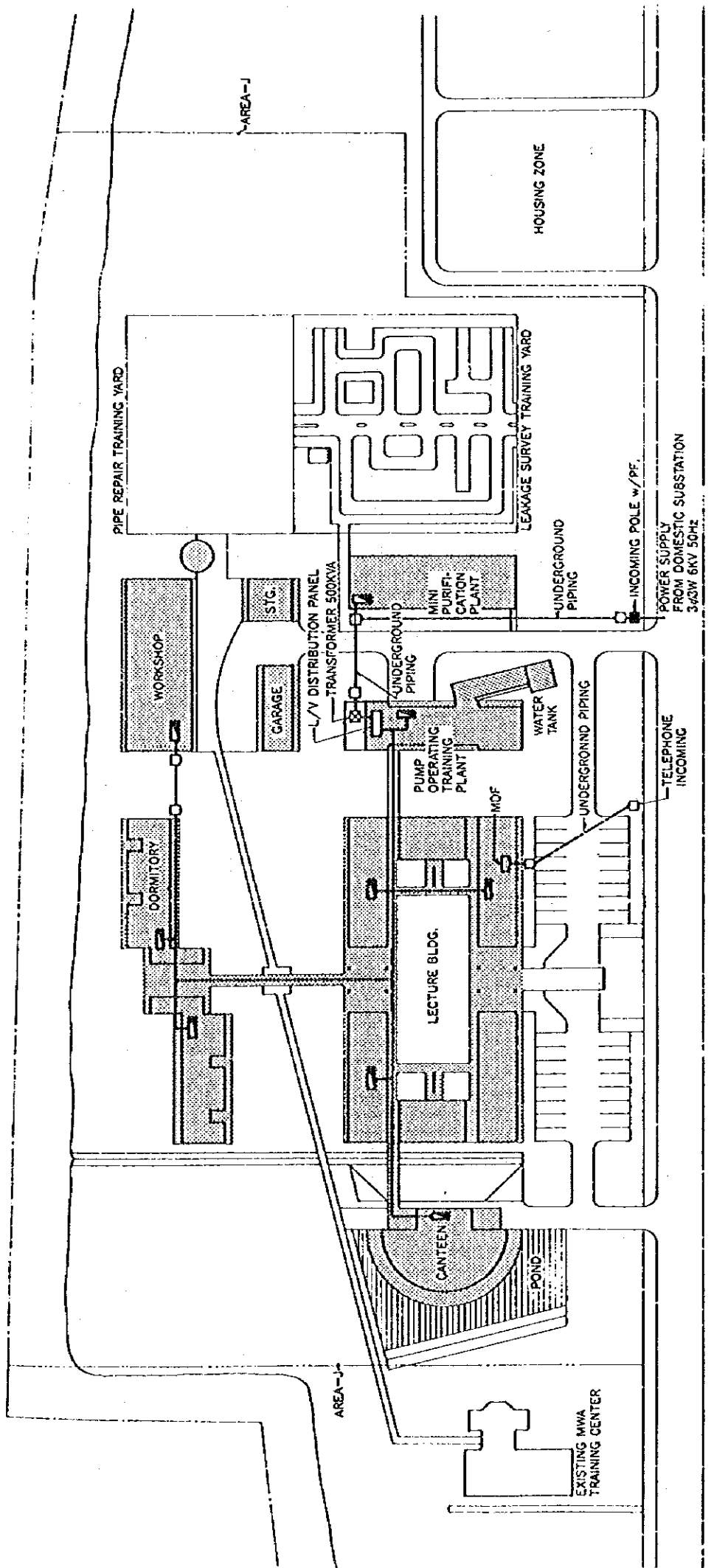
ELEVATION & SECTION

05





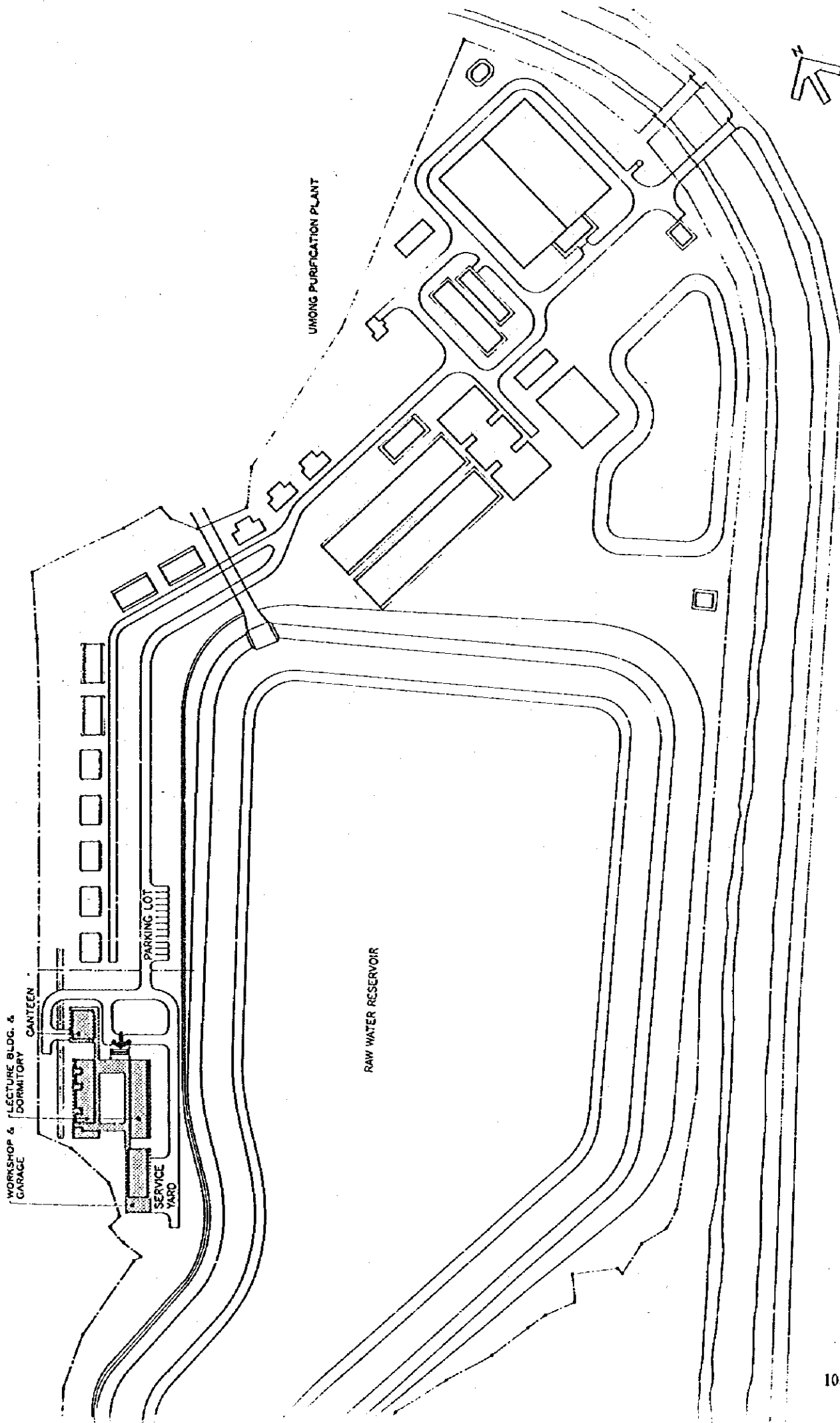




- ELECTRICAL POWER LINE
- - - TELEPHONE MAIN LINE
- ▬ DISTRIBUTION BOARD
- HAND HOLE







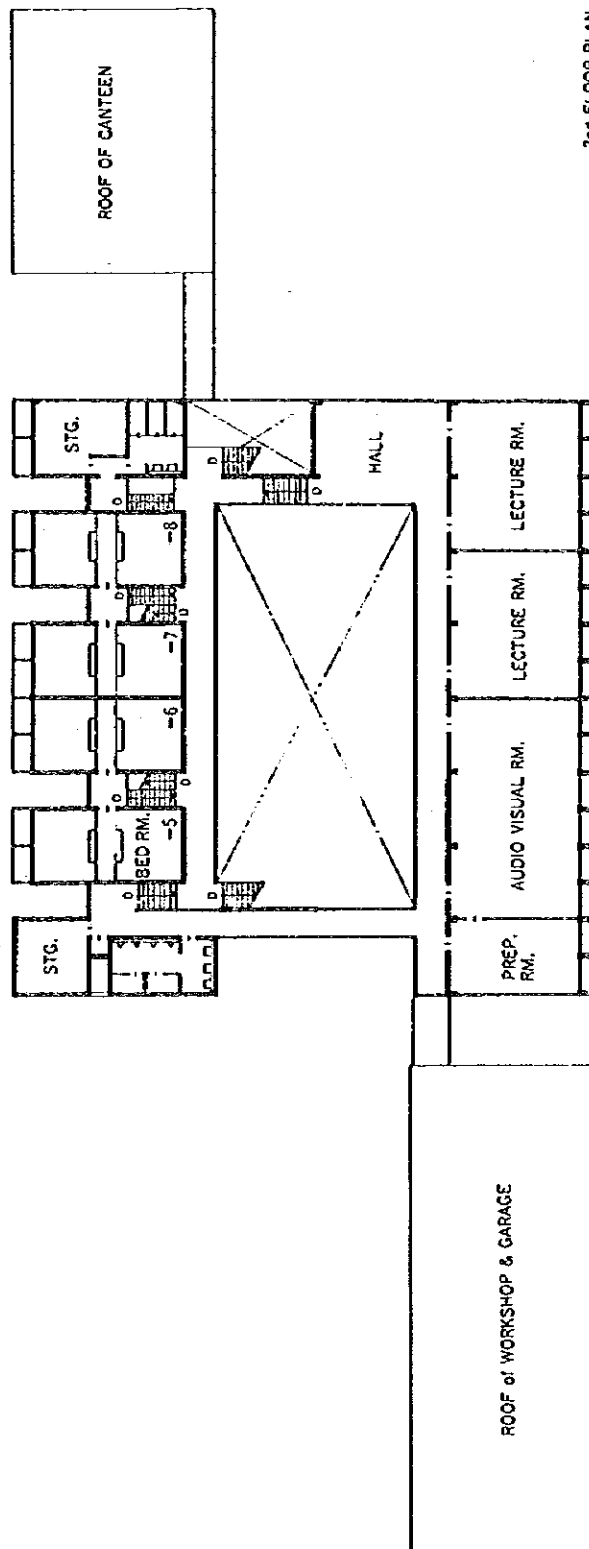
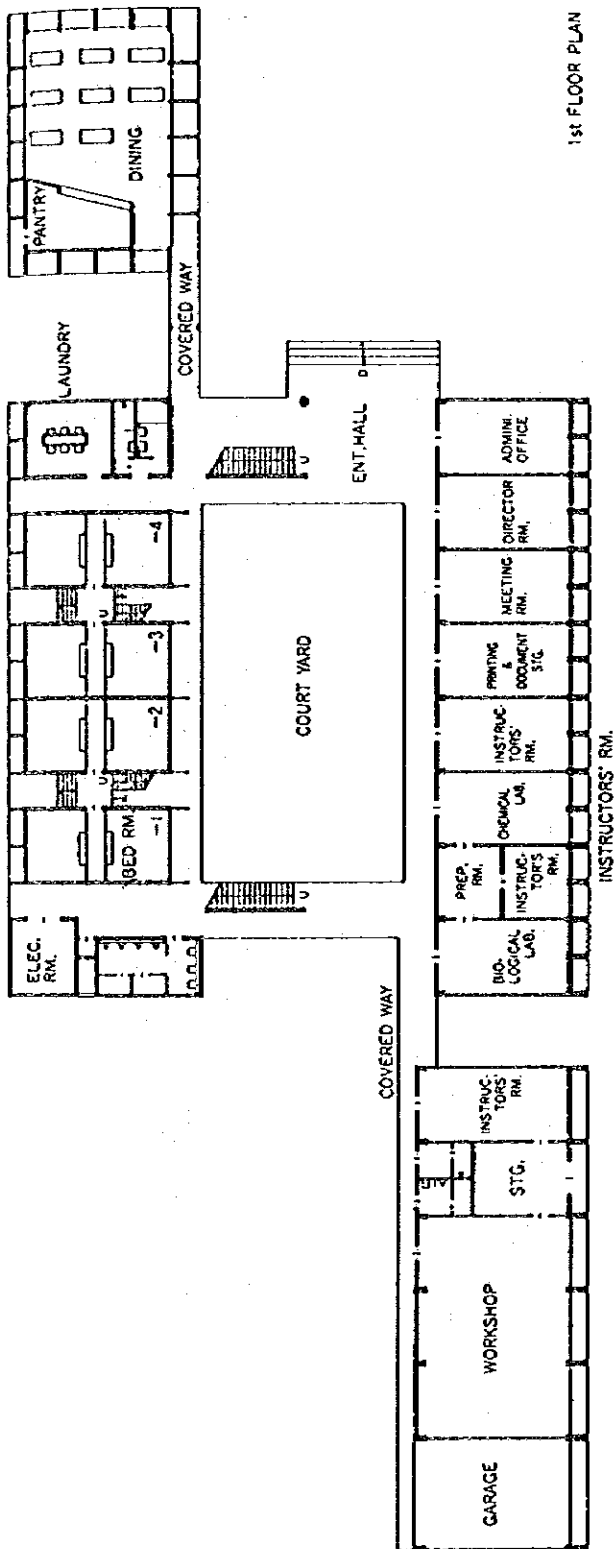
0 50 100m

08

REGIONAL TRAINING CENTER (CHIANG MAI) SITE PLAN



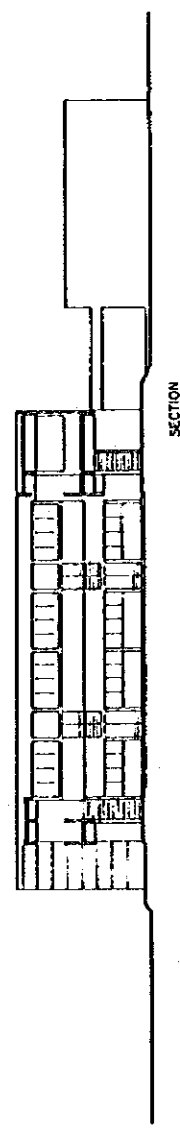
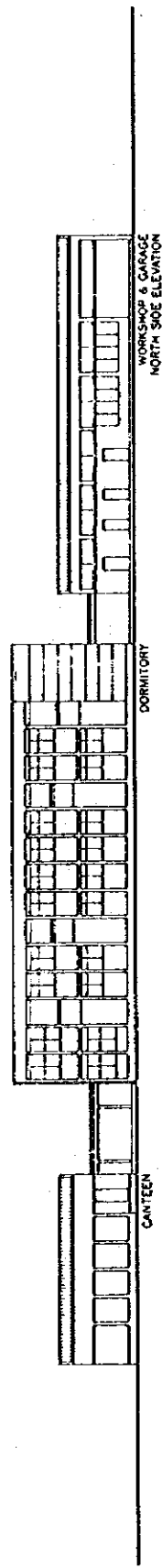
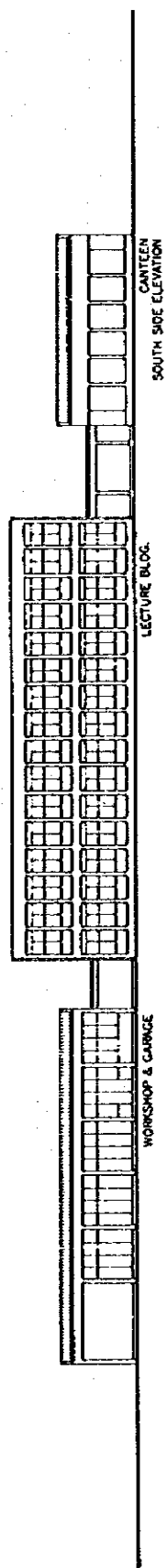




09

REGIONAL TRAINING CENTER (CHIANG MAI) FLOOR PLAN

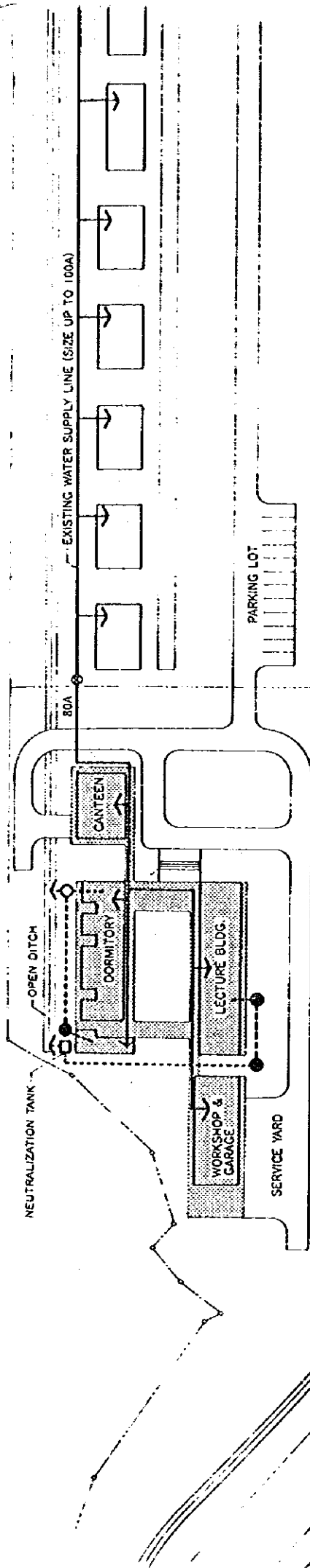




REGIONAL TRAINING CENTER (CHIANG MAI)

ELEVATION & SECTION





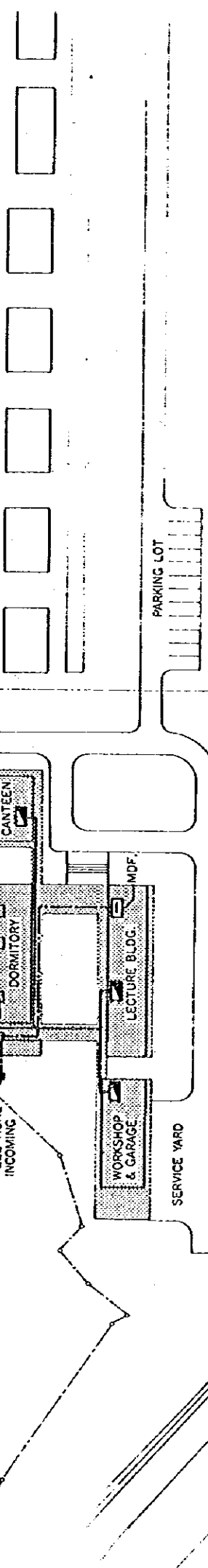
WATER SUPPLY & DRAINAGE SYSTEM

- WATER SUPPLY LINE
- - - DRAINAGE LINE
- SEPTIC TANK
- CATCH BASIN

INCOMING POLE w/PF  
PEA 343W 11KV 50HZ  
(FUTURE 22KV)

