4. Team Leader's Letter

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)
DETAILED DESIGN SURVEY TEAM
FOR
THE AGRICULTURAL DEVELOPMENT RESEARCH PROJECT PHASE II
IN
NORTHEAST THAILAND

December 7, 1989

Permanent Secretary
Office of the Permanent Secretary
Ministry of Agriculture and
Cooperatives
Rajadamnern Ave.,
Bangkok 10200

Dear Sir,

Re : The Pilot Infrastructure Improvement Works for the Agricultural Development Research Project Phase II

The Detailed Design Survey Team has been organized by Japan International Cooperation Agency (JICA) for the purpose of formulating detailed plan on the Pilot Infrastructure Improvement Works for the Agricultural Development Research Project Phase II.

The Team has, so far, made a series of site reconnaissances and discussions with your staff concerned in order to determine the location and scale of the Demonstration Farm for Proper Land Use (hereinafter referred to as "the Farm") and its facilities. As the result, we would like to submit to you the tentative idea for designing of the Farm as per the attached.

Two team members, Mr. Ishiyama and Mr. Kondo, will proceed with your staff to conduct further field surveys and investigations at the site and make the detailed design on the basis of the result of those surveys. After the completion of the detailed design and assessment of its cost estimation, you will be informed of its result through the JICA Thailand Office.

For the timely commencement of the construction of the Farm, we would like to ask you to take the necessary formalities in due consultation with the JICA Thailand Office.

Lastly, we would like to express our appreciation for the kind cooperation of your staff during our stay.

Sincerely Yours,

Satoshi Ishida

Satoshi ISHIDA
Team Leader
Detailed Design Survey Team
Japan International Cooperation Agency

cc : Director General
Department of Agriculture
MOAC
(Att : Dr. Thanongjit Wongsiri)
cc : Deputy Director General
Department of Land Development
MOAC
(Att : Mr. Boonyarak Seubsiri)
cc : Dean, Faculty of Agriculture
Khon Kaen University
(Att : Dr. Taweesuk Saentaweesuk)
cc : Chief of Japan Sub-Division
Department of Technical and Economic Cooperation
(Att : Mr. A-cha-ri Yooktanan)
cc : Embassy of Japan

1. Objective

This survey is to carry out the detailed design on the Demonstration Farm for Proper Land Use (the Farm) which is to

1) undertake the experiment/trials to check the techniques, which were developed so far, on their adaptability to local conditions and
2) develop and demonstrate proper land use system to improve soil productivity under the conditions of typical topography of the Northeast.

The Farm, therefore, will play the important role for research and technology transfer to the farmers as a project activity of the technical cooperation.

The Farm will be managed by the Agriculture Development Research Center (ADRC), and composed of irrigation, soil erosion survey and land use demonstration fields which involve the construction of land consolidation, irrigation system, drainage canals, farm roads, pump station, water tank, reservoir and runoff plots, etc.

The Farm will also equip those facilities such as field laboratory, machinery store-house, survey and storage house and dry yard.

In light of the above, the Team conducted the surveys on selection of site, scale of farm, condition of power and domestic water supply and water right, and had preliminary discussions on the framework of the Farm.

2. Location and Scale

(1) The location of the Farm is planned in consideration of following conditions :

(a) soil type,
(b) rainfall,
(c) topographic features,
(d) efficiency for demonstration.

Considering the above, the Farm is selected at the area in Khao Suan Kwang, about 40 kilometers north of Khon Kaen City, as shown in Fig.1.

(2) The area of the Farm is about 25 ha including the facility yard as shown in Fig.2.

3. Components of the Farm

3.1 Farm Fields

The Farm consists of the following fields and related constructions.

(1) Field

The area of the experimental and demonstration fields will be about 19 ha. The Farm consists of the following three kinds of field.

1) Irrigation field

The irrigation field will be 6 plots (about 5.6 ha). This field will be used for experimental activities related to irrigation.

2) Soil erosion survey field

The soil erosion survey field will be 1 plot (about 0.5 ha). This field will equip runoff plots for measuring soil loss and runoff water.