OVER HEAD WIRING

TRANSFORMER  
150KVA  
LV DISTRIBUTION  
PANEL  
TELEPHONE  
INCOMING



ELECTRICAL SUPPLY SYSTEM

- ELECTRICAL POWER LINE
- - - TELEPHONE MAIN LINE
- DISTRIBUTION BOARD
- ELECTRICAL POST

0 2 10 50m

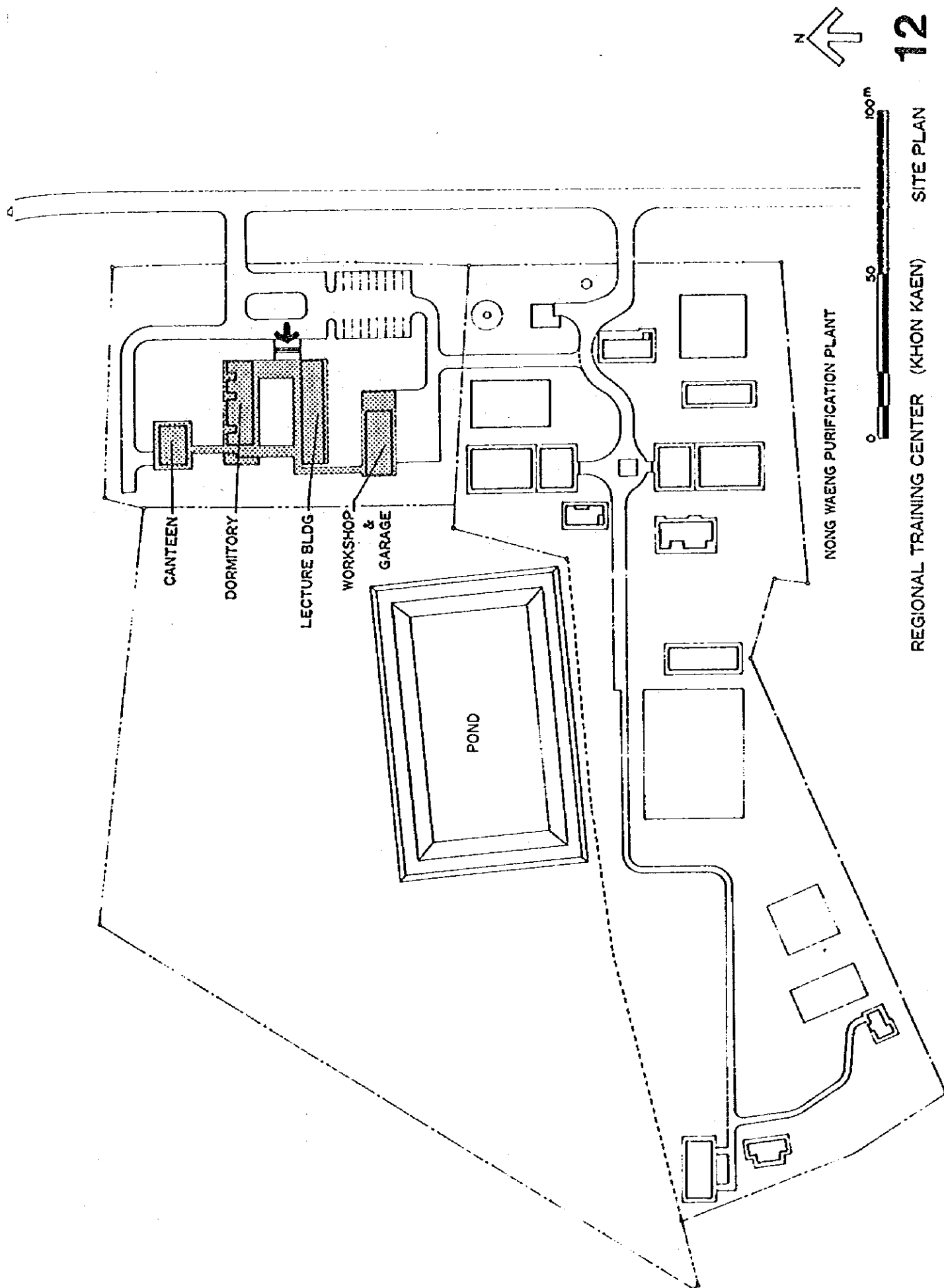


REGIONAL TRAINING CENTER (CHIANG MAI)

WATER SUPPLY, DRAINAGE SYSTEM &  
ELECTRICAL SUPPLY SYSTEM

11





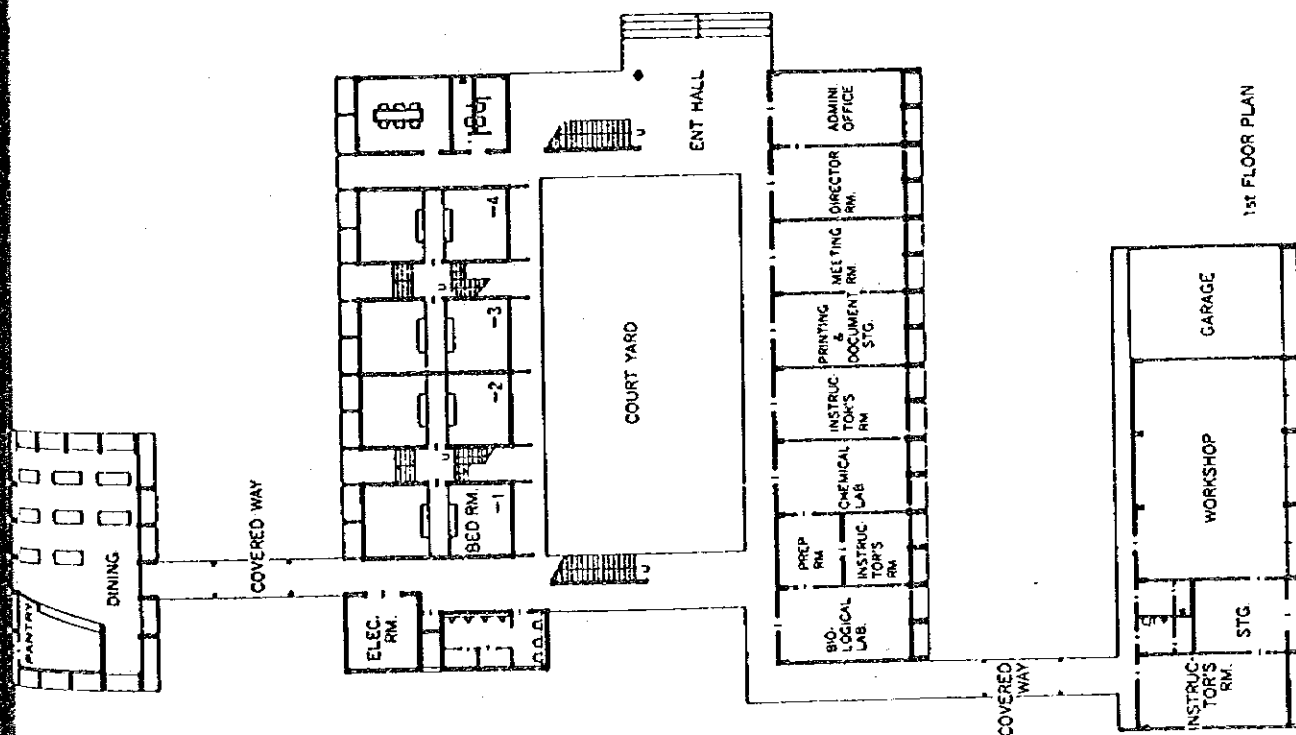
12

SITE PLAN

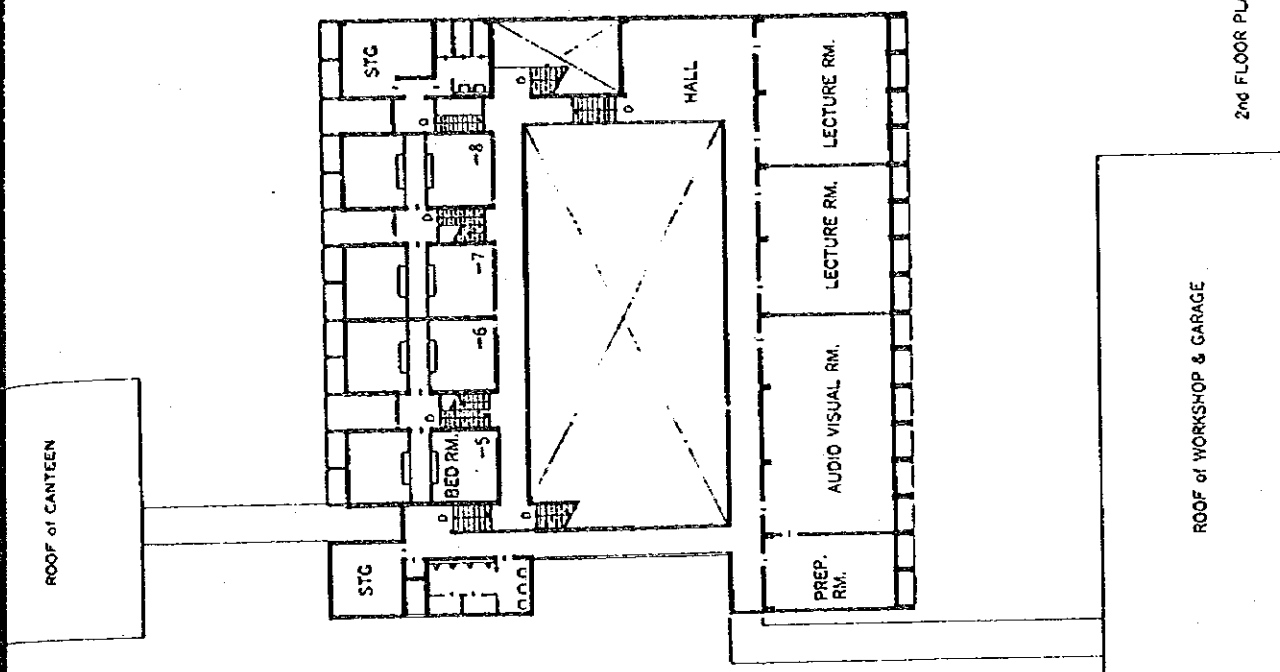
REGIONAL TRAINING CENTER (KHON KAEN)



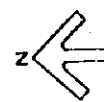




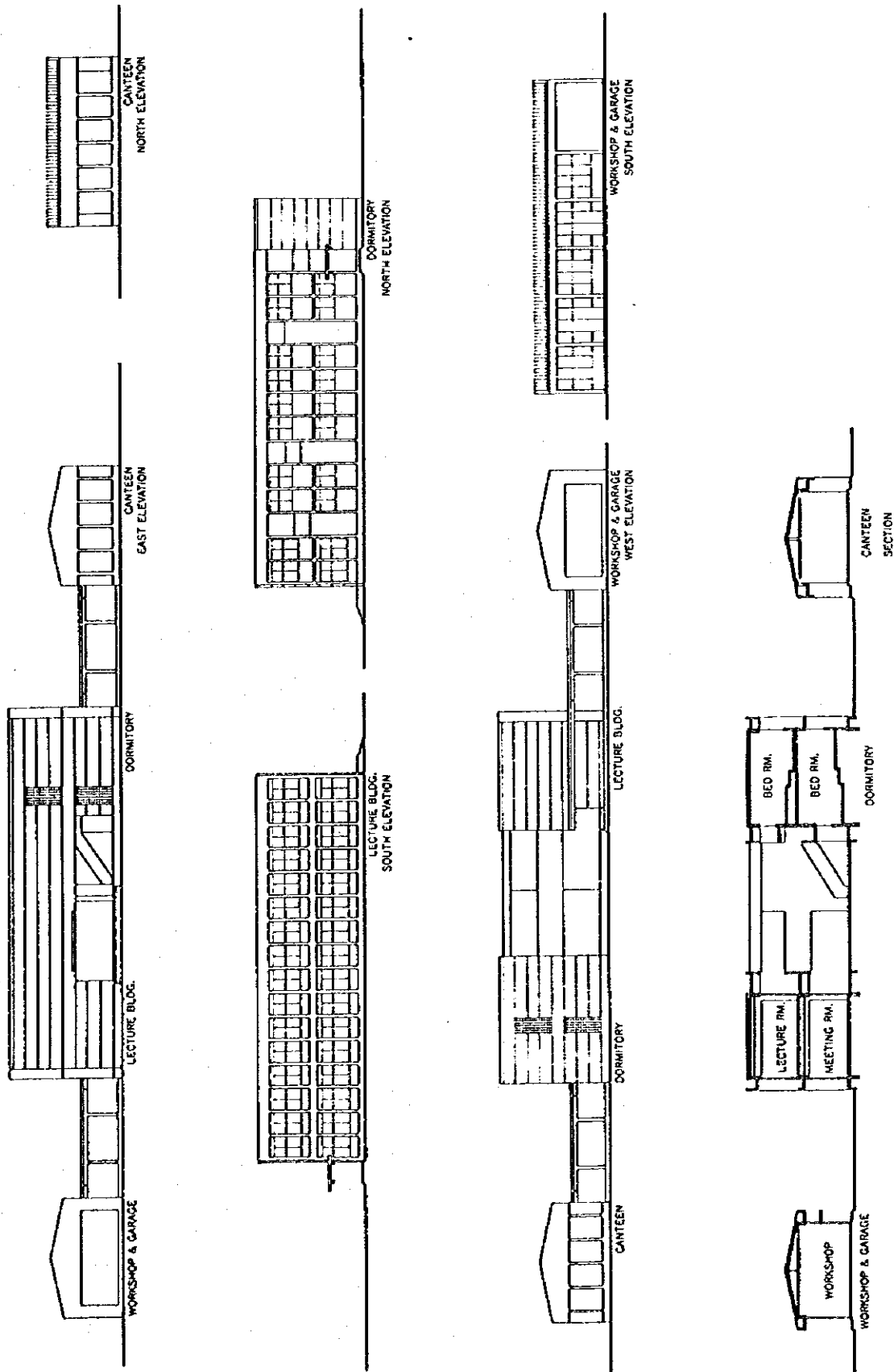
1st FLOOR PLAN



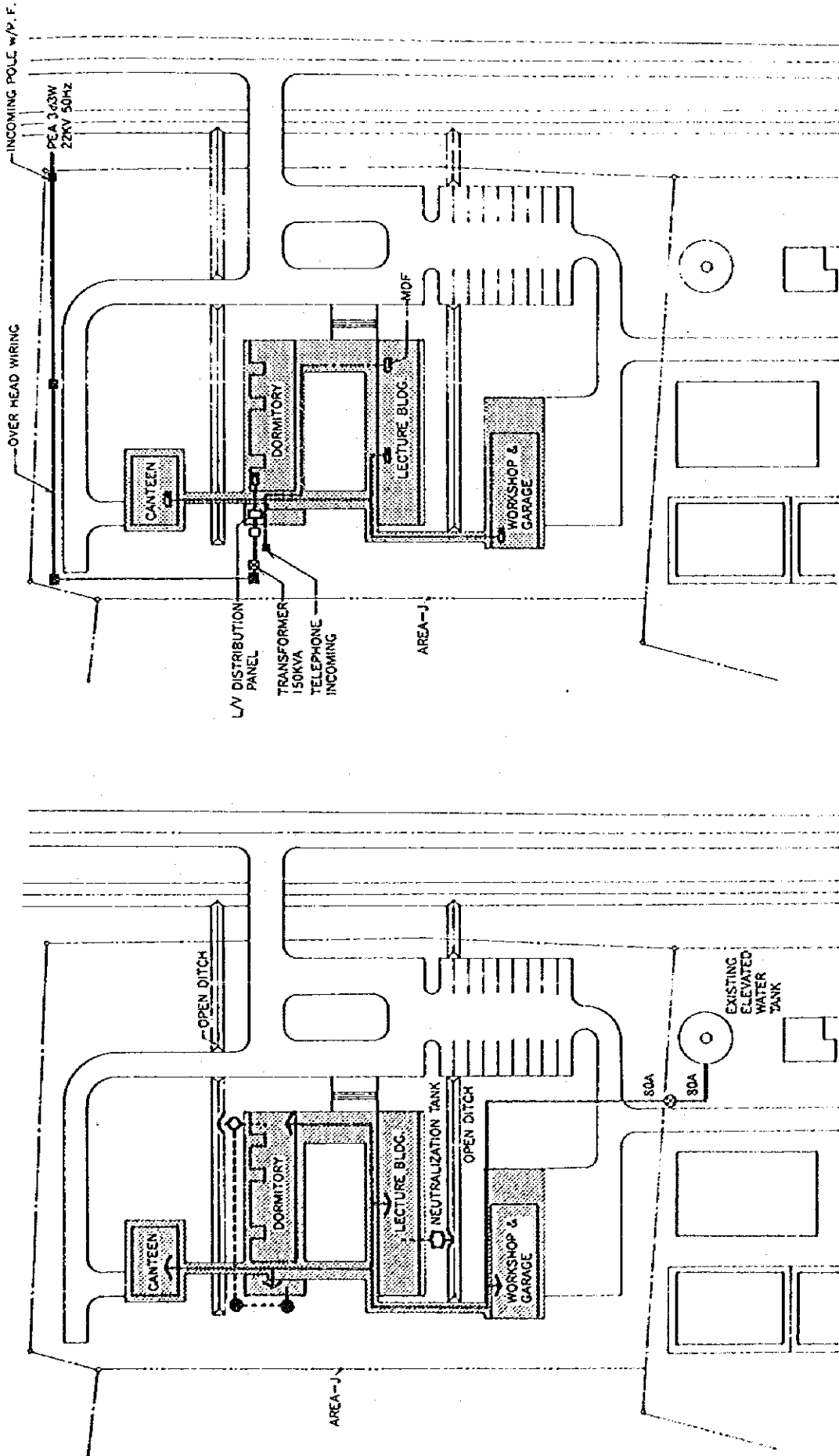
2nd FLOOR PLAN



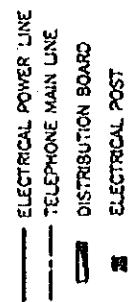




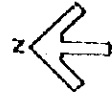




WATER SUPPLY & DRAINAGE SYSTEM



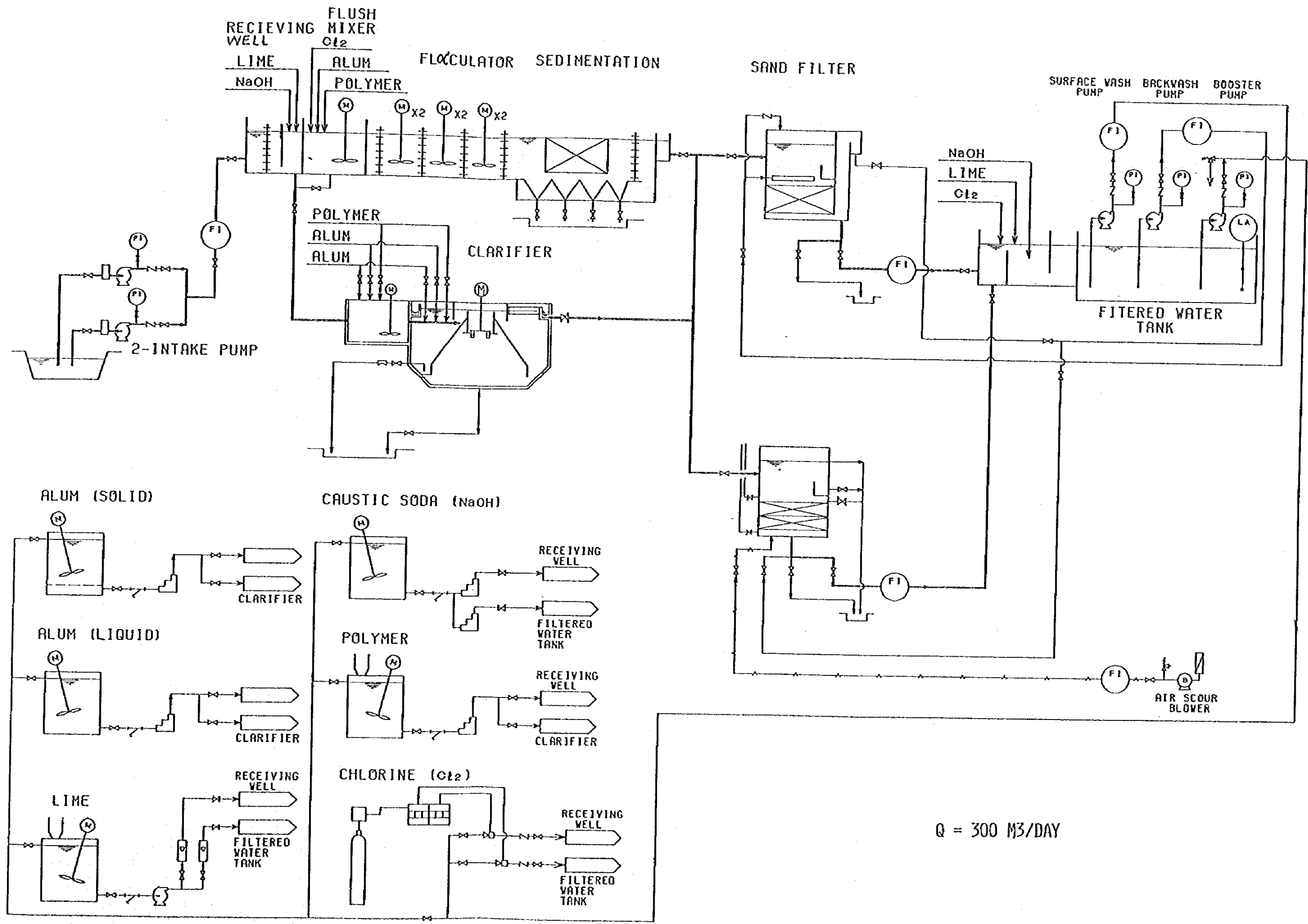
ELECTRICAL SUPPLY SYSTEM



WATER SUPPLY, DRAINAGE &  
ELECTRICAL SUPPLY SYSTEM

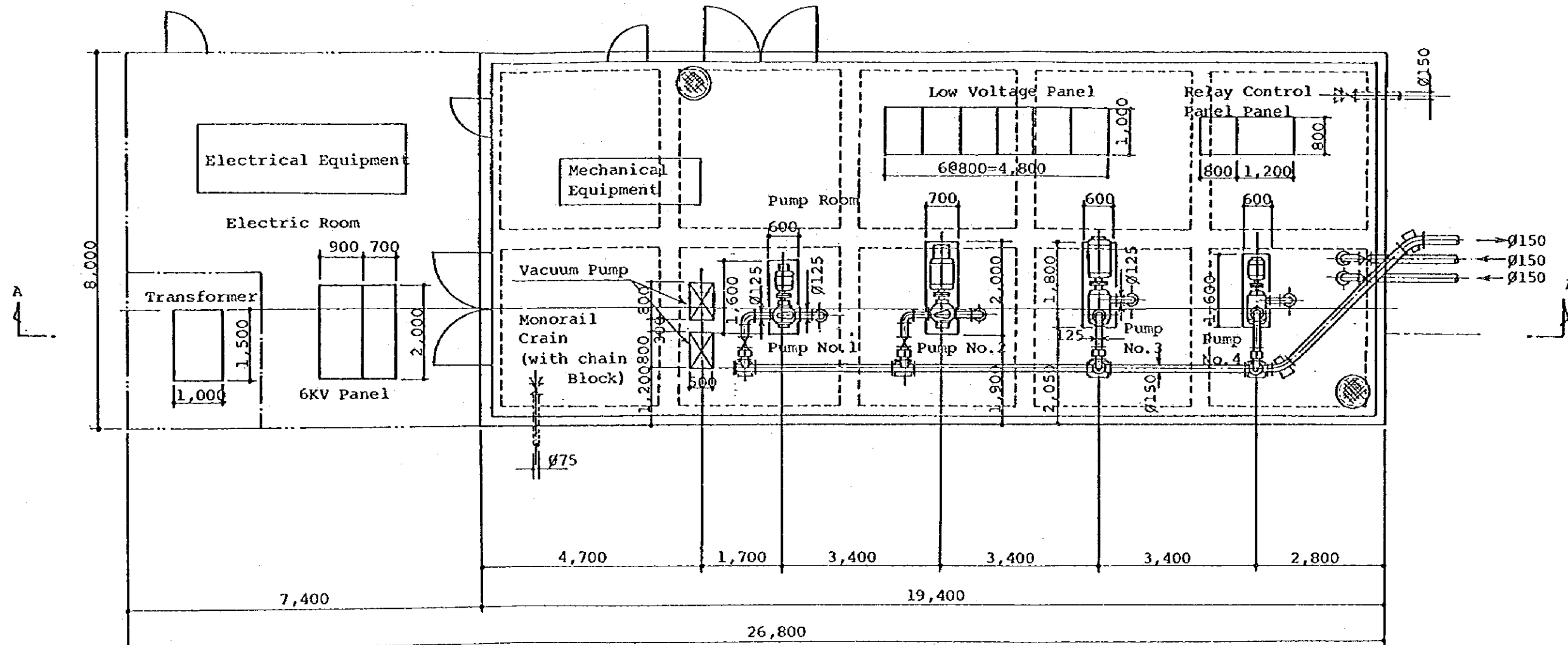
REGIONAL TRAINING CENTER (KHON KAEN)





Q = 300 M<sup>3</sup>/DAY

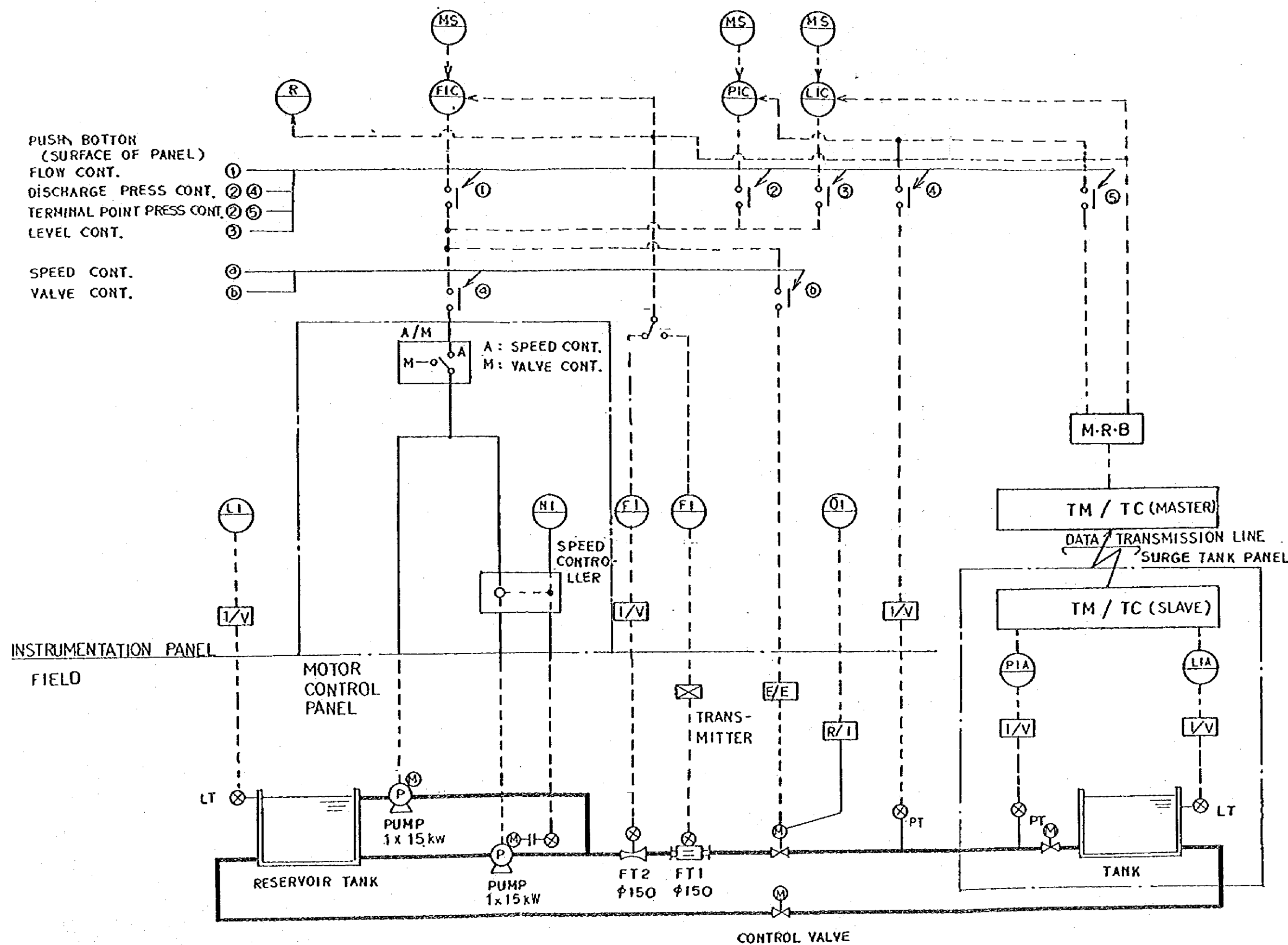
PLAN



- Pump No.1 Double Suction Volute Pump  
1 m<sup>3</sup>/min x 35 m x 15 Kw , VVVF
- Pump No.2 Double Suction Volute Pump  
1 m<sup>3</sup>/min x 35 m x 15 Kw , AS Commutator
- Pump No.3 Single Suction Volute Pump  
1 m<sup>3</sup>/min x 35 m x 15 Kw , ECC
- Pump No.4 Single Suction Volute Pump  
1 m<sup>3</sup>/min x 35 m x 15 Kw , Fixed Rate



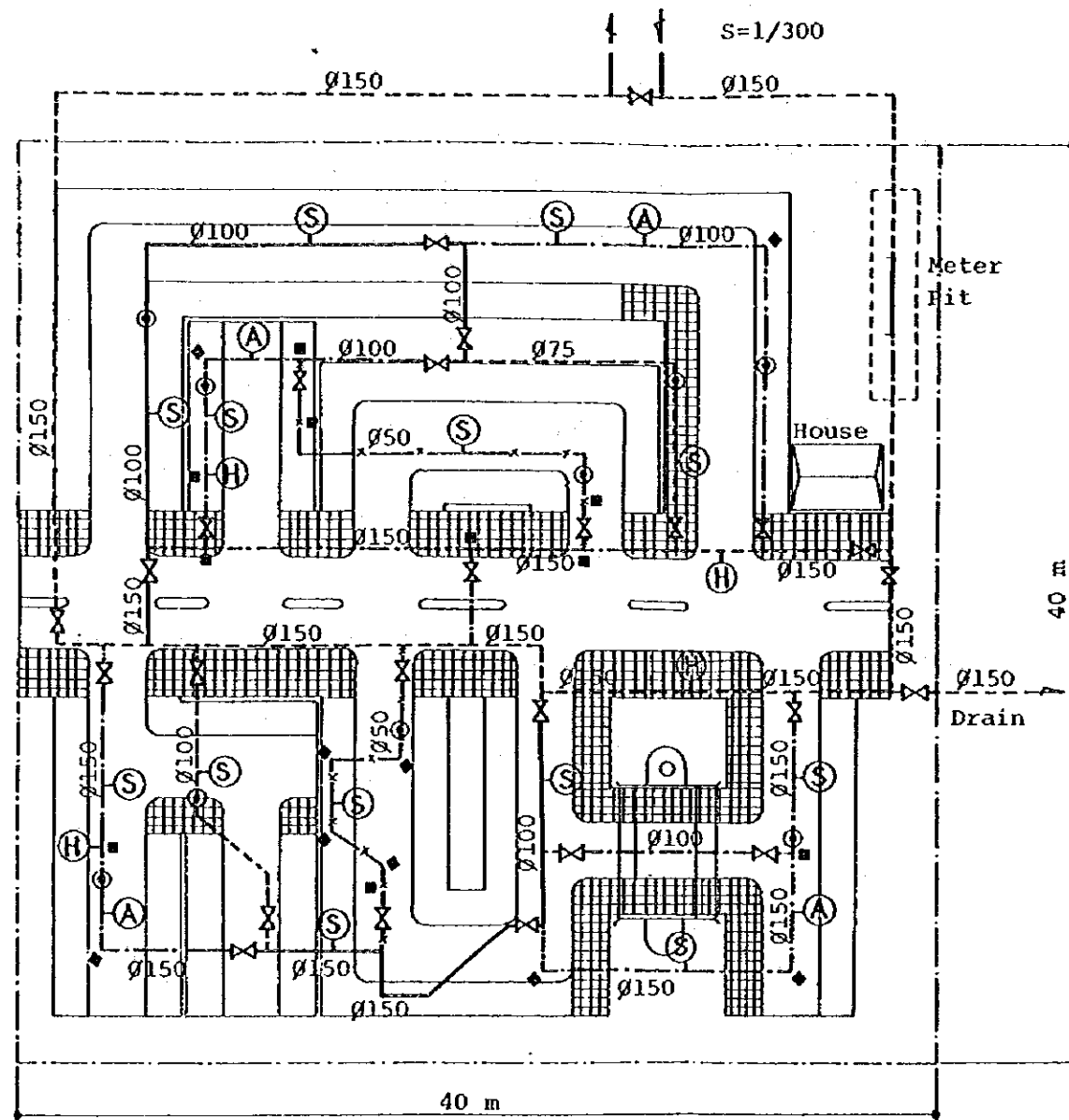
FOR REFERENCE



# LEGEND

FT1	MAGNETIC FLOW TRANSMITTER
FT2	VENTURY TUBE FLOW TRANSMITTER
MY	MOTOR VALVE
PT	PRESSURE TRANSMITTER
COS	CLOSS OVER CHANGE SWITCH
A/M	AUTO MANUAL STATION
TM / TC	TELEMETERING SYSTEM
M.R.B	MARSHALING RELAY BOARD
MS	MANUAL STATION
A	ALARM SETTER
R	2 PENS RECORDER
NI	SPEED INDICATOR
LI	LEVEL INDICATOR
PI	PRESSURE INDICATOR
OI	POSITION INDICATOR
R/I	RESISTANCE mV CONVERTER
LIA	LEVEL INDICATOR WITH ALARM
PIA	PRESSURE INDICATOR WITH ALARM
LT	LEVEL TRANSMITTER
I/V	I/V CONVERTER

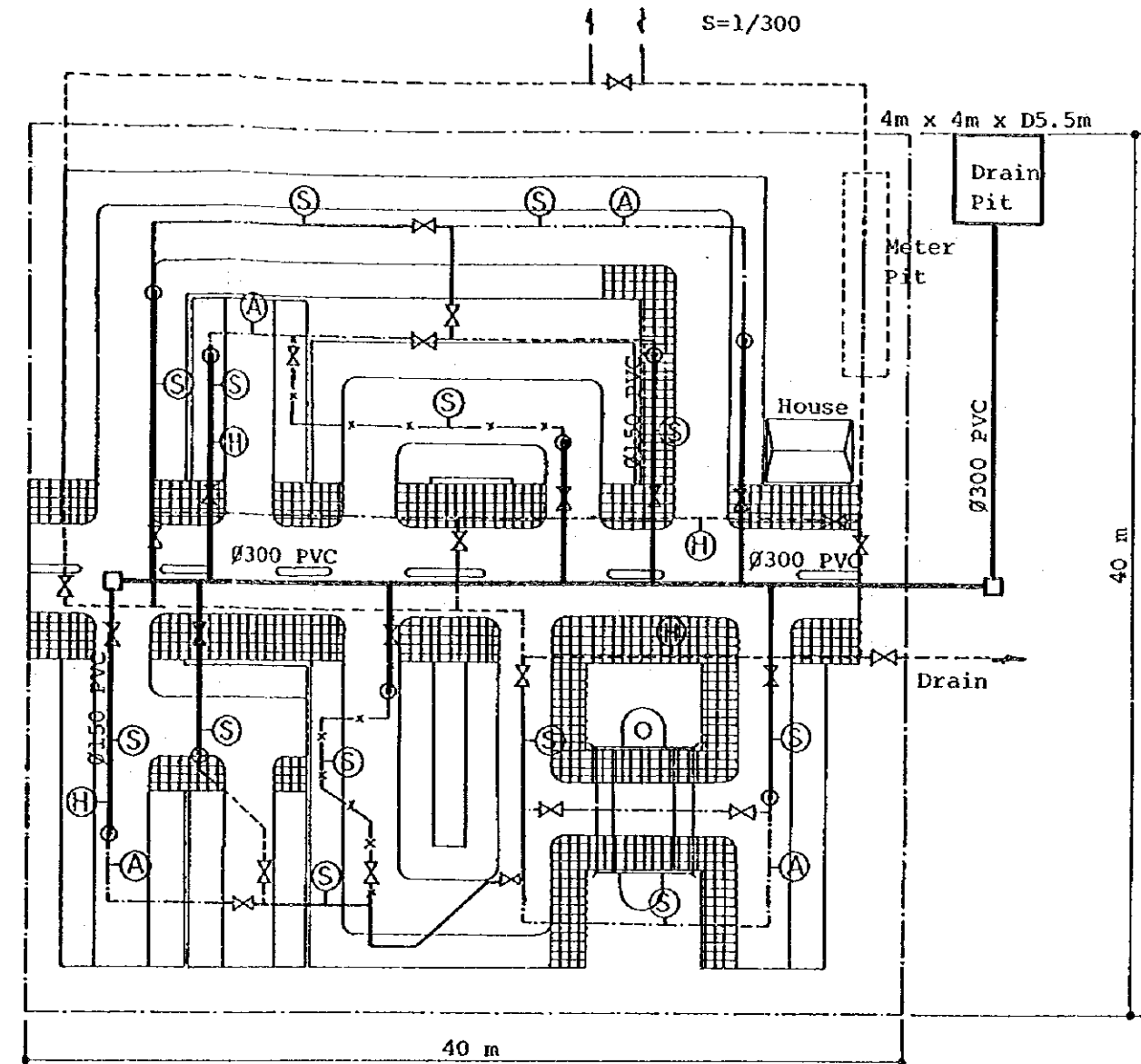
PLAN OF PIPELINES



LEGEND

- : Steel Pipe (SP)/Galvanized Steel Pipe (GP)
- - - : Ductile Iron Pipe (DIP)
- · - · : Asbestos Cement Pipe (ACP)
- x - x : Polyvinyl Chloride Pipe (PVC)
- ⊕ : Fire Hydrant
- Ⓐ : Air Valve
- Ⓢ : Service Pipe Stand
- ⌞ : Valve
- ⊙ : Leak point
- : Concrete Thrust Block

PLAN OF DRAIN SYSTEM



LEGEND

- : PVC Drain Pipe
- : Manhole
- ⊠ : Drain Pit

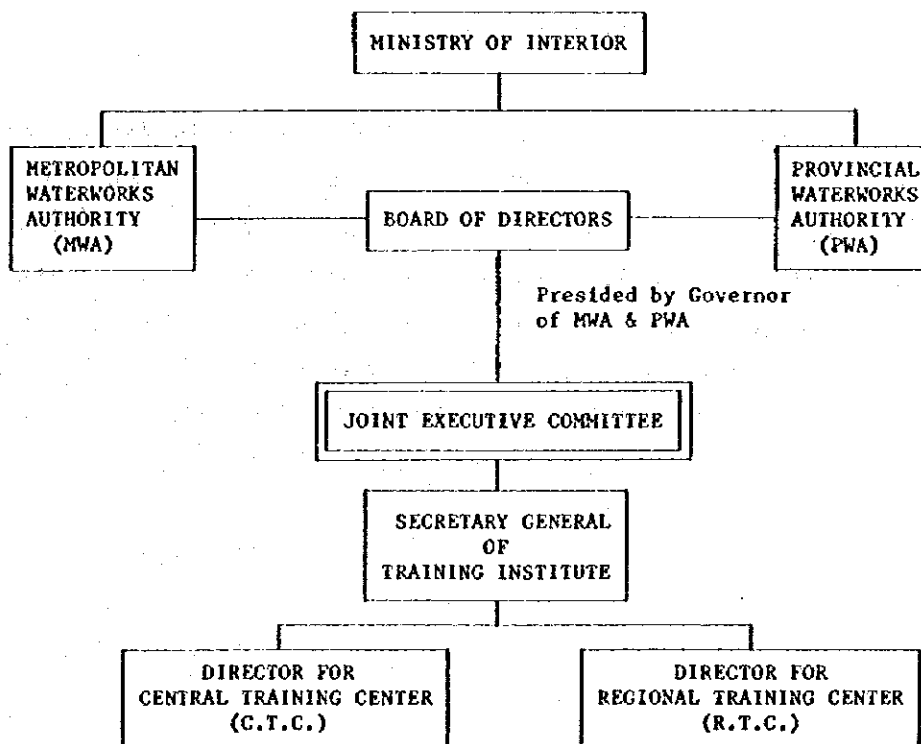


## CHAPTER 6. PROJECT EXECUTION PLAN

### 6-1 Executing System

This is a joint project by MWA and PWA, and the responsibility for its planning and implementation will rest with the Board of Directors (led by the Governors of MWA and PWA), supported by the Joint Executive Committee organized under the board. Personnels of MWA and PWA appointed by Governors of MWA and PWA will be co-signatory for the various contract procedures required under the financial assistance system of the Government of Japan, including detail design and supervisory service contract, construction contract, and bank arrangement. Because the committee has not yet been established, the Working Group (joint committee of MWA and PWA) has been organized as a preparatory body, and will be reorganized to the joint executive committee. The study team had discussion with the working group.