3) Land use demonstration field

This field will be about 13 ha. In the field, the technology developed by the Project will be systematized for demonstration to the farmers.

(2) Runoff plots for measuring soil loss and runoff water

Eighteen (18) runoff plots for measuring soil loss and runoff water will be constructed in the soil erosion survey field. Size of the runoff plot will be 5 m width and about 20 m lenght.

(3) Irrigation water supply system (1,500 m)

Vinyl chloride or polyethylene pipe will be adopted for the water distributing pipeline. Valves will be installed in the pipeline system in order to regulate discharge and pressure of the irrigation water.

(4) Drainage canal (1,400 m)

Drainage canal will be constructed as the earth canal. Gabionates will be placed in the drainage canal to prevent the canal from scouring.

(5) Farm road (580 m)

Farm road will be constructed in the Farm for easy approach by machinery and for maintenance work. Main and sloping portion of the farm road will be paved with laterite.

(6) Reservoir (about 30,000 m^3)

In addition to the existing pond capacity, the reservoir will be newly constructed in order to increase the storage capacity for the irrigation on the Farm.

(7) Pump and Pump station

Pump station will be installed on the site which will be suitable to intake the low water in the reservoir. Electricity will be considered as power for pump. (submersible pump ; ϕ80 mm)

(8) Water tank (50 m^2)

Water tank will be cylindrical tank made of reinforced concrete, and installed on the highest portion of the Farm.

(9) Water supply pipeline (620 m)

Steel pipe will be adopted for the water supply pipeline connecting the pump station and the water tank. Valves will be installed in the pipeline in order to operate and maintain the water supply pipeline safely.

3.2 Farm Facilities

In order to conduct the experiment and the demonstration activities in the Farm, the following facilities will be constructed.

(1) Field laboratory (144 m^2)

Field laboratory will equip those such as

(i) laboratory for farming researches,
(ii) laboratory for soil researches and
(iii) equipment room.

The laboratory will be constructed with concrete block wall and slate roof.

(2) Machinery store-house (72 m^2)

The machinery store-house will store agricultural machinery such as tractor, etc.

The house will be constructed with concrete pillar and slate roof, but without wall.

(3) Survey and storage house (192 m^2)

The survey and storage house will equip those such as

(i) preliminary survey room,
(ii) fertilizer and chemical storage and
(iii) products storage.

The house will be constructed with concrete block wall and slate roof.

(4) Dry yard (216 m^2)

In order to dry the products such as cassava, cow pea, maize, mung bean, etc., the dry yard will be facilitated.

4. Necessary measures taken by Thai side

For the establishment of the Farm, following measures should be taken by Thai side.

1) Provision of land for the Farm

2) Management of the Farm

a) Establishment of management system
b) Assignment of farm manager and at least two assistants
c) Budget allocation of the salaries for the employees and other expenses for management of the Farm

3) Supplementary construction works

a) Gate and fence
b) Electricity and domestic water supply up to the Farm

5. Others

The tentative schedule and procedure for the construction work of the Farm is shown in Table 1.

Table-1

OUTLINE OF THE TENTATIVE SCHEDULE
ON
THE PILOT INFRASTRUCTURE IMPROVEMENT WORK

	Japanese Side	Thai Side
1989 Nov.	Detailed design survey --Nov. 28 to Jan. 11, 1990--	To provide land for the Farm
Dec.		
1990 Jan.	Detailed design work in Japan	
Feb.		
Mar.	Submission of final report →	
Apr.		Request of construction work for the Farm (to JICA Thailand Office)
	← JICA HDQ	
May		Submission of A1 form for supervising expert (to the Embassy of Japan)
	Signing of Supplementary Note on the Record of Discussion	
Jun.		
Jul.		
Aug.	Exchange of Note Verbale	
Sep.	Dispatch of supervising expert Remittance of budget Contract for construction	
Oct.	Start of construction work	