#### PROJECT IMPLEMENTATION COMMITTEE



## 6-2 Construction Execution Plan

### 6-2-1 Execution Plan

After a conclusion of the Exchange of Notes between the two governments to decide the construction project execution, the appointed design consultant and the Joint Executive Committee need to discuss and coordinate matters pertaining to detail design, tender, construction contract, and execution of construction in accordance with basic design policies.

Before commencing the construction of the project, filling and leveling work at the proposed sites needs to be completed by the Thai side.

In the construction plan, the Joint Executive Committee and its Japanese consultant need to study the implementation schedule, to determine the time for starting construction activities (in consideration of the demarcation and interface of responsibilities between the two governments), and to establish a detailed project schedule (including the procurement, delivery, installation of materials and attendance by Thai engineers appointed by the joint executive committee for the project to a test run of installed equipment).

Construction activities need to be scheduled in consideration of local climatic conditions, i.e., earthworks, piling, and all foundation, structural frame, finish, and exterior work should be scheduled during the dry season (November - April), with interior work reserved for the rainy season. Also, appropriate coordination should be made between the time required for the delivery of equipment and materials imported from Japan and the schedule of work using local materials. This will establish an efficient construction schedule, without idling or need for rescheduling.

## 6-2-2 Supervisory Plan

In accordance with the policy on financial aid by the Government of Japan, an appointed consultant needs to organize an project team to carry out detail design and supervising services in accordance with the basic design policies. This ensures appropriate coordination among concerned parties, and the smooth construction of planned facilities.

At the construction stage, the consultant should dispatch resident supervisors with ample technical capabilities to issue instructions to contractors and to communicate with them. Also, the consultant should assign technical experts on a short-term basis in accordance with the progress of the work, in order to carry out inspection, attendance, and instructions.

### 1) Basic policies of supervision plan

To keep close communication with the responsible agencies to complete the facilities on schedule

To direct and assist construction contractors

To give priority to local equipment, materials, and construction methods

To carry out technology transfer in relation to construction methods and technologies

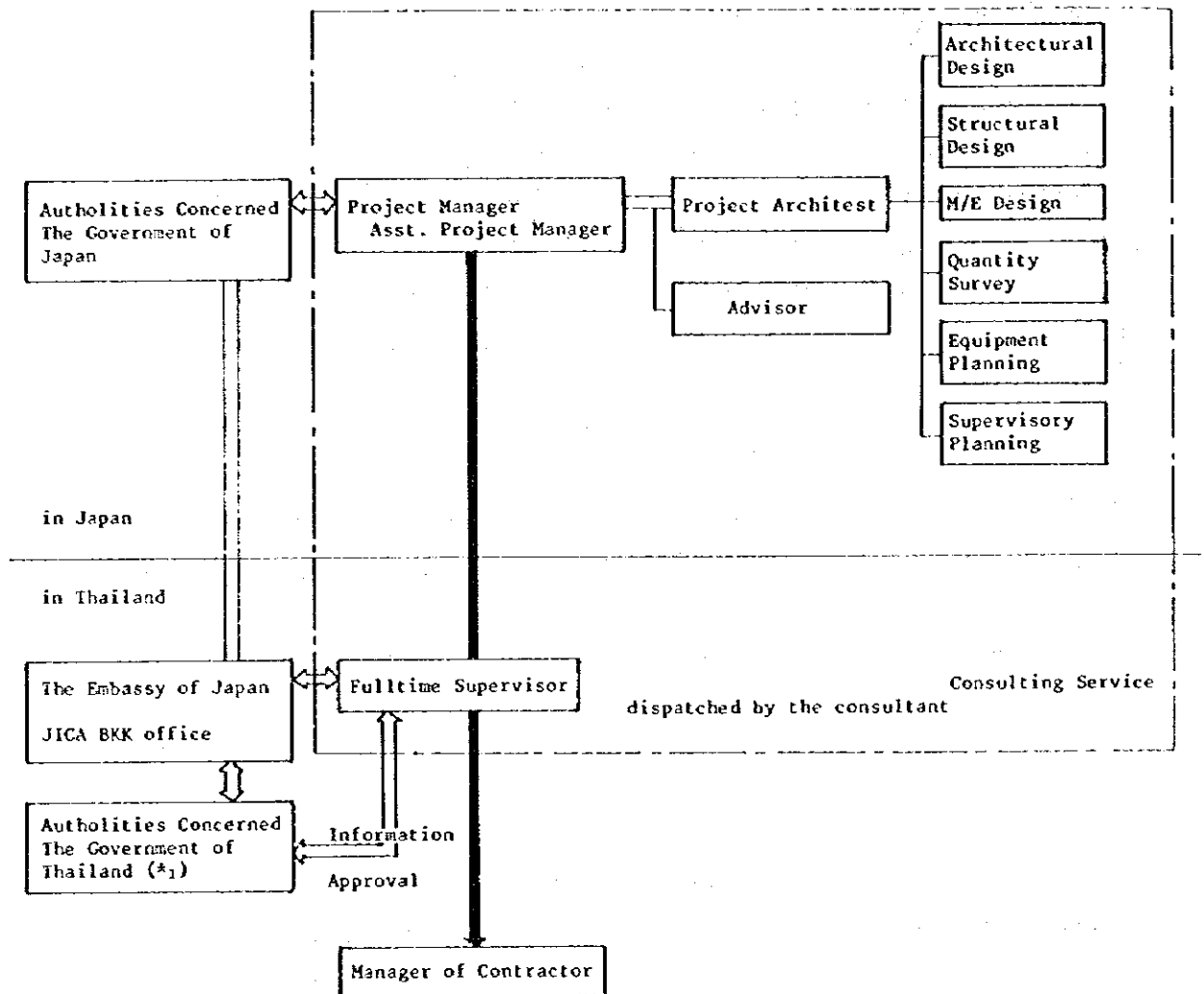
To provide facility management agencies with appropriate advice and guidance for efficient operation and management

### 2) Scope of supervision

#### (1) Assistance in construction contract

Selection of contractors, determination of construction contract method, preparation of contract forms, evaluation of cost estimates, and attendance at signing of contract.

# Supervisory System



(\*1) The Joint Executive Committee organized by MWA and PWA

(2) Inspection and approval of shop drawings

Inspection and approval of shop drawings, materials, finished samples, equipment, and machinery submitted by contractors

(3) Instruction on contract

Evaluation of construction plan and schedule, instructions to contractors, and progress reporting to the owner

(4) Assistance in payment approval procedures

Evaluation of bills to be payable during or after the construction, and assistance in payment procedures

(5) Inspection and approval

Inspection and approval of work from commencement to completion, and ordering to remedy defects

The consultant mission confirm the completion of work in accordance with the conditions of the contract, attend delivery of the completed work, and obtain acceptance from the owner. Also, they report to the Government of Japan any matters related to the progress.



### 6-3 Demarcation of Construction

Scope of works for the project implementation will be divided as described below between the both Governments.

#### 6-3-1 Works to be done by the Government of Japan

##### CTC

- 1) Facilities
  - a) Training building
  - b) Dormitory
  - c) Workshop
  - d) Pump operation training building
  - e) Garage and Storage
  - f) Others (Covered way, cafeteria)
- 2) Infrastructure works
  - a) Elevated water tank for pump operation training plant
  - b) Water supply system
  - c) Drainage system
  - d) Sewage treatment system
  - e) Power receiving/transformation/distribution system
  - f) Telephone exchange system
- 3) External works within the site
  - a) Pavement of road and parking (partial)
  - b) Drainage
- 4) Training Plants
  - a) Mini purification plant
  - b) Pump operation training plant
  - c) Leakage survey training yard
- 5) Training equipment

RTC (Chiang Mai and Khon Kaen)

- 1) Facilities
  - a) Training building
  - b) Dormitory
  - c) Workshop
  - d) Garage and Storage
  - e) Others (Covered way, Cafeteria)
- 2) Infrastructure works
  - a) Water supply system
  - b) Drainage system
  - c) Sawage treatment system
  - d) Power receiving/transformation/distribution system
  - e) Telephone exchange system
- 3) External works within the site
  - a) Pavement of road (partial)
  - b) Drainage
- 4) Training equipment

**6-3-2 Works to be done by the Government of Thailand**

- 1) Securing of land area for the construction of the project
- 2) Filling and leveling of sites
- 3) Construction of gates and fences
- 4) Pavement of road and parking within the sites (partial)
- 5) External works within the sites (CTC: pond, walkway, filling etc)
- 6) Piping training yard at CTC
- 7) Construction and pavement of access roads to sites
- 8) Infrastructure works
  - a) Power electricity incoming
  - b) Water supply incoming
  - c) Drainage (outside of the sites)
  - d) Telephone line incoming
  - e) Raw water supply to Mini purification plant at CTC

PROJECT EXECUTION PLAN

- 9) Supply of furnitures and fixtures
- 10) Landscaping and planting work

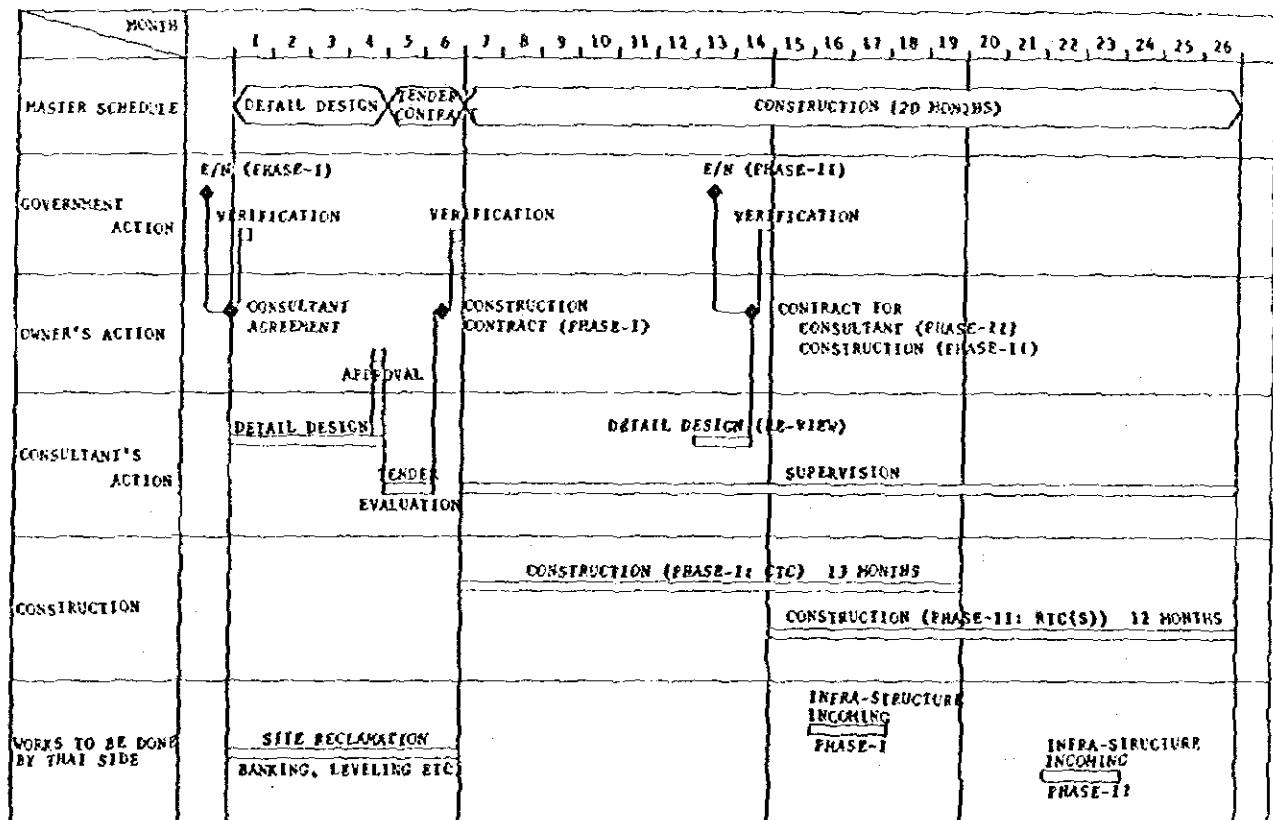
Services and cost defrayment

- 1) Provision of technical information required for project implementation
- 2) Cost defrayment
  - ° Costs related to bank arrangement
  - ° Connections to power electricity, telephone and other utilities
  - ° Tax exemption procedures
- 3) Defrayment of operation and maintenance costs for facilities and equipment
- 4) Appropriate assistance in prompt customs clearance and inland transportation
- 5) Obtaining of exemption for Japanese personnel involved in the project from customs duties and other taxes imposed in Thailand
- 6) Necessary assistance in immigration and resident permits for Japanese personnel involved in the project
- 7) Assignment of Thai personnel required for management and operation of the project, in accordance with detailed manpower plan

# **Rough Cost Estimate of Works to be done by the Government of Thailand**

	(1,000 Bahts)		
	CTC	RTC	RTC
	(Chiang Mai) (Khon Kaen)		
Within Proposed Sites			
(1) Filling and leveling of sites	1,116	77.5	455
(2) Construction of gates and fences	1,218.8	522.2	590.6
(3) Pavement of road and parking (partial)	370	245.9	420.6
(4) Walkway (CTC to Existing MWA Training Center)	32.2	-	-
(5) Pond	823.4	-	-
(6) Piping training yard	199	-	-
(7) Filling and shoring wall around Cafeteria	497.3	-	-
(8) Tennis court	200	-	-
(9) Acquiring part of farmland	-	1,000	-
Sub-total	4,456.7	1,845.6	1,466.2
Outside of Proposed Sites			
(1) Raw water supply to Mini Purification Plant	194	-	-
(2) Construction and pavement of access road	-	737.3	529
(3) Power electricity incoming (w/meter)	100	300	50
(4) Water supply incoming	186	125	15
(5) Drainage	103.6	106.2	6.9
(6) Telephone line incoming	24	75	6
(7) Supply of furnitures and fixtures	2,090	730	730
(8) Landscaping and planting work	620	140	140
Sub-total	3,317.6	2,213.5	1,476.9
Grand Total	7,774.3	4,059.1	2,943.1

## Execution Schedule



#### 6-4 Schedule for Execution

After a conclusion of the Exchange of Notes between the two governments to decide the construction project execution, the project will proceed through the following three stages.

##### Detail design

After the detail design and supervisory service contract between the Joint Executive Committee and the consultant has been verified by the Government of Japan, tender documents will be prepared on the basis of the basic design report. Consultation with responsible Thai government agencies will be required at the preliminary, intermediate, and final stages of preparation. Required time for this stage will be approximately four months.

##### Tender

Tender procedures cover notification, qualification of tenderers, evaluation of cost estimate, and signing of contract, all of which requires approximately two months after completion of the detail design.

##### Construction

After signing of the construction contract, and verification by the Government of Japan, construction will commence. Judging from the project scale and facilities type, the construction period will be approximately twenty months, provided that filling and leveling and other preparatory works by Thai side has been completed as scheduled.

## 6-5 Procurement of Construction Materials

Construction equipment and materials will be procured from local sources, as far as permitted by the construction technologies, the ability of operation and maintenance of facilities, the designed functions of facilities, and the construction period.

As for manpower planning, Japanese supervisors will be assigned to install and adjust training equipment and plants. Construction materials and equipment to be imported from Japan will be installed and incorporated by a local labor force with assistance from Japanese engineers and supervisors.

### 1) Equipment and materials to be procured from Japan

Air conditioning equipment

Pumps

Transformers

Ventilation fans

Valves

Piping equipment

Telephone exchanges

Training equipment

Equipment for training plants

(These types of equipment in Thailand are expensive due to import, so it is desirable to procure them from Japan under customs exemption. Spare parts can be procured from local sources.)

2) Equipment and materials to be procured in Thailand

Surveying equipment

Construction machinery (cranes, tractors, bulldozers, concrete mixers, etc.)

Scaffolding

Cement and aggregates (sand and gravel)

Concrete products (piles, concrete blocks, pipes, etc.)

Reinforcing bars and light gauge steel

Wood

Plywood

Galvanized steel plates

Fixtures (aluminum, stainless steel)

Glass

Bricks

Asbestos products

Paint

Interior finishing materials (for ceiling, wall, and floor)

Pipes

Cables and electric pipes

Panels

Lighting fixture

Electric outlets and switches

Construction equipment and materials produced in Thailand, although lacking uniformity in quantity and quality, can be used for the project. The amount and location of their use should be carefully determined, and strict selection should be made.

Manufacturers, plants, and agencies concerned with the above equipment and materials are mostly located in the Bangkok metropolitan area. Delivery times should be carefully determined after checking production capacity and inventory.



## Staff Allocation Plan (Proposed by Thai side)

## Administrative Staff

	CTC	RTC (each center)
Director	1	1
Deputy Director	3	-
Secretary	1	-
Registrars	-	-
Clerks	3	2
General Staff	9	-
Others	9	7
<hr/>		
Total	26 person	10 person

## Instructor

Management	2	3
Civil Engineer	3	
Sanitary Engineer	2	
Environment Engineer	-	
Electrical Engineer	2	
Mechanical Engineer	2	
Others	2	7
Work Head		(1)
Civil Technician		(1)
Mechanic		(1)
Electrician		(1)
Scientist		(1)
Laboratory Technicians		(2)
<hr/>		
Total	13 person	10 persons

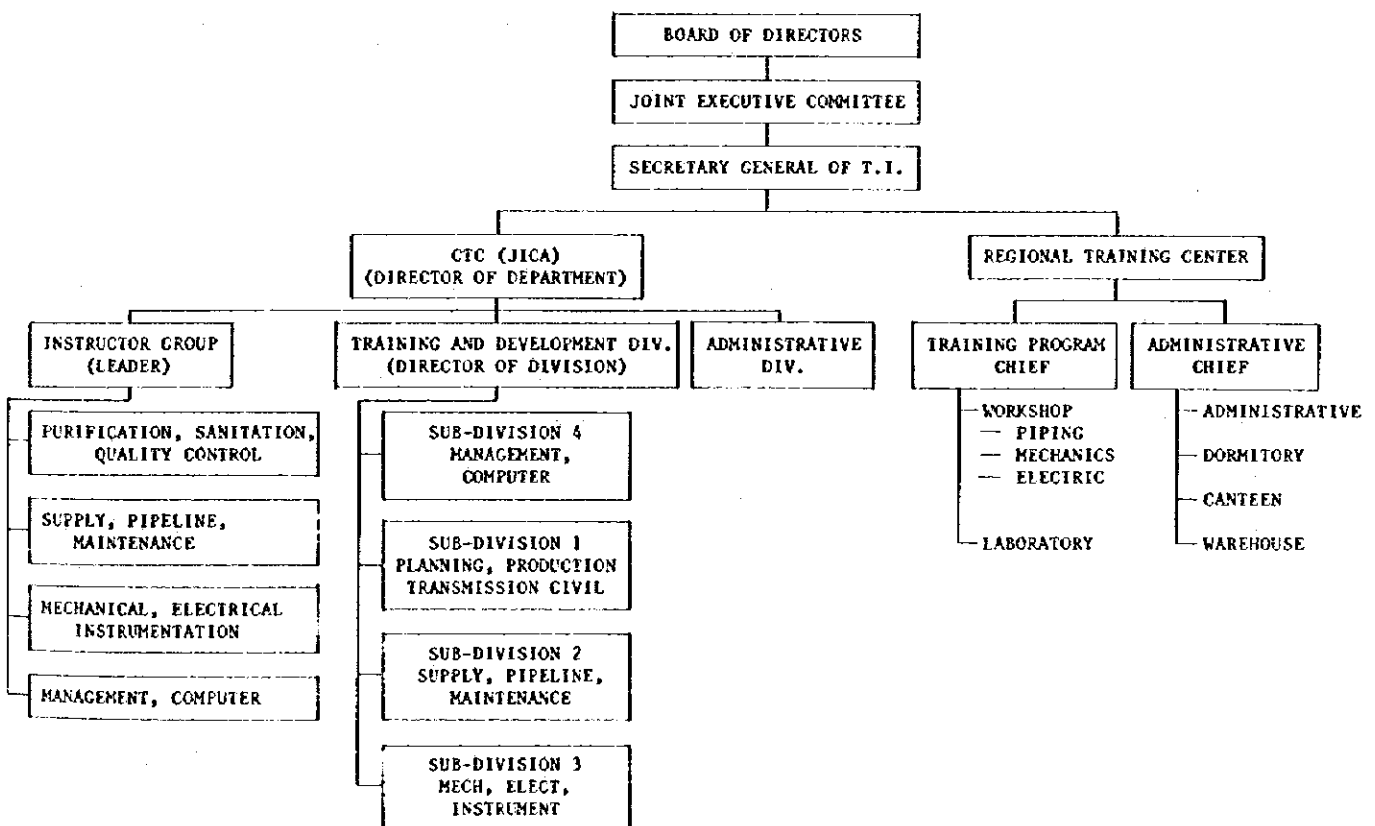
## CHAPTER 7. OPERATION AND MAINTENANCE PLAN

Grant aid assistance is not limited to the supply of equipment, materials, and facilities. It shows its real effect when such facilities are operated by the receiving country to carry out activities in accordance with the designed objectives.

This is also true in this project. To provide a sufficient number and quality of waterworks engineers and technicians through the Institute, an appropriate operation and maintenance organization should be established.

### 7-1 Administration System

The Institute consists of a Central Training Center (CTC) and two Regional Training Centers (RTC). MWA and PWA plan to assign 26 management and administrative personnel (including a director) and 13 training staffs (instructors) to CTC. In addition, 10 management and administrative personnel and 10 training staffs will be assigned to each RTC. The general organization of the Institute is planned by Thai side, as shown below.



The Budgetary Plan Estimated by Thai side

Bahts

CTC	1987 responsibility		1990		200	
	MWA	PWA	MWA	PWA	MMWA	PWA
Total Budget	11,720,000	1,188,000	14,796,000	1,500,000	28,800,000	1,700,000
Breakdown	5,000,000	-	6,050,000	-	12,000,000	-
Personnel Expenses						
Travelling Expenses	300,000	1,000,000	400,000	1,200,000	800,000	1,300,000
Operation Expenses	6,420,000	188,000	8,346,000	300,000	16,000,000	400,000

RTC Chiang Mai	1987	1990	2000
Total Budget	2,585,000	3,046,000	3,526,000
Breakdown	1,586,000	1,746,000	1,925,000
Personnel Expenses			
Travelling Expenses	800,000	1,000,000	1,200,000
Operation Expenses	200,000	300,000	400,000

## 7-2 Operation and Maintenance Plan

Buildings must be designed in consideration of easy operation and maintenance. In addition, at the time of delivery of the centers, appropriate operation and maintenance manuals on the building, the system and equipment, the training equipment, and the plants should be given to maintenance engineers, along with proper demonstrations to suggest and instruct adequate methods of operation and maintenance. Particularly, the general use, cleaning, and maintenance methods should be explained regarding the building and facilities. The operation method, optimum operating time, and maintenance and inspection methods should be taught regarding the system and equipment, training equipment, and plants. In addition, names of manufacturers, contractors, and their agencies should be given to the execution body to facilitate repairs and purchase orders after the delivery of facilities and equipment.

On the basis of the above arrangement, MWA and PWA need to work together to prepare the operation and maintenance plan (including training curriculum, and schedule of facilities and equipment uses) to make the most use of the facilities' functions. They also need to obtain budgets for implementing the plan.

## 7-3 Operation and Maintenance Costs

Operation and maintenance costs, as well as general expenses related to the Institute, will be covered by the MWA and PWA budgets. Educational costs for training staff at the CTC will be shared by both agencies in proportion to their actual numbers of trainees.

Based on the field study, data analysis, and facility scale, the annual operation and maintenance costs (in the initial year) can be estimated as follows.

# OPERATION AND MAINTENANCE PLAN

	CTC Bahts	RTC (each center) Bahts	TOTAL Bahts
Personnel Expenses	4,985,880	1,586,040	8,157,960
Operation Costs for Facilities	1,642,720	598,380	2,839,480
Facility operation (electricity and water etc.)	(711,120)	(304,980)	
Operation and maintenance for facilities and equipment	(329,000)	( 94,800)	
Expendables and general expenses (10%)	(602,600)	(198,600)	
Total	6,628,600	2,184,420 <sup>x2</sup>	10,997,440

The budgetary plan estimated by Thai side for operation and maintenance costs related to the institute is satisfactory plan without operation costs for facilities for RTC in comparison with the above costs estimated by the study team. The operation costs for facilities for RTC estimated by Thai side is as about 1/3 of estimation by the study team. For the operation of RTC, Thai side should transfar some of travelling expenses to the operation costs for facilities.

## CHAPTER 8. TECHNICAL COOPERATION

To make the Institute's activities more efficient and useful, the Government of Thailand requested project-type technical cooperation (such as dispatch of experts to the Institute) from the Government of Japan. In response, the Government of Japan sent the Preliminary Survey Mission for Technical Cooperation to Thailand during October 8 to 20, 1984.

The mission discussed with MWA and PWA personnel the possibility of technical cooperation with the Institute. All agreed on the basic principles of technical cooperation by the Government of Japan, and the commitment required from the Thai side was confirmed. Details of the technical cooperation will be determined at the time of final survey on this matter.

The following technical cooperation are contemplated by the Government of Japan:

### 1) Objectives

Advice and assistance will be extended to Thai counterparts regarding the training plan, details, and method for the five educational courses, which courses are implemented for the Thai training staff at the CTC. Also, advice will be given on planning and implementation of training programs as a whole, with short-term seminars conducted for the Thai training staff.

#### (1) Water Supply Training Course

Master Planning

Facility Planning

Distribution Planning

#### (2) Management Course

(3) Water Purification and Sanitation Course

Water Purification  
Water Quality Analysis  
Water Quality Control

(4) Pipeline Maintenance Course

Piping  
Pipe line Maintenance  
Leakage Prevention

(5) Mechanical and Electrical Installation Course

Mechanical Installation  
Electrical Installation  
Instrumentation

2) Duration of technical cooperation

The technical cooperation will be provided for five years (including preparation period) after the completion of facilities.

3) Services rendered through technical cooperation

(1) Dispatch of Japanese experts

Five experts (including a team leader) will be dispatched on a long-term basis.

Expert for Water Supply Planning	1
Expert for Water Purification	1
Expert for Pipeline	1
Expert for Mechanical Installations or for Electrical Installations	1
Liaison Officer	1

In addition, several experts will be dispatched for management courses on a short-term basis (3-4 months)

(2) Provision of equipment and materials

Equipment and materials considered necessary for the institute's activities will be supplied.

(3) Acceptance of counterparts

Four counterparts per year will be accepted during the period of technical cooperation.

(4) Implementation schedule

year	1	2	3	4	5	6
1. detail design	<input type="checkbox"/>					
2. construction		<input type="checkbox"/>	<input type="checkbox"/>			
3. equipment			<input type="checkbox"/>			
Technical Cooperation						
4. counterparts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. technical cooperation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Acceptance of counterparts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
8. Provision of Equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	



## CHAPTER 9. PROJECT EVALUATION

The project is evaluated in terms of social and economic impact.'

### 1) Social/Economic Evaluation

In Thailand, about 65% of the population in the Bangkok metropolitan area and 10% of the population in other regions are served by public waterworks. MWA and PWA, as the primary water supply agencies, established development programs to meet the social needs and to implement the expansion of water supply facilities.

To expand waterworks and to operate existing facilities, trained waterworks engineers and technicians are essential. MWA and PWA implemented their own training programs but have not obtained sufficient results due to shortages in training staff, facilities, and budget.

To train engineers and technicians in a more effective and integrated manner, both agencies proposed the "Construction of the National Waterworks Technology Training Institute" as their joint project. Therefore, this project is a very effective means to improve and expand the water supply, through provision of competent engineers and technicians in terms of quantity and quality.

When the project is completed, 2,182 MWA personnel and 2,408 PWA personnel will receive their technical training annually. These figures represent 37% of the MWA personnel and 47% of the PWA personnel in 1985, and 30% of the MWA personnel and 44% of the PWA personnel in 1990. Within a three-year period, all members of the MWA and PWA personnels will be able to receive training. The project will provide a sufficient number of the engineers and technicians that are urgently needed.

At the same time, improvement of technical standards can be expected, due to training programs to be organized according to technical level and job type, as well as availability of training facilities, equipment, and staffs.

Altogether, the improvement of technical standard is expected to bring about the following direct impacts on water supply agencies;

1. The amount of water supply can be increased with lowered leakage rate owing to upgrading of leakage survey and repairing techniques and with better operating efficiency owing to improvement of operating technique for purification facilities. If the present leakage rate of 50% can be reduced to 15 - 20% as same as Japan, the daily water supply by MWA is estimated to increase by approximately 635,000 m<sup>3</sup> (equivalent to 1,905,000 bahts) and by PWA to approximately 267,000 m<sup>3</sup> (1,869,000 bahts), on the basis of capacity in 1985.
2. If proper maintenance of purification facilities can be improved by upgrading of operating and maintenance techniques, the maintenance cost can be reduced due to decreasing breakdown rate.
3. Water quality can be improved through better maintenance of purification facilities, leading to increase in demand to encourage the further expansion program.

The provision of good quality water to wider areas due to improvement of waterworks technology is expected to have direct impacts on society;

1. Safe drinking water can be supplied to residents within the service areas.
2. Occurrence of epidemics can be considerably reduced through the supply of good quality water, to educate the general public on sanitation.
3. Waterworks which supply pressurized water in quantities can be used for fire-fighting purposes, to reduce occurrence and extent of fire and thereby to decrease property damages by fire.
4. The provision of water to households is expected to encourage the adoption of flush toilets, thereby improving public health and living conditions.
5. Access to running water is expected to relieve many people from heavy labor in drawing water and to eliminate loss and contamination of water on transportation.

At the same time, its indirect impacts on society include;

1. Wider use of public water is expected to reduce excessive underground water drawing by residents, and thereby to slow down the rate of land settlement.
2. The new provision of industrial water is expected to attract factories and other establishments to newly serviced areas, thereby encouraging the growth of local industries and employment.

MWA and PWA are reducing the number of personnel in accordance with the government's instruction, due to financial difficulties. Nevertheless, if the technical standard of personnels is raised because of training, the range of services per personnel can be expanded, thereby enabling facility operation with less required manpower.

In this project, a CTC is located in Bang Khen, with two RTCs in Chiang Mai and Khon Kaen. Establishment of regional training centers with lodging facilities will reduce traveling expenses (including staying expenses), which currently take up a major part of the training funds for PWA. This will naturally increase actual training funds to provide more effective training. Furthermore, with the combined use of CTC and RTC, the technical standards of the MWA and PWA staffs can be raised to the same level as to ensure good quality water supply throughout the country.

Moreover, the establishment of RTCs will allow the training curriculum to be organized which reflect locality, including variations in water quality at the purification plants. The centers are expected to have some demonstrable effects on stimulating training in water supply agencies other than MWA and PWA.

Altogether, the project can be regarded as the most appropriate one to train the engineers and technicians needed by the country. It is evaluated to be highly eligible for grant aid assistance from the government of Japan.

## 2) Financial Evaluation

The development and operating costs required for the Institute are evaluated as follows.

### (Development Costs)

In this project, the Government of Thailand is expected to carry out the work and services listed in the previous section, for which costs are estimated by the study team to be 14,776,500 bahts. MWA and PWA will share the development costs through their own budgets, which will not constitute a heavy financial burden insofar as these works and services are implemented without affecting the planned training schedule.

### (Operation Costs)

The facilities in the Institute are planned in full consideration of the natural conditions in the regions, so that their maintenance will be basically easy if they are properly managed and operated. The annual maintenance and operating costs for the centers are estimated to be 11,000,000 bahts (in the initial year), including personnel expenses of 8,157,960 bahts, and operation costs for facilities of 2,842,040 bahts. Of these, the expendable items will be sufficiently covered by the follow-up equipment and materials that will be furnished under the technical cooperation. Also, because the MWA and PWA personnels will manage the Institute, the salaries and wages for the personnels paid by both agencies can be transferred to personnel expenses for the Institute. As for the annual operation cost (excluding traveling expenses) at the time of the opening of the Institute, the Thai side estimates it to be 11,608,000 Bahts for CTC and 1,786,000 Bahts for RTC (each center). The total amount of these is 15,180,000 Bahts and it exceeds the total amount estimated by the study team. Assuming that the Thai side provides all the funds in compliance with the above estimation of the Thai side, there should be no problem in the operation of the Institute.

However, the amounts RTC's operation costs for facilities estimated by the Thai side are only 1/3 of the same amounts estimated by the study team. It, therefore, is deemed that the operation cost for facilities for RTC must be increased by transferring some fund from the travelling expenses.

### 3) Evaluation of operation and maintenance organization

As described in Chapter 7, the operation and maintenance organization of the Institute is made up of the management and training sections at the CTC and the RTCs. These appear to be capable of implementing training courses as planned. In addition, Japanese experts are expected to help development of training programs, particularly in preparing the training curriculum for each course.

## CHAPTER 10. CONCLUSIONS AND RECOMMENDATIONS

### 1) Conclusions

The project is designed to train waterworks engineers and technicians with the twin objectives of expanding water supply facilities and supplying good quality water. The project is evaluated on its usefulness, appropriateness, and social/economic impact. It can be concluded that it is highly beneficial in these aspects.

Moreover, it is meaningful for the Government of Japan to provide grant aid assistance and technical cooperation for the implementation of this project. Such assistance contributes to the further development of Thailand's waterworks, and therefore to economic development and the improvement of public health.

### 2) Recommendations

The following efforts by the Thai side are essential to achieve the ultimate goals.

#### 1) Establishment of operation and management organization

It is planned that the Institute will be managed by management and training personnel selected from MWA and PWA. Those personnel should be selected as early as possible to establish the training programs in detail and to understand the facilities' design and functions. Then, they will be ready for smooth operation and management after the completion of the facilities.

#### 2) Recruitment of training staffs

Training staffs in the Institute will be selected from MWA (for CTC) and PWA (for RTCs). In addition, Japanese experts assigned under technical cooperation and possible teaching staffs from universities and research institutions should be fully utilized for advance courses.

3) Timely execution of work and services

To ensure timely execution of filling work and utility connections, as well as prompt proceeding with customs clearance and other procedures which will largely affect the construction period, the establishment of an execution system is recommended. The work is to be executed by the Thai side is estimated at 14,776,500 bahts.

4) Securing of operating budgets

Needless to say, the securing of appropriate amounts in operating budgets is a primary requirement for accomplishment of the planned objectives.

5) Proper maintenance of facilities

Staff responsible for building maintenance, systems and equipment operation, and training plants and equipment operation should be appointed before the delivery of the facilities. This will enable them to become familiar with their jobs during the construction, and to establish maintenance and inspection systems and programs.

6) Technical cooperation

To support the activities of the Institute, project-type technical cooperation by the Government of Japan is considered. It is desirable to send experts as early as possible, in order for them to prepare training programs and curriculum and to instruct training staff. This will enable the timely start of training after completion of the facilities. Also, it is recommended to extend the scope of technical cooperation to the maintenance of training plants (mini purification plant and pump operation training plant) by providing training for counterparts in Japan and by supplying training materials.

In conclusion, it should be emphasized that three types of activity are necessary: 1) grant aid assistance to provide facilities, 2) technical cooperation, and 3) active involvement of the Thai side. These constitute the basic components that enable the Institute to provide competent waterworks engineers and technicians for more efficient and expanded water supply services in Thailand.





## **Appendix**

- 1. Dispatch of the Survey Team**
- 2. Minutes of Discussions**
- 3. Condition of the Sites**
- 4. Data for Operation & Maintenance Cost**
- 5. List of Training Equipment**



## APPENDIX 1. DISPATCH OF THE SURVEY TEAM

For the planning and design of the Construction of the National Waterworks Technology Training Institute concerned, survey teams have been dispatched.

### 1) Member of the Survey Team

#### ☐ Basic Design Study Team (January 8 - January 28, 1985)

Team Leader	Mr. Kazuyoshi OKAZAWA Deputy Director, Water Supply Division Environmental Health Bureau Ministry of Health & Welfare
Technical Adviser	Mr. Haruo IWAHORI Development Specialist Institute for International Cooperation JICA
Project Coordinator	Mr. Michimasa NUMATA Basic Design Survey Division Grant Aid Department, JICA
Architectural Planner	Mr. Akitada YANAGISAWA Kume Architects-Engineers
Architectural Designer	Mr. Shigeru YASUMATSU Kume Architects-Engineers
Mechanical Planner	Mr. Yoshizo OHMAE Kume Architects-Engineers
Water Supply Planner	Mr. Hideki YAMAZAKI Nihon Suido Consultants

#### ☐ Draft Report of Basic Design Study Team (April 7 - April 13, 1985)

Team Leader	Mr. Michimasa NUMATA Basic Design Survey Division Grant Aid Department, JICA
Architectural Planner	Mr. Akitada YANAGISAWA Kume Architects-Engineers
Mechanical Planner	Mr. Yoshizo OHMAE Kume Architects-Engineers

## 2) Cooperative Officials in the Survey

### Thai Authorities Concerned

#### MWA (Metropolitan Water Works Authority)

Dr. Arthit Ourairat	Governor
Mr. Suvich Futrakul	Deputy Governor for Engineering
Mr. Visit Lorthrapong	Deputy Governor for Customer Service
Mr. Niwat Sooksomboon	Deputy Governor for Administration
Mr. Wirat Hutangkul	Deputy Governor for Operation
Mr. Tien Kattapan	Assistant Governor
Ms. Pongpaka Techasen	Assistant Governor
Mr. Thongterm Yukranantana	Assistant Governor
Mr. Klahan Voraputhaport	Director, Bangkhen Water Treatment Plant
Mr. Suthep Sungpetch	Director, Personnel Department
Mr. Rattana Supanich	Director of Project Management Department
Mr. Potchana Sivaraksa	Director of Governor's Secretarial Division
Mr. Vira Rojanavongse	Director, Training Center
Mr. Thanom Vongchanta	Director, Personnel Planning Division
Ms. Sonthaya Sinthuyont	Chief, Training Support Section
Mr. Vikrom Suwanchompoo	Engineering 4, Water Loss Reduction Department
Mr. Samphan Oumtrakul	Chief, Technical Training Section
Mr. Thawatchai Saisamorn	Chief, Maintenance Water Productive Section
Mr. Kamolwon Chuencharoensuk	Instructor, Administrative Training Section

PWA (Provincial Waterworks Authority)

Mr. Mechai Viravidaya	Governor
Mr. Lert Chainarong	Deputy Governor (Operation and Maintenance II)
Mr. Anant Tantidhamma	Deputy Governor (Technical Affair)
Mrs. Kanya Singcharoen	Assistant Governor (Administration)
Mr. Suwat Vissurak	Representative Director of Operation and Maintenance II
Mr. Virusah Mahakkapong	Director, Office of Operation and Maintenance I
Mr. Chatchawan Punmanee	Director, Office of the Governor
Mr. Jongchana Sitalaphruk	Director, Training Center
Dr. Wanchai Chooprasert	Director, Corporate Planning Department
Mr. Anuchit Thumtaranon	Director, Construction Supervision Department
Dr. Prasert Chuaphanich	Director, Engineering Department
Mrs. Virayu Amoraketrakul	Director, Finance and Accounting Department
Mr. Kamthorn Nakalak	General Management grade 9
Ms. Tassanee Samroengvate	General Management

DTEC (Department of Technical and Economic Cooperation)

Mr. Kasem Unahasuan	Deputy Director General
Mr. Sutin Susila	Colombo Plan Sub-Division
Mr. Surayuth Kungsadan	Colombo Plan Sub-Division

Japanese Expert

Mr. Norio Taguchi	Colombo Expert (MWA)
Mr. Yoshifumi Ono	Colombo Expert (MWA)
Mr. Kumpei Igarashi	Colombo Expert (PWA)
Mr. Masaru Tanaka	Colombo Expert (PWA)

**Japanese Officials Concerned in Thailand**

**Embassy of Japan in Thailand**

Mr. Kazuyoshi Urabe	Councilor
Mr. Yasunobu Takayama	First Secretary

**JICA Bangkok Office**

Mr. Michimoto Goto	Director
Mr. Fumio Kikuchi	Assistant Resident Representative

**Japanese Expert**

Mr. Norio Taguchi	Colombo Expert (MWA)
Mr. Yoshifumi Ono	Colombo Expert (MWA)
Mr. Kumpei Igarashi	Colombo Expert (PWA)
Mr. Masaru Tanaka	Colombo Expert (PWA)

## **APPENDIX 2. MINUTES OF DISCUSSIONS**

**Minutes-1 on Basic Design Study (January 18, 1985 signed)**

**Minutes-2 on Draft Report of Basic Design Study (April 12, 1985 signed)**



Minutes of Discussions  
on  
Construction of National Waterworks Technology Training Institute  
in  
the Kingdom of Thailand

In response to the request made by the Government of the Kingdom of Thailand, the Government of Japan has sent, through Japan International Cooperation Agency (hereinafter referred to as "JICA"), a team headed by Mr. Kazuyoshi OKAZAWA, Deputy Director of Water Supply Division, Environmental Health Bureau, Ministry of Health and Welfare, to conduct a basic design study from 8 to 28 January 1985.