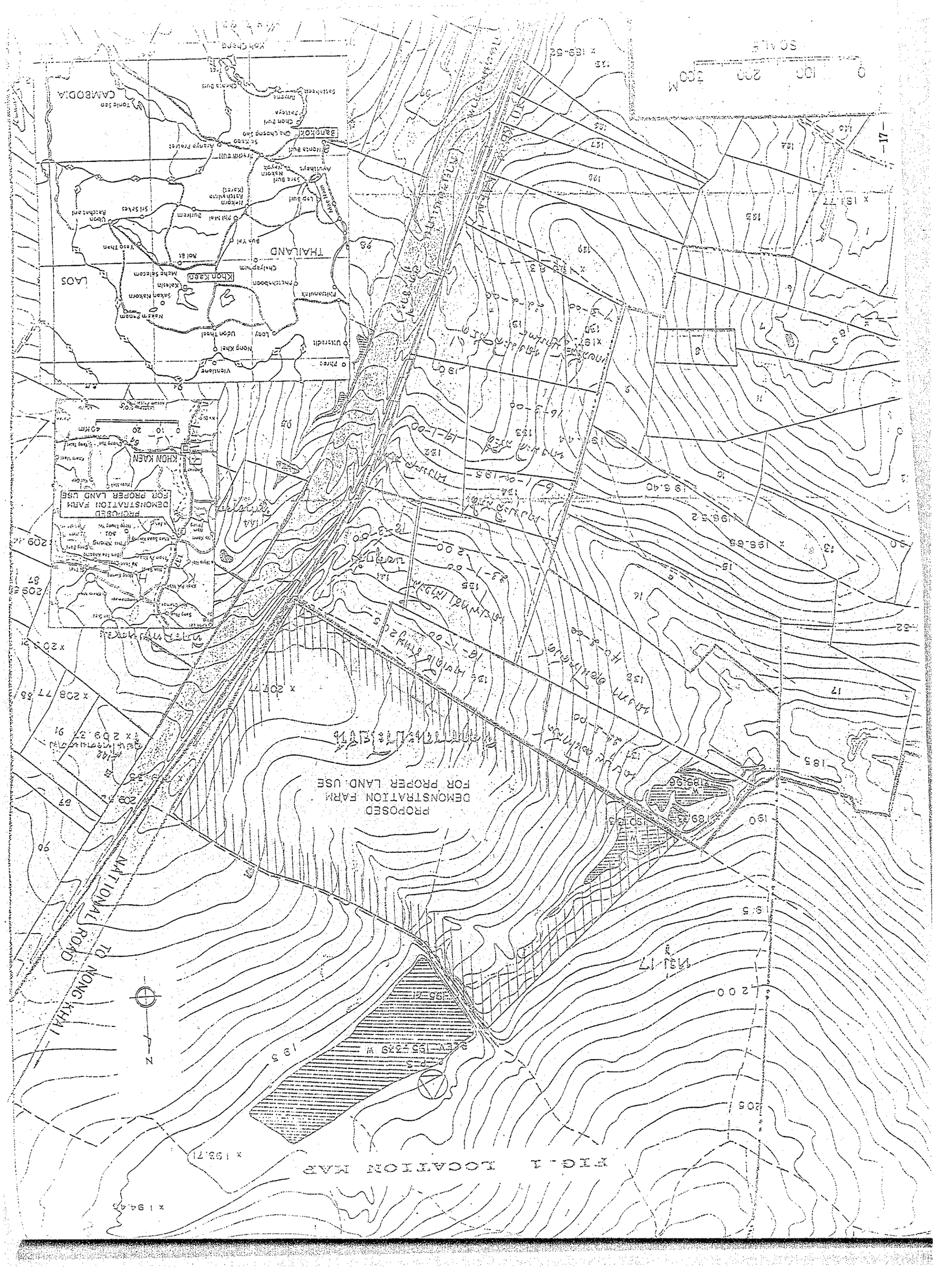