The team has carried out a field survey, held a series of discussions and exchanged views with the Thai authorities concerned. As conclusion of the study and discussions, both parties have agreed to recommend to their respective governments to examine the results of the survey attached herewith (ATTACHMENT) towards the realization of the Project.

18 January 1985

Bangkok, Thailand

*Kazuyoshi Okazawa*  
.....

(Mr. Kazuyoshi OKAZAWA)  
Leader  
Basic Design Team  
Japan International  
Cooperation Agency

*S. Pitakul*  
.....

for (Dr. Arthit Ourairat)  
Governor  
Metropolitan Waterworks  
Authority

*Anant Tanthakham*  
.....

(Mr. Mechai Viravaldya)  
Governor  
Provincial Waterworks  
Authority

1. The objective of the Project is to train the MWA and PWA personnel for water supply and thus to contribute to the improvement of water supply in Thailand.
  2. The construction of National Waterworks Technology Training Institute (NWTPI) includes necessary buildings, facilities and equipment for the training, which are described in Annex I.
  3. The sites of the Project are located at Bangkok, Chiang Mai and Khon Kaen.
  4. The Thai authorities concerned have accepted Japan's grant aid system for implementation of the Project explained by the basic design team, which includes principles of use of Japanese consultant firm(s) and Japanese general contractor(s).
  5. The Thai authorities concerned will take necessary measures listed in Annex II on the condition that the grant aid by the Government of Japan is extended to the Project.
- A.

EO.

S. K. Bull

A N N E X I

Major buildings and equipment requested from Thai side

1. B u i l d i n g s

- (1) Central Training Center (C.T.C.) which consists of main building, mechanical workshop, electrical workshop and dormitory,
- (2) Regional Training Centers (R.T.C.), one of which consists of main building, workshop and dormitory,

2. E q u i p m e n t   a n d   o t h e r s

- (1) Water purification demonstration plant
- (2) Water leakage field unit
- (3) Pumping equipment
- (4) Electric equipment
- (5) Measurement equipment
- (6) Laboratory equipment
- (7) Machines and Tools
- (8) Audio-Visual equipment
- (9) Automobiles

A.

K.O.

S. F. Fall

## ANNEX I I

Following arrangements are to be taken by the Government of the Kingdom of Thailand.

1. To provide necessary data and information for basic design, detail design and construction.
2. To secure land necessary for the construction and to clear, fill and level the Project sites as needed before the start of the construction.
3. To provide, during the construction and after the completion, temporary and permanent access road, electricity, telephone, water, drainage and other necessary facilities at the Project sites.
4. To undertake incidental civil works such as planting and fencing, if needed.
5. To provide the space necessary for temporary offices, working areas, stock yards and others.
6. To use properly the facilities constructed and equipment purchased under the grant aid.
7. To ensure prompt unloading, tax exemption and custom clearance at ports of disembarkation in Thailand and prompt internal transportation therein, of the products and related equipment purchased under the grant aid.

A.

K.O.

S. Kufell

8. To exempt Japanese nationals engaged in the Project from custom duties, internal taxes and other fiscal levies which may be imposed in Thailand with respect to the supply of the related goods and services under the verified contracts.
9. To accord without delay to Japanese nationals whose services may be required in connection with the supply of the related goods and services under the verified contracts such facilities as may be necessary for the entry into Thailand and their stay therein for the performance of their work.
10. To bear all the expenses, other than those to be borne by the grant aid, necessary for construction of the facilities as well as for the transportation and the installation of the equipment.

A.

K.O.

S. Fuhrer

MINUTES OF DISCUSSIONS

## THE DRAFT FINAL REPORT OF THE BASIC DESIGN STUDY

ON

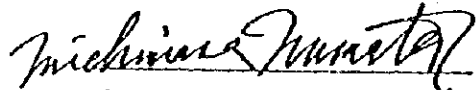
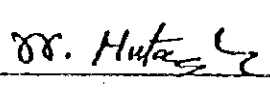
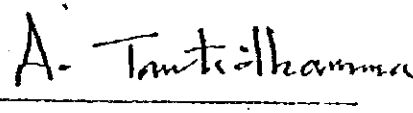
## NATIONAL WATERWORKS TECHNOLOGY TRAINING INSTITUTE

The Government of Japan has sent, through Japan International Cooperation Agency (JICA), a Basic Design Study Team to the Kingdom of Thailand from 7 to 13 April 1985 for the purpose of presenting and explaining the Draft Final Report of the Basic Design Study on National Waterworks Technology Training Institute (NWTI).

After a series of discussions between the Team and the Thai authorities concerned, both parties confirmed the following results attached herewith (ATTACHMENT).

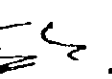
12 April 1985

Bangkok, Thailand

		
(Mr. Michimasa Numata)	for (Dr. Arthit Ourairat)	for (Mr. Mechai Viravaidya)
Leader	Governor	Governor
Basic Design Study Team	Metropolitan Waterworks	Provincial Waterworks
JICA	Authority	Authority

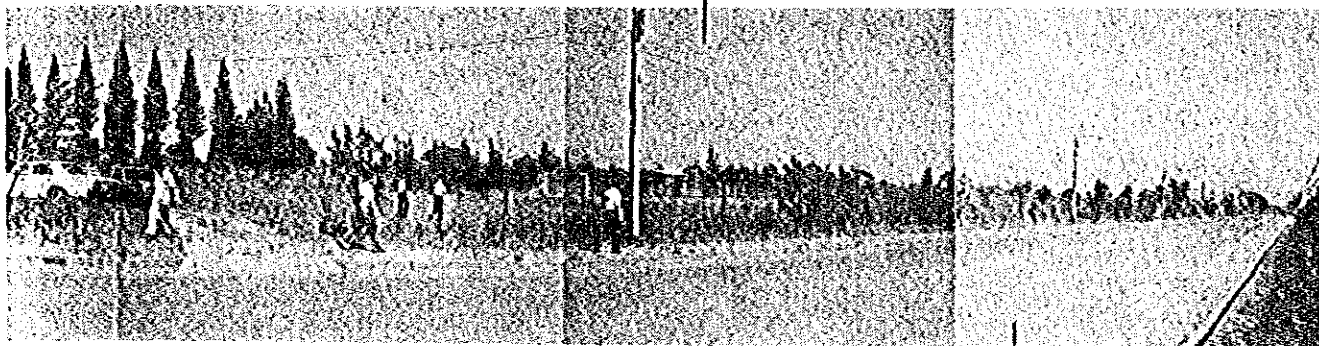
ATTACHMENT

1. Both parties agreed to reconfirm the Minutes of Discussions which was mutually signed on 18 January 1985.
2. The Thai authorities concerned have agreed in principle to the basic design proposed in the Draft Final Report and appropriate alterations agreed upon during the discussions will be incorporated in the Final Report.
3. The Thai authorities concerned have accepted Japan's grant aid system and the arrangement to be taken by the Thai side for realization of the Project.
4. The Final Report (10 copies in English) will be submitted to the Thai side by the end of June 1985.

A.I. Dr. Huta 

M.N.

PROPOSED SITE

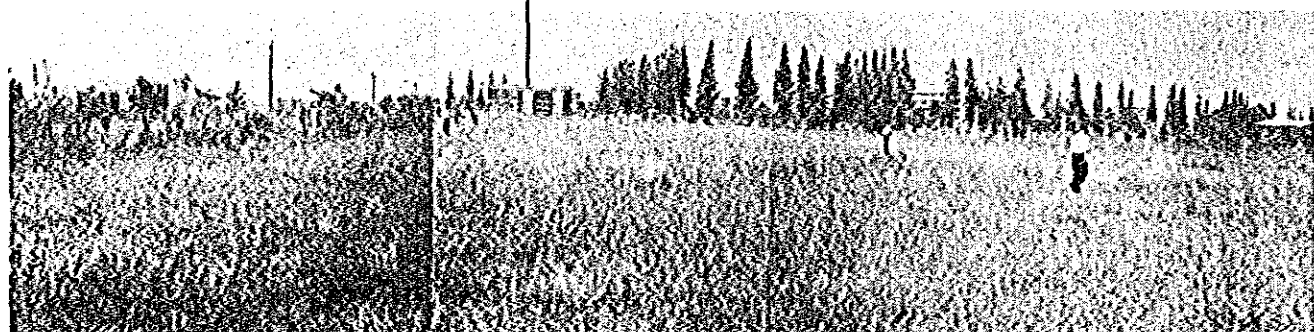


ROAD

STAFF HOUSING



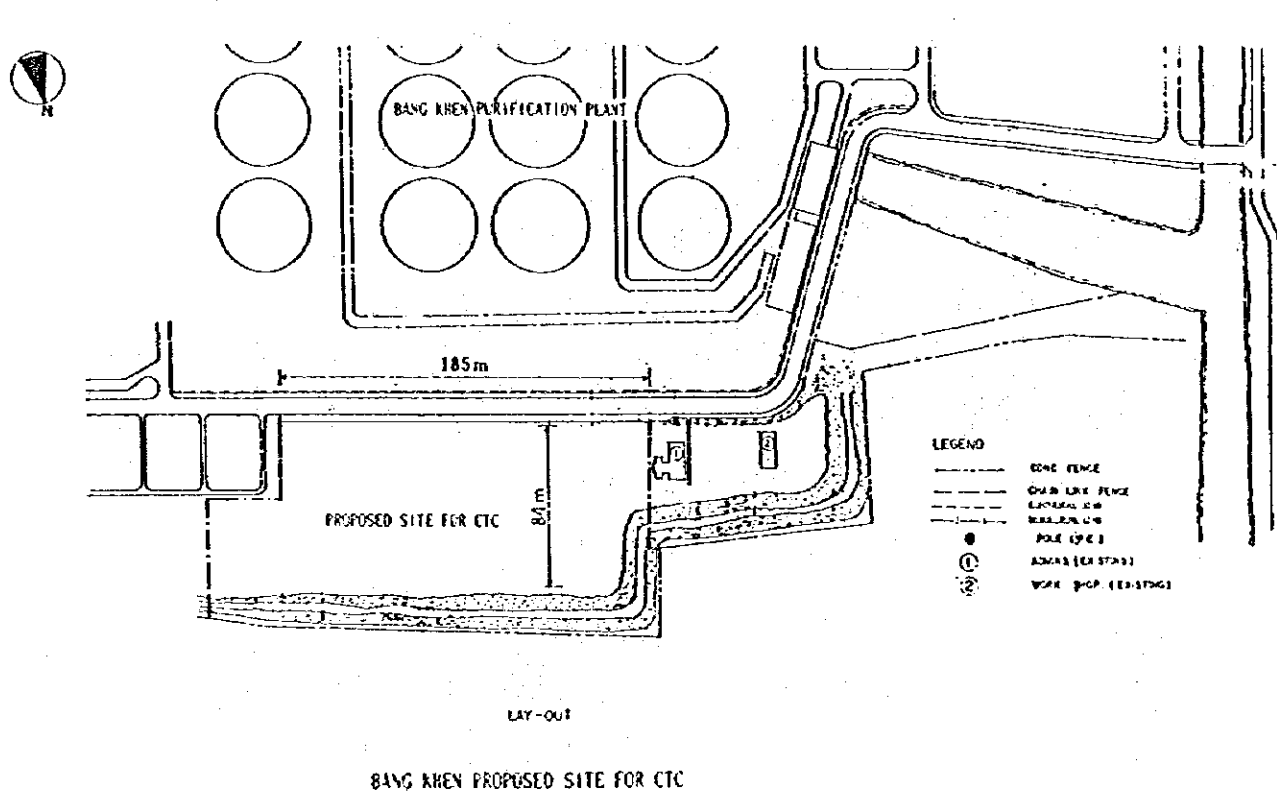
MWA TRAINING CENTER

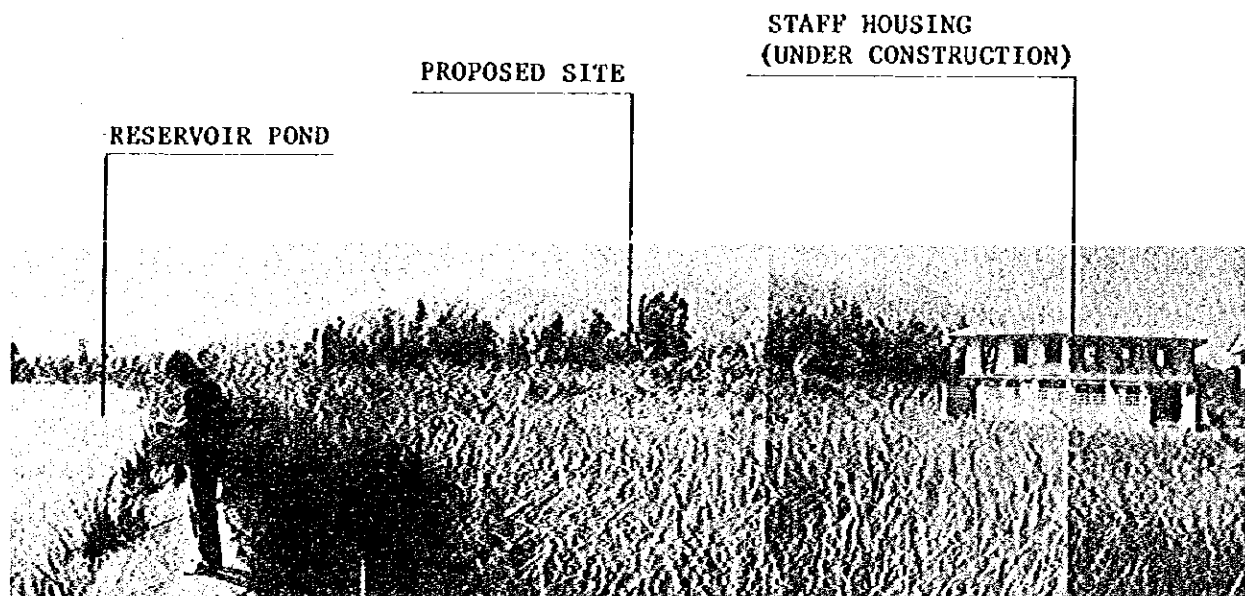
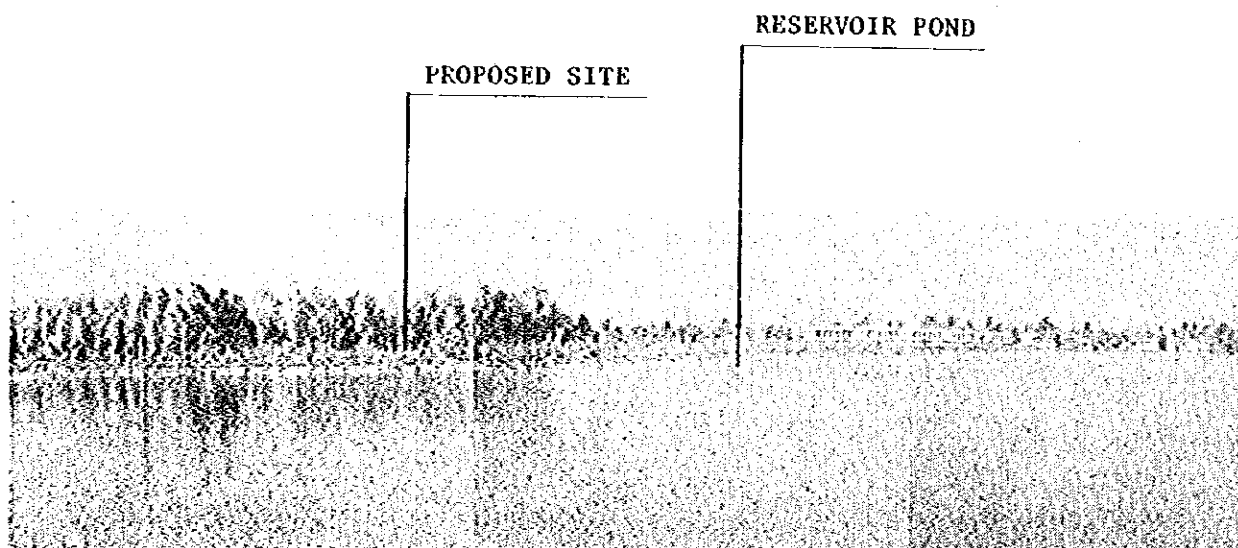
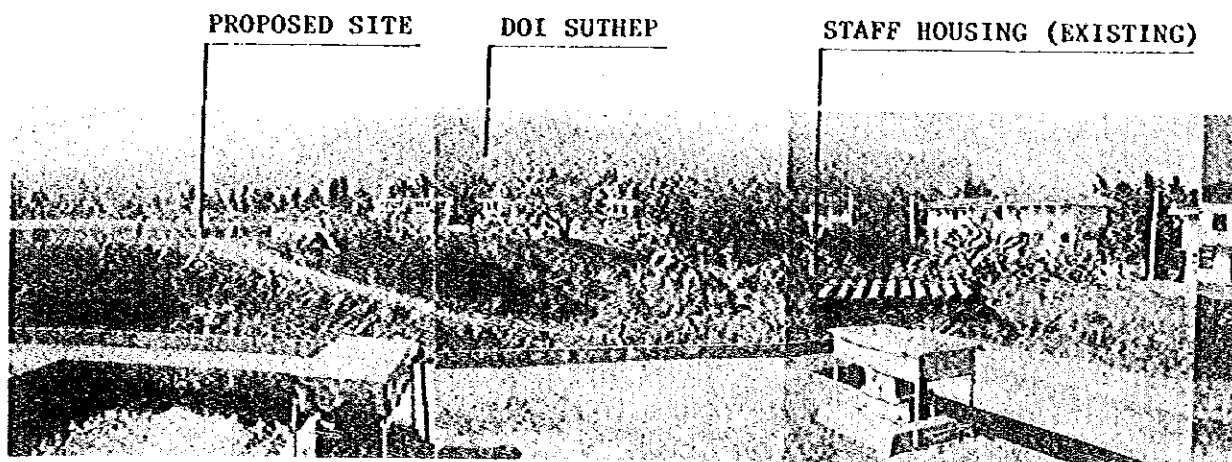





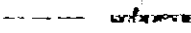
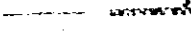


## APPENDIX 3. CONDITIONS OF THE SITES

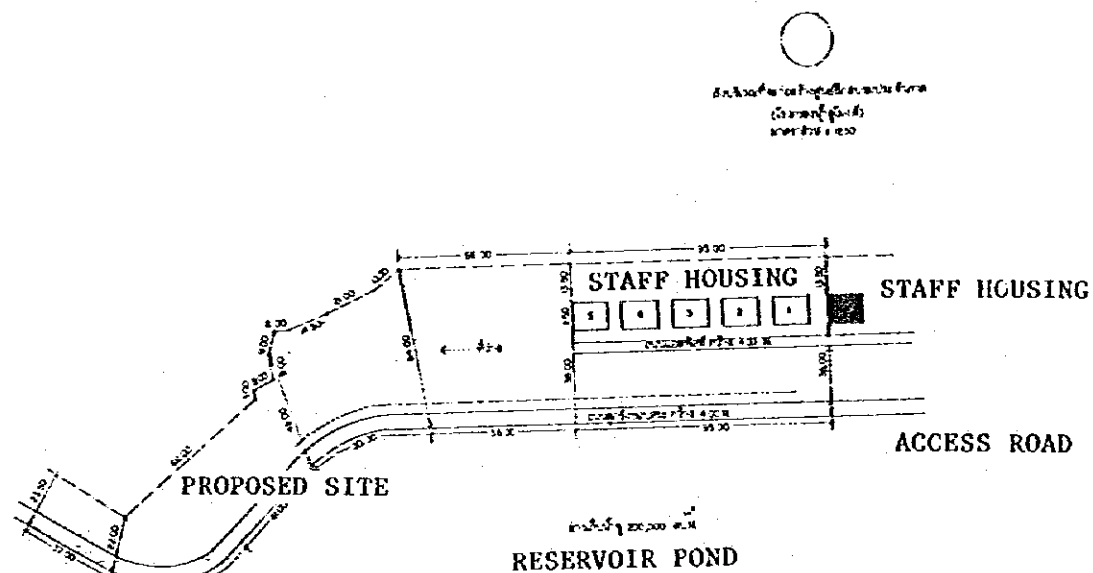
### Central Training Center: Proposed Site





# Regional Training Center (Chiang Mai): Proposed Site

-  U MONG PURIFICATION PLANT (Chiang Mai)
-  PROPOSED SITE
-  OPEN-DITCH
-  STAFF HOUSING (EXISTING)
-  STAFF HOUSING (UNDER CONSTRUCTION)



PROPOSED SITE

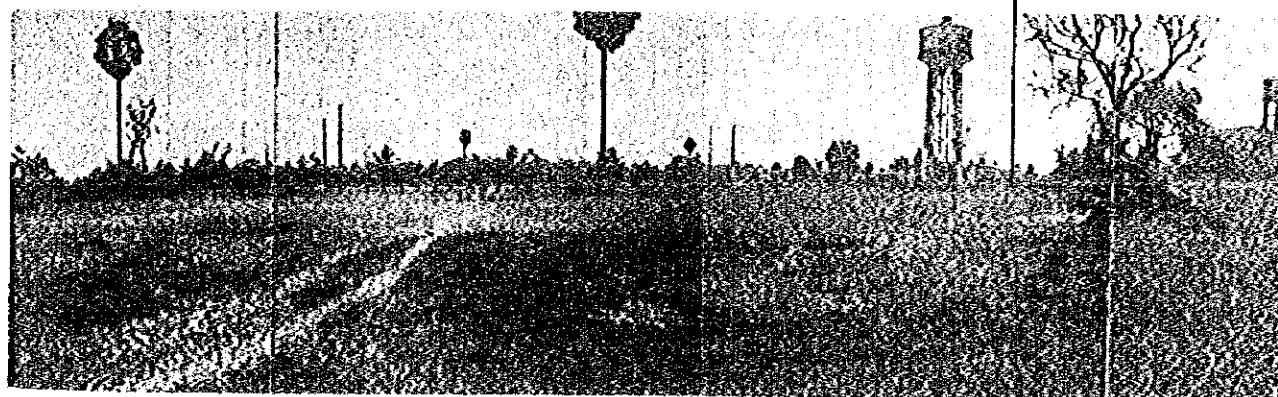
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(TO KHON KAEN)  
ROAD

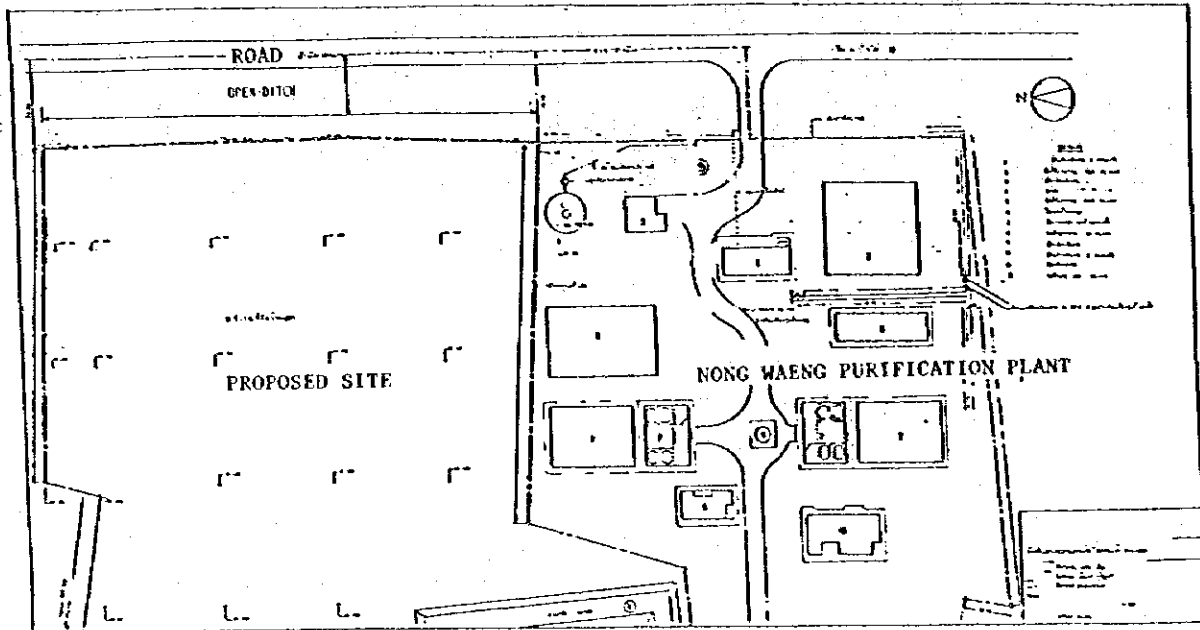


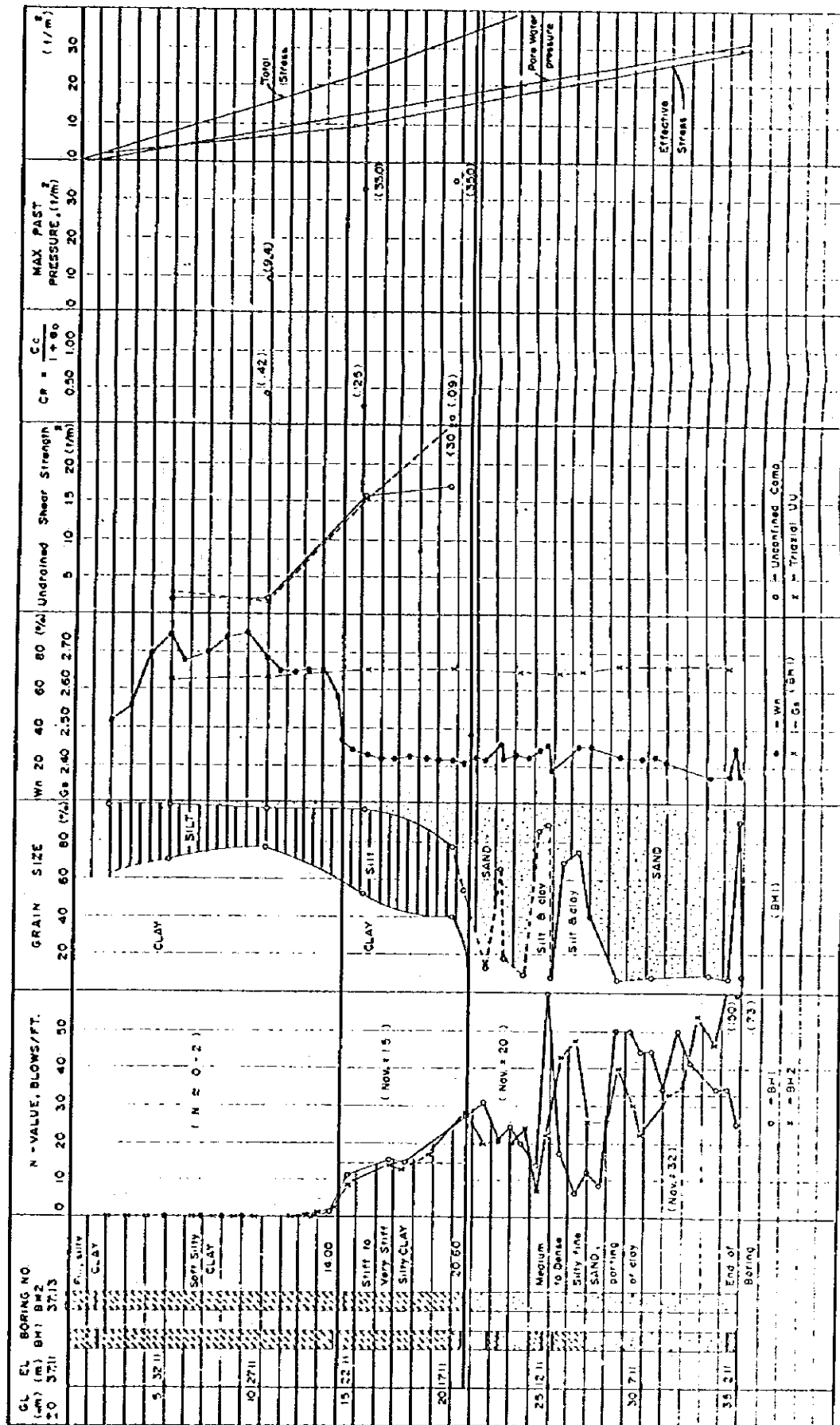
NONG WAENG PURIFICATION PLANT



**Regional Training Center (Khon Kaen): Proposed Site**

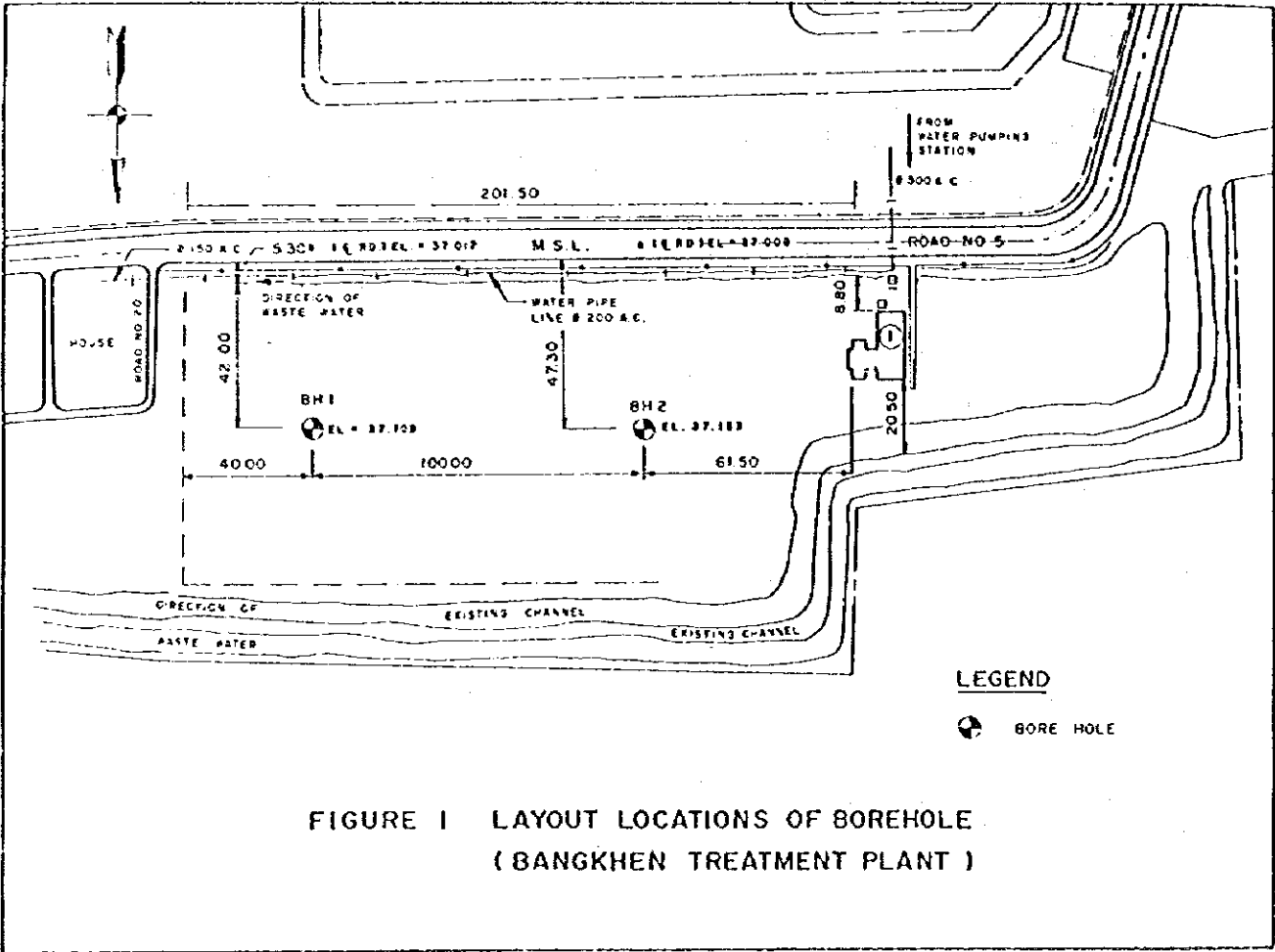
**NONG WAENG PURIFICATION PLANT (Khon Kaen)**





Boring Records

Central Training Center

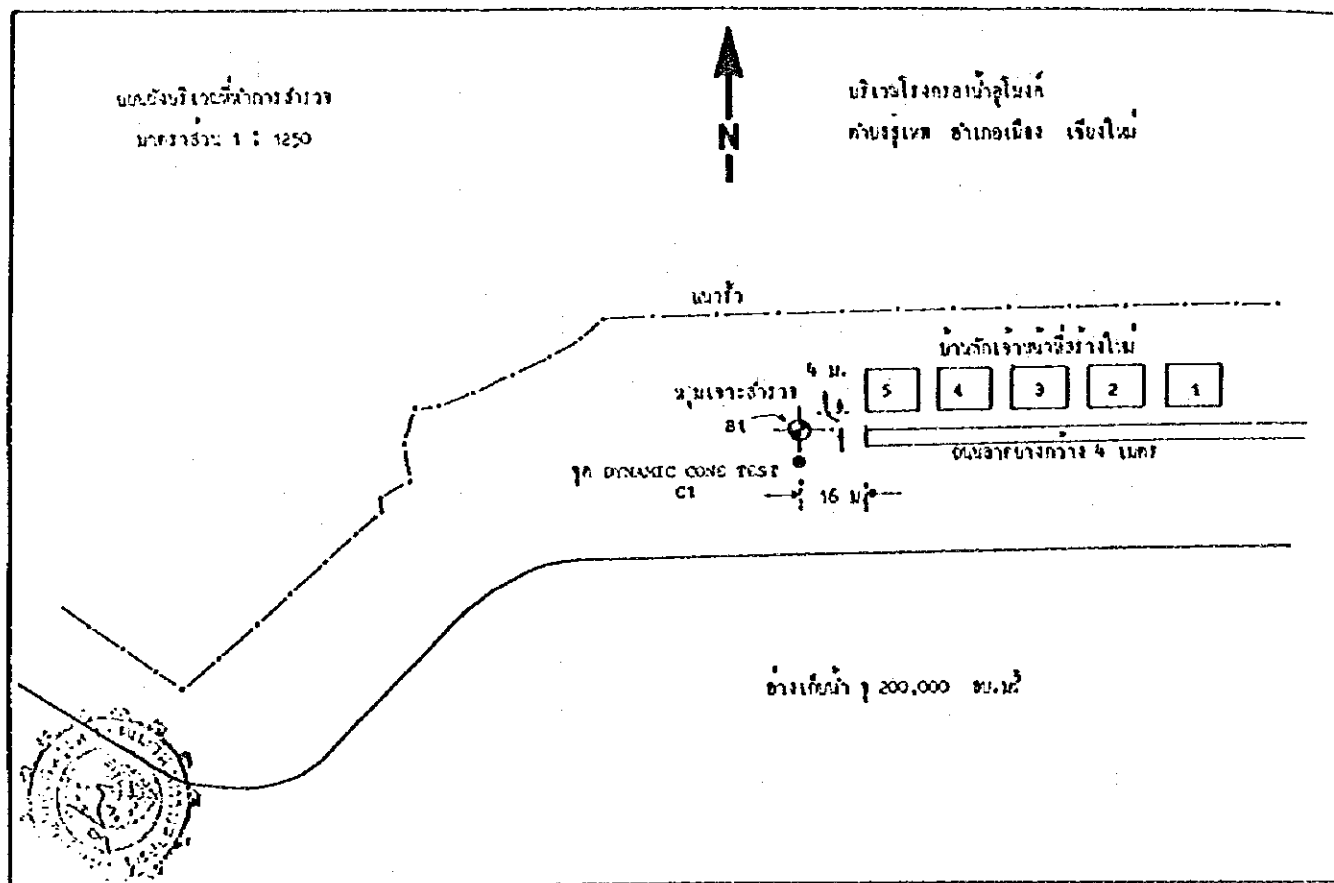


SOIL MECHANICS LABORATORY FACULTY OF ENGINEERING CHIANG MAI UNIVERSITY									
BOREHOLE RECORD									
PROJECT ภูมิปัญญาชน 8, 9 ไร่				DATE START 22/2/28		JOB NO. 25/2528			
LOCATION ภูมิปัญญาชน 8, 9 ไร่				DATE FINISH 24/2/28		BOREHOLE NO. B1			
TYPE & SIZE OF BORE 105 mm. pier						SHEET NO. 1 OF 2			
REMARKS: L: Recovery Length, N: SPT blows/30cm, q: Pocket Penetrometer Strength									
DEPTH (m)	CLASSIFICATION	TESTS AND SAMPLINGS							
		TYPE	DEPTH (m) From - To	L (cm)	SPT 'N'	q <sub>p</sub> (t/m <sup>2</sup> )			
0.00	TOP SOIL SANDY SILT (ML) grey brown, low plasticity, dry, fine sand and some fine gravel, hard								
0.90	SILTY SAND (SM) yellow brown silt, white grey sand, sand fine to medium, medium plasticity silt and clay, some fine gravel, wet, medium dense, less silt and clay below 1.70 m.	SPT	0.70 - 1.15	40	9				
1.30		SPT	1.00 - 2.25	40	16				
	water table encountered at 1.70 m. steady level (3 days later) at 1.30 m.	SPT	2.75 - 3.20	45	8				
4.00	SILTY CLAY (CL) dark grey with yellow brown mottled, medium plasticity, w > PL, fine to medium sand, stiff	SPT	3.75 - 4.20	45	11				
		U3	4.60 - 5.10	37					
		SPT	5.10 - 5.55	45	21				
5.80	CLAYEY SAND (SC) grey and yellow brown mottled, fine to medium sand, some gravel up to 3/4", approx. 45% medium plasticity clay and silt, w < PL, dense	U3	5.90 - 6.35	45					
		SPT	6.35 - 6.80	45	28				
		U3	7.30 - 7.70	40					
		SPT	7.70 - 8.15	40					
8.00	below 8.00 m this colour is mostly grey, with little yellow brown streak, grey decomposed rock gravel increasing, dense	U3	9.10 - 9.60	50					
9.60	SANDY CLAY (CL) yellow brown and grey mottled, medium plasticity clay and silt, w ≈ PL, approx. 50%	SPT	9.60 - 10.05	45	19				
10.00	medium to coarse sand and fine gravel, stiff	U3	11.00 - 11.45	45					
		SPT	11.45 - 11.90	33	21				
12.70	more gravel and coarse sand below 12.70 m, white grey decomposed rock gravel up to 1/2", very stiff	U3	12.60 - 13.05	45					
		SPT	13.05 - 13.50	45	39				
		U3	14.20 - 14.55	35					
		SPT	14.55 - 15.00	45	32				
15.00	END OF BOREHOLE at 15.00 m.								