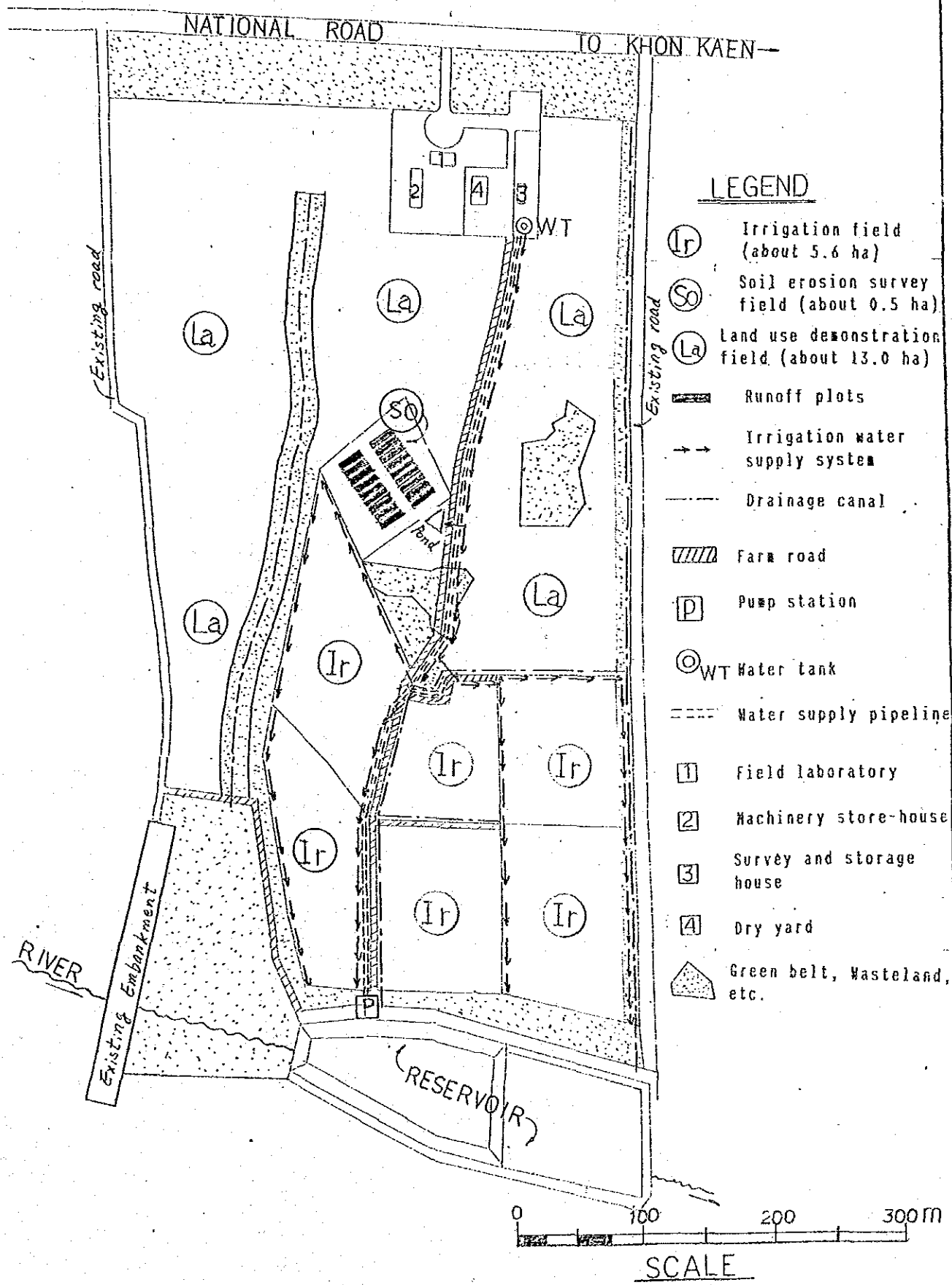

PROPOSED
DEMONSTRATION FARM
FOR PROPER LAND USE
TO NONG KHAI
NATIONAL ROAD
THAILAND
LAOS
CAMBODIA
KHON KAEN
FIG. 1 LOCATION MAP

FIG. 2 DEMONSTRATION FARM FOR PROPER LAND USE

TOTAL AREA APPROX. 25 HA



5. Field Report

THE KINGDOM OF THAILAND

DETAILED DESIGN SURVEY

FOR

THE AGRICULTURAL DEVELOPMENT RESEARCH PROJECT

PHASE II

IN NORTHEAST THAILAND

FIELD REPORT

JANUARY 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

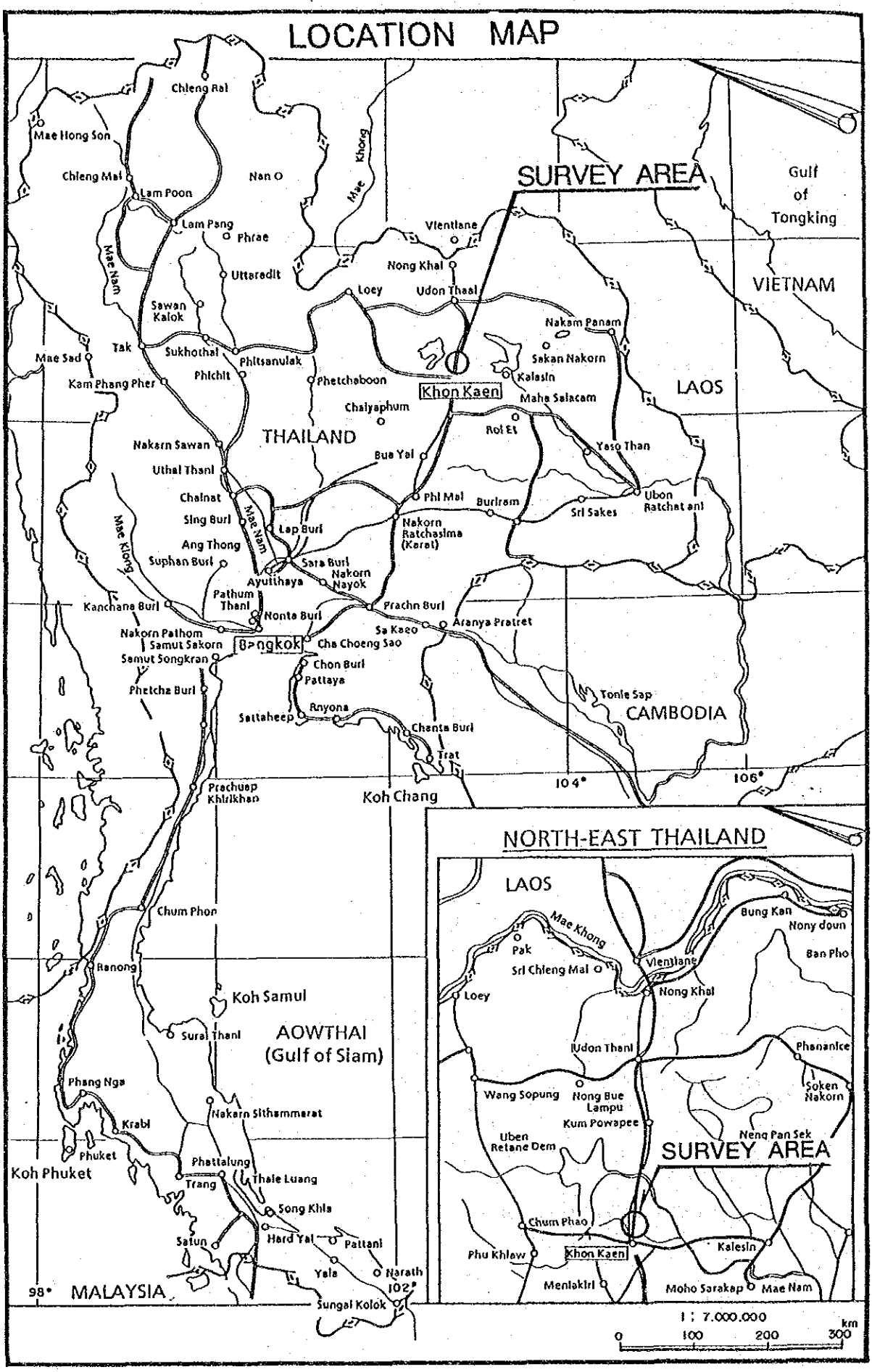

LOCATION MAP
SURVEY AREA
Gulf of Tongking
VIETNAM
LAOS
THAILAND
CAMBODIA
MALAYSIA
AOWTHAI (Gulf of Siam)
Koh Chang
Koh Samui
Koh Phuket
Khon Kaen
Bangkok
Chiang Rai
Mae Hong Son
Chiang Mai
Lam Poon
Lam Pang
Phrae
Nan
Mae Khong
Mae Nam
Uttaradit
Sawan Kalok
Tak
Sukhothai
Phitsanulak
Phichit
Mae Sad
Kam Phang Phet
Phetchaboon
Chaiyaphum
Nakorn Sawan
Uthai Thani
Chainat
Sing Buri
Ang Thong
Suphan Buri
Lop Buri
Sara Buri
Nakorn Nayok
Ayutthaya
Pathum Thani
Nonta Buri
Nakorn Pathom
Samut Sakorn
Samut Songkran
Phetcha Buri
Kanchana Buri
Mae Klong
Prachuap Khirikhan
Chum Phon
Ranong
Surat Thani
Phang Nga
Krabi
Phuket
Nakorn Sithammarat
Phattalung
Trang
Thale Luang
Song Khla
Satun
Hard Yai
Pattani
Yala
Narath
Sungai Kolok
Vientiane
Nong Khai
Loey
Udon Thani
Nakorn Panom
Sakon Nakorn
Kalasin
Maha Salacam
Roi Et
Yaso Thon
Bua Yai
Phi Mai
Buriram
Srl Sakes
Ubon Ratchat ani
Nakorn Ratchasima (Korat)
Prachin Buri
Sa Kaeo
Aranya Pratret
Cha Choeng Sao
Chon Buri
Pattaya
Rnyona
Sattaheep
Chanta Buri
Trat
Tonle Sap
104°
106°
98°
102°
NORTH-EAST THAILAND
LAOS
Mae Khong
Pak
Sri Chieng Mai
Vientiane
Loey
Nong Khai
Bung Kan
Nony doun
Ban Pho
Udon Thani
Phananice
Wang Sopung
Nong Bue Lampu
Kum Powapee
Soken Nakorn
Uben Retane Dem
Neng Pan Sek
SURVEY AREA
Chum Phao
Khon Kaen
Kalesin
Phu Khlaw
Menlakiri
Moho Sarakap
Mae Nam
1 : 7.000.000
0 100 200 300 km

TABLE OF CONTENTS

1. General

1.1 Background

The Agricultural Development Research Project in Northeast Thailand as the Japanese Technical Cooperation had been commenced based on the Record of Discussions signed on December 20, 1983 and completed on December 1988, after a cooperation period of five (5) years.

This project was intended to strengthen the research activities which was directed towards the development of agricultural technology adaptable to the Northeast Thailand, and to propel the development of the Northeast Thailand. The main subjects were i) assessment of natural environment and natural resources, ii) improvement of crop performance and iii) soil conditions and its improvement. The research activities were performed at the Agricultural Development Research Center (ADRC) and its Annex and at the Khon kaen Field Crop Research Center (FCRC).

For promoting the further agricultural development suitable for Northeast Thailand with its characteristics environment, the Agricultural Development Research Project Phase II in Northeast Thailand has started based on the Record of Discussions signed on December 16, 1988 for a cooperation period of five (5) years until December 1993. The Tentative Schedule of Implementation for the Phase II was signed on August 17, 1989 containing research and cooperation of i) classification of agro-ecological zones and land use planning, ii) development of farm management system and iii) development of low-input technology.

In the course of the Phase II, the Royal Thail Government (RTG) planned the Demonstration Farm for Proper Land Use (the Farm) and requested the Government of Japan (GOJ) to provide the cooperation for the plan. In response to the request, the GOJ has decided to implement the Farm by the Pilot Infrastructure Improvement Works and conduct the Detailed Design Survey (the Survey).

1.2 Objective of the Survey

The objective of the Survey is to execute the Detailed Design Survey for the construction of the Farm, including land consolidation, irrigation and drainage facilities, farm roads, reservoir, farm facilities, etc. The Survey is to perform the data collection and field survey necessary to the planning, detailed design and cost estimation during the stay in Thailand, and to work up the planning and detailed design etc. into reports and prepare the tentative contract documents at the home office in Japan.

1.3 Members of the Survey

(1) JICA Survey Team

Name	Speciality	Organization
Mr. Satoshi ISHIDA	Team Leader	Deputy Director, Project Planning Division, Agricultural Structure Improvement Bureau, MAFF
Mr. Kazuo NAGAI	Coordinator	Deputy Director, Technical Cooperation Div., Agricultural Development Cooperation Dept., JICA
Mr. Shigeki ISHIYAMA	Land Consolidation Plan	Nippon Giken Inc.
Mr. Ken-ichiro KONDO	Facility Design	Nippon Giken Inc.

(2) Counterparts

Name	Speciality	Organization
Mr. Chaiporn Vachirakornwatana	Irrigation	Engineering Div., DLD
Mr. Wanchai Wongsa	Agriculture	Engineering Div., DLD
Mr. Chartchai Poonpanich	Mechanics	Engineering Div., DLD

1.4 Work Schedule in Thailand

The Survey in Thailand was conducted for 45 days from November 28, 1989 to January 11, 1990.

No.	Date	Day	Member	City	Work Schedule
1.	11/28	Tue.	4	Bangkok	Departure from Japan
2.	29	Wed.	4	Bangkok	Courtesy call at JICA, Embassy of Japan and MOAC
3.	30	Thu.	4	Khon Kaen	Field reconnaissance and discussion meeting at ADRC
4.	12/1	Fri.	4	Khon Kaen	Data collection
5.	2	Sat.	4	Khon Kaen	Preparation for letter of team leader
6.	3	Sun.	4	Khon Kaen	-do-
7.	4	Mon.	4	Khon Kaen	Discussion meeting at ADRC
8.	5	Tue.	3	Bangkok	Preparation for letter of team leader
			1	Khon Kaen	-do-
9.	6	Wed.	3	Bangkok	Discussion meeting at DLD
			1	Khon Kaen	Preparation for Survey
10.	7	Thu.	3	Bangkok	Submission of letter, reporting to JICA and Embassy of Japan
			1	Khon Kaen	Preparation for survey
11.	8	Fri.	2		Lv. Bangkok
			2	Khon Kaen	Preparation for survey
12.	9	Sat.	2		Ar. Tokyo
			2	Khon Kaen	Preparation for survey
13.	10	Sun.	2	Khon Kaen	Data arrangement
14.	11	Mon.	2	Khon Kaen	Investigation of present conditions
15.	12	Tue.	2	Khon Kaen	-do-
16.	13	Wed.	2	Khon Kaen	-do-
17.	14	Thu.	2	Khon Kaen	-do-
18.	15	Fri.	2	Khon Kaen	-do-
19.	16	Sat.	2	Khon Kaen	-do-
20.	17	Sun.	2	Khon Kaen	-do-
21.	18	Mon.	2	Khon Kaen	-do-
22.	19	Tue.	2	Khon Kaen	-do-
23.	20	Wed.	2	Khon Kaen	-do-
24.	21	Thu.	2	Khon Kaen	-do-
25.	22	Fri.	2	Khon Kaen	-do-
26.	23	Sat.	2	Khon Kaen	-do-
27.	24	Sun.	2	Khon Kaen	Data arrangement
28.	25	Mon.	2	Khon Kaen	Planning and detailed design
29.	26	Tue.	2	Khon Kaen	-do-
30.	27	Wed.	2	Khon Kaen	-do-

No.	Date	Day	Member	City	Work Schedule
31.	28	Thu.	2	Khon Kaen	-do-
32.	29	Fri.	2	Khon Kaen	-do-
33.	30	Sat.	2	Khon Kaen	-do-
34.	31	Sun.	2	Khon Kaen	Data arrangement
35.	1/1	Mon.	2	Khon Kaen	-do-
36.	2	Tue.	2	Khon Kaen	Preparation of field report
37.	3	Wed.	2	Khon Kaen	-do-
38.	4	Thu.	2	Khon Kaen	Reporting to ADRC
39.	5	Fri.	2	Khon Kaen	Data arrangement
40.	6	Sat.	2	Bangkok	Office closing, etc.
41.	7	Sun.	2	Bangkok	Data arrangement
42.	8	Mon.	2	Bangkok	Reporting to MOAC
43.	9	Tue.	2	Bangkok	Additional data collection
44.	10	Wed.	2	Bangkok	Reporting to JICA and Embassy of Japan
45.	11	Thu.	2		Lv. Bangkok

2. Location and Scale of the Farm

The Farm site is located immediately to the west of the Khon Kaen-Udon Thani Highway, about 40 km north of Khon Kaen. The Farm lies within Changwat Khon Kaen, Amphur Khao Suan Kwang, Tambon Khao Suan Kwang administratively.

The scale of the Farm is about 25 ha including the facility yard.

3. Major Works Performed in the Survey Period

3.1 Topographic Survey

Topographic survey at the Farm site was performed on the following items, based on the existing topographic map of 1/1000 scale;

(i) traverse surveying along the boundary of the Farm,
(ii) drainage canal route surveying,
(iii) farm road route surveying,
(iv) profile and cross sectional leveling at the reservoir site, and
(v) contour line check surveying, etc.

3.2 Water Quality Survey

Water quality was investigated on the following three (3) test items;

(i) electrical conductivity (EC),
(ii) pH, and
(iii)total dissolved solid (TDS).

Two (2) water samples from existing reservoir and test pit (TP.1) were analysed.

3.3 Soil Survey

Soil survey was carried out by excavating two (2) test pits (STP.1 and STP.2). Soil profile and soil analysis were executed.

3.4 Soil Mechanics and Foundation Survey

Soil mechanics and foundation survey was carried out as a basis of the design and construction plan of the reservoir. This survey was performed as follows;

(i) Three (3) test pitting (TP.1, Tp.2 and TP.3) and
(ii) seven (7) auger boring (AH.1 to AH.7).

Foundation profile, underground water table measurement and soil sampling were executed.

3.5 Intake Rate Survey

Intake rates were measured using the double ring infiltrometer on the Farm site. The measurements were executed on the four (4) points (IR.1 to IR.4).

3.6 Data Collection

Data collection on soil, geology, meteorology and hydrology, etc. was carried out. Major collected data list is attached in ANNEX-2.

3.7 Construction Cost Survey

Data and information on the construction materials, equipments and labour, etc. were collected in the field survey period.

3.8 General Layout of the Farm

General layout of the Farm was designed during the field survey period. This layout had been drawn up based on the due consideration of locations and sizes of all facilities.

3.9 Land Consolidation Plan

Proposed area of the Farm is gentle slope with gradient of 2° to 3°. The Farm fields consist of three (3) kinds of field, such as (i) irrigation field, (ii) soil erosion survey field, and (iii) land use demonstration field. Land consolidation plan of these fields are as follows;

(1) Irrigation field

Irrigation field has been designed to uniform gradient within each plot.

(2) Soil erosion survey field

This field equip runoff plots for measuring soil loss and runoff water. Gradient of these runoff plots has been designed to 3° and 5°.

(3) Land use demonstration field

In this field, contour bands have been designed.

3.10 Irrigation Facilities Plan