## Boring Records

**Regional Training Center (Chiang Mai)**



FIELD BORING LOG									
SURVEY BORDING UNIT				JOB NO. 1					
LOCATION				WATER LEVEL OBSERVATION					
<div style="display: flex; justify-content: space-between;"> <div>                     HOLE NO. 3                      ORIGINATOR                      SURVEYOR                      DATE                 </div> <div>                     HOLE NO. 3                      ORIGINATOR                      SURVEYOR                      DATE                 </div> </div>				WL - 10.00 M WL - 10.00 M WL - 10.00 M WL - 10.00 M					
PENETRATION PILE SPLIT SPON SAMPLE SPT PENETRATION PILE SPT				TEMP. - 10.00 M TEMP. - 10.00 M TEMP. - 10.00 M TEMP. - 10.00 M					
DEPTH (m) FROM TO 0.00 1.00 1.00 2.00 2.00 3.00				TV TV TV TV					
SPT SPT SPT				SURFACE ELEVATION SURFACE ELEVATION SURFACE ELEVATION					
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3				10.00 M 10.00 M 10.00 M 10.00 M					
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6				10.00 M 10.00 M 10.00 M 10.00 M					
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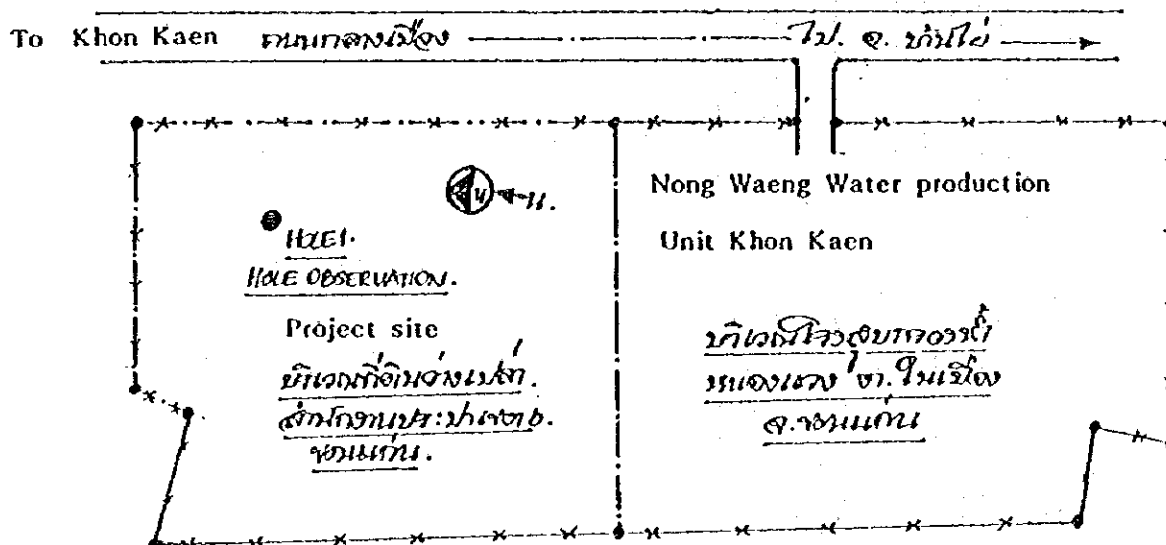
## Boring Records

### Regional Training Center (Khon Kaen)

#### Khon Kaen Public Work office

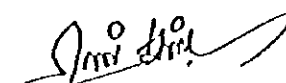
#### Report of Boring Test

Location : Nong Waeng Water production Unit , Khon Kaen  
 Client : Provincial Waterwork Regional office 6 Khon Kaen  
 Boring Team : 1. Mr. Surasak Charoenpan Engineer gr.3  
 2. Mr. Smart Laochaturapis Technician gr. 2  
 Engineer : Mr. Surasak Charoenpan  
 Date of Test : 12 February 1985



#### Result of the boring test

The boring test has been done by hand auger , top soil condition from surface to 1 m depth is brownish & greyish silty clay and from 1 m to 2 m is white grey clay with trace of Laterite and after 20m it is very stiff clay and can not drill by hand auger , so standard penetration test has been used. The number of blow per one foot of penetration is 25 , which means that the strength of the soil is higher than 10 ton/m<sup>2</sup>

  
 วิศวกร/ผู้ทำ (เจษฎาพันธ์)  
 วิศวกรโยธา ๓

## APPENDIX 4. DATA FOR OPERATION &amp; MAINTENANCE COST

## Personnel Expenses

## Administrative Staff

	CTC No.	Salaries per year	RTC (each center) No.	Salaries per year
Director	1	244,080 Bahts	1	155,040 Bahts
Deputy Director	3	566,640	-	-
Secretary	1	155,040	-	-
Registrars	3	160,920	-	-
Clerks			2	125,280
General Staff	9	482,760	-	-
Others	9	1,223,640	7	390,120
Total	persons 26	2,833,080 Bahts	persons 10	670,440 Bahts

## Instructor

	CTC No.	Salaries per year	RTC (each center) No.	Salaries per year
Management	2	331,200 Bahts	3	252,000
Civil Eng.	3	496,800		
Sanitary Eng.	2	331,200		
Environment Eng.	-	-		
Electrical Eng.	2	331,200		
Mechanical Eng.	2	331,200	7	663,600
Others	2	331,200		
Total	persons 13	2,152,800 Bahts	persons 10	915,600 Bahts

**Estimates of Facility Operation Costs****1) Basis for estimation**

(1) Based on estimated electricity consumption per month

(2) Operating time of equipment - 8 hours/day, 25 days/month

(3) Operating time of training plants

Mini purification plant	:	Training courses	33 weeks/3
			= 77 days per annum
Pump operation training plant	:	"	50 weeks/3
			= 115 days per annum
Leakage survey training yard	:	"	16 weeks/3
			= 37 days per annum
Piping training yard	:	"	18 weeks/3
			= 42 days per annum

**2) Electricity consumption (rough estimate)**CTC

Training building	140,000 KWH/year
Dormitory	26,000 "
Workshop	12,000 "
Pump operation training building	3,000 "
Garage and storage	1,100 "
Cafeteria	3,000 "
Covered way	4,000 "

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Sub total	189,100 KWH/year
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Mini purification plant	28,000 KWH/year
Pump operation training plant	5,000 "
Leakage survey training yard	3,000 KWH/year

---

Sub total	36,000 KWH/year
-----------	-----------------

Total electricity consumption per annum  
at CTC facilities ..... 225,100 KWH/year

Power electricity incoming demand: 400 KW

Electric charges:  $\{200\text{KWH} \times 0.8\text{B/KWH} + 280\text{KWH} \times 0.79\text{B/KWH}$   
 $+ (225,100\text{KWH}/12 - 480\text{KWH}) \times 0.77\text{B/KWH}$   
 $+ 400\text{KW} \times 90\text{B/KW}\} \times 12\text{months} = 605,460\text{B/year}$

RTC (each center)

Training building	
Dormitory	} 53,000 KWH/year
Workshop	11,300 "
Garage and storage	1,100 "
Cafeteria	1,500 "
Covered way	7,200 "

---

Sub total 74,100 KWH/year

Total electricity consumption per annum  
at RTC facilities ..... 74,100 KWH/year

Power electricity incoming demand: 130 KW

Electric charges:  $\{200\text{KWH} \times 1.44\text{B/KWH} + 280\text{KWH} \times 1.43\text{B/KWH}$   
 $+ (74,100\text{KWH}/12 - 480\text{KWH}) \times 1.41\text{B/KWH}$   
 $+ 130\text{KW} \times 95\text{B/KW}\} \times 12\text{months} = 252,810\text{B/year}$

### 3) Estimates of water charges

CTC

Training building	240persons x 120liter/person•day =	28,800 L/day
Dormitory	60 " x 500 "	= 30,000 "
Cafeteria		7,200 "

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Sub total 66,000 L/day

Mini purification plant

Pump operation training plant

Leakage survey training equipment

Use raw water from intake

of Bang Khen purification plan

**Total water consumption per annum at CTC**

Water consumption per year

$$66\text{m}^3/\text{day} \times 300\text{day}/\text{year} = 19,800\text{m}^3/\text{year}$$

$$(1,650\text{m}^3/\text{month})$$

Water charges per annum for CTC

$$\text{Basic charges } \{50\text{B} + 40\text{m}^3 \times 3.25\text{B}/\text{m}^3 + 50\text{m}^3 \times 4\text{B}/\text{m}^3 + 200\text{m}^3 \times 5\text{B}/\text{m}^3 + (1,650\text{m}^3 - 300\text{m}^3) \times 5.5\text{B}/\text{m}^3\} \times 12\text{months}$$

$$= 105,660\text{B}/\text{year}$$

**RTC (each center)**

Training building 45persons  $\times$  120liter/person $\cdot$ day = 5,400 L/day

Dormitory 30 "  $\times$  500 " = 15,800 "

Cafeteria 1,600 "

---

Sub total

22,000 L/day  
(22m<sup>3</sup>/day)

**Total water consumption per annum at RTC**

Water consumption per year

$$22\text{m}^3/\text{day} \times 300\text{day}/\text{year} = 6,600\text{m}^3/\text{year}$$

$$(550\text{m}^3/\text{month})$$

Water charges per annum for RTC

$$\text{Basic charges } \{10\text{m}^3 \times 3.75\text{B}/\text{m}^3 + 10\text{m}^3 \times 4.5\text{B}/\text{m}^3 + 30\text{m}^3 \times 6\text{B}/\text{m}^3 + 30\text{m}^3 \times 7\text{B}/\text{m}^3 + 20\text{m}^3 \times 7.5\text{B}/\text{m}^3 + 200\text{m}^3 \times 8\text{B}/\text{m}^3 + (550\text{m}^3 - 300\text{m}^3) \times 8.5\text{B}/\text{m}^3\} \times 12\text{months}$$

$$= 52,170\text{B}/\text{year}$$

## APPENDIX 5. LIST OF TRAINING EQUIPMENT

	Quantity of Equipment	
	CTC	RTC (each center)
<b>A. COMPUTER AND DRAWING INSTRUMENT</b>		
1. Personal Computer	4	-
2. Drafting Machine w/board, chair, light	25	-
<b>B. AUDIO VISUAL AND PRINTING EQUIPMENT</b>		
1. Slide Projector	1	1
2. Overhead Projector	1	1
3. Audio Equipment System	1	1
4. Slide Sincro Recorder	1	1
5. Color VTR System	1	1
6. Screen (movable)	1	1
7. Screen (fix)	1	-
8. Tape Recorder (portable) w/microphone	1	1
9. Audio Equipment System for Seminar Room	1	-
10. Electric Typewriter English	1	1
Thai	1	1
11. Plain Paper Copier	1	1
12. Offset Printing Machine	1	-
13. Direct Process Machine	1	-
14. Paper Cutter	1	-
15. Stapler	1	1
16. Black Board	9	3
17. Accessories for Offset Printing Machine	1 lot	-
Accessories for Plain Paper Copier	-	1 lot



## C. INSTRUMENTATION EQUIPMENT

C-(1). INSTRUMENTATION EQUIPMENT	CTC	RTC (each center)
1. Digital Logic Analyzer	1	-
2. Digital Voltage & Current Checker	1	-
3. Digital Standard Voltage & Current Source	1	-
4. System Power Supply Unit	1	-
5. Distributor	2	-
6. Arrester	2	-
7. Maintenance Tool for Industrial Measuring Instrument	1	-
8. Recorder	1	-
9. Integrator	1	-
10. Indicator	1	-
11. Adder	1	-
12. Multiplier	1	-
13. Isolator	1	-
14. Alarm Unit	1	-
15. Compact Controller	1	-
16. Differential Pressure Transmitter	1	-
17. Digital Manometer	1	-
18. Root Extractor	1	-
19. Standard Pressure Gauge	1	-
20. Differential Pressure Gauge	1	-
21. Air Filter Regulator	1	-
22. Pressure Transmitter	1	-
23. Purge Set	1	-
24. Resistance Bulb	1	-
25. MV/I Converter	1	-
26. Dead Weight Tester	1	-
27. Hg. Column	1	-
28. Vacuum Tester	1	-
C-(2). INSTRUMENTATION MODEL		
1. Process Instrumentation Training Desk	6	-
2. Model Plant for Simulation of Water Level	1	-
3. Air Compressor	1	-
4. Pneumatic Piping and Electric Wiring	1	-

D. WATER QUALITY EXAMINATION EQUIPMENT	CTC	RTC (each center)
1. Spectrophotometer	1	-
2. Shaking Water bath	1	-
3. Autoclave	1	-
4. Microscope	1	-
5. Shaker	1	-
6. Magnetic Stirrer	2	1
7. Muffle Furnace	1	-
8. Refrigerator	1	1
9. Residual Cl Meter	1	1
10. Jar Tester	1	1
11. Turbidity Meter	1	1
12. Conductivity Meter	1	1
13. PH Meter	1	1
14. Water Still (Distillatory)	1	1
15. Incubator	1	1
16. Incubator (Low temperature)	1	-
17. Centrifuge	1	1
18. Chemical Storage	1	-
19. Draft Chamber	1	-
20. Sampling Device	1	1
21. Mantle Heater	1	1
22. Hot Plate	1	-
23. Electric Dryer	1	1
24. Ultrasonic Cleaner	1	-
25. Color Meter	1	1
26. Stabilizer	1	1
27. Photomicrographic Apparatus	1	-
28. Membran Filter	3	2
29. Center Table	4	-
30. Storage Cabinet (1)	2	2
31. Storage Cabinet (2)	1	1
32. Balance Table	1	1
33. Analitical Balance	1	1
34. Vacuum Pump	1	1
35. Ion-Exchanger	1	-
36. Miscellaneous	1 lot	1 lot

	CTC	RTC (each center)
37. Glass Ware	1 lot	1 lot
38. Chemical	1 lot	1 lot
39. Desiccator	2	2
40. Lab. Cart	1	1
41. Stop Watch	1	1
42. Top-Pan Balance	1	-
43. Instructor's Table	2	-
44. Microscope Table	1	-
45. Table for Water Still	1	-
46. Assembling Shelf	6	4

## E. LEAKAGE SURVEY EQUIPMENT

1. Leakage Detector	8	2
2. Hearing Bar	5	2
3. Drilling Bar	2	1
4. Electric Hearing Bar	2	2
5. Metallic Pipe Locator	2	1
6. Box Locator	2	1
7. Non-Metalic Pipe Locator	1	-
8. Tools	2	1
9. Drill	2	1
10. Electric Water Pressure Recorder	1	-
11. Water Pressure Gauge	4	3
12. Chlorine Test Kit	2	2
13. Portable Ultrasonic Flow Meter	1	-
14. High Speed Cutter	2	1
15. Pipe Repair Tool Set	2	1
16. Pipe Vise	2	1
17. Accessories	1 lot	1 lot
18. Portable Recorder (2 pens type)	1	-
19. Compound Meter ( $\phi 150\text{mm}$ )	1	-
20. Master Meter ( $\phi 100\text{mm}$ )	1	-
21. Electric Water Pressure Gauge	1	-
22. Branch Iron Pipe Locator	1	-

## F. ELECTRICAL EQUIPMENT

	CTC	RTC (each center)
1. Oscilloscope	1	1
2. Portable Standard Voltmeter (AC., DC.)	1	1
3. Portable Precision Ampmeter (AC., DC.)	1	1
4. Portable Standard Wattmeter	1	1
5. Portable Power Factor Meter	1	1
6. Portable Frequency Meter	1	1
7. Portable High-frequency Voltmeter	1	1
8. Portable High-frequency Milliampmeter	1	1
9. Voltage Standard Meter (AC., DC.)	1	1
10. Current Standard Meter (AC., DC.)	1	1
11. Vacuum Cleaner	1	1
12. Portable Recorder (Universal recorder)	1	1
13. Portable Recorder (Temperature recorder)	1	-
14. Battery Testing Voltmeter	1	1
15. Wheatstone Bridge	1	1
16. Galvanometer	1	1
17. Shunts, Multipliers, Transformers	1	1
18. DC. Potentiometer	1	1
19. Decade Resistance Boxes	1	1
20. Transistor Checker	1	1
21. Insulation Tester	1	1
22. Relay Tester	1	1
23. Earth Tester	1	1
24. Leakage Current Tester	1	1
25. Portable Luxmeter	1	1
26. Circuit Tester (Multi meter)	1	1
27. Photo Tachometer	1	1
28. Mechanical Tachometer	1	-
29. Clip-on AC. Power Meter	1	1
30. Frequency Counter	1	1
31. Digital AC. Meter	1	1
32. High Voltage Detector	1	1
33. Static Relay Test Set	1	1
34. Transmitter and Receiver Training Set	1	1
35. Electrical Accessories	1 lot	1 lot
36. Shock Pulse Meter	1	1

	CTC	RTC (each center)
37. Low Frequency Signal Generator	1	-
38. DC. High Potential Test Set	1	-
39. Power Cable Fault Locator	1	-
40. Oscillograph and Accessories	1	-
41. 3 Phase Power Regulator	1	1
42. Laboratory Portable Regulator	1	1
43. Phase Rotation Meter	1	1
44. Winding Machine	1	1
45. Eddy Current Bearing Puller	1	-
46. Electric Dryer	1	1
<b>G. MECHANICAL EQUIPMENT</b>		
1. Vernier Caliper (3 size - 10 pcs)	1	1
2. Micrometer (3 size - 3 sets)	1	1
3. Dial Gauge (5pcs)	1	1
4. Mechanical Tool Set	1	1
5. Steel Rule (10 sets)	1	-
6. Gauge Block (2 sets)	1	-
7. Surface Plate	1	1
8. Bench Type Drill Press	1	1
9. Portable Type Electric Drill Press	1	1
10. Accessories for Drill Press	1	1
11. Precision Lathe	1	1
12. Attachment for Lathe	1	1
13. Pipe Threading Machine	1	1
14. Universal Milling Machine	1	-
15. Attachment for Milling Machine	1	-
16. Plane Grinding Machine	1	-
17. Double Grinding Machine	1	1
18. Hack Sawing Machine	1	1
19. Hydraulic Press	1	1
20. Oxyacetylene Gas Welding Machine	1	1
21. AC/DC Arc Welding Machine	1	1
22. Foot Shearing Machine	1	1
23. Hydraulic Pipe Bending Machine	1	1
24. Folding Machine	1	1

	CTC	RTC (each center)
25. Parts Washing Stand	1	1
26. Air Compressor	1	1
27. Portable Electric Drill	-	1
28. Portable Engine Generator	-	1
29. Portable Engine Pump	-	1
30. Portable Crane	1	1
31. Accessories for Workshop	1 lot	1 lot
32. Height Gauge	1 lot	-
33. Surface Gauge	1 lot	-
34. Square	1 lot	-
35. Scriber	1 lot	-
<b>H. STANDARD METERS/ANALYSERS &amp; SAFETY EQUIPMENT</b>		
1. Voltage Standard Meter	1	-
2. Power Monitor	1	-
3. Isolation Type Gas Mask	1	1
4. Protection Gloves	1	1
<b>I. PUMP CHARACTERISTIC TEST INSTRUMENT</b>		
1. Pressure Gauge	1	1
2. Vacuum Gauge	1	1
3. Tachometer	1	1
4. Ampmeter	1	1
5. Wattmeter (2 Ranges)	1	1
6. Voltmeter	1	1
7. Frequency Meter	1	1
8. Weir (V-Notch)	1	1
9. Manometer	1	1
10. Potential Transformer	1	1
11. Current Transformer	1	1

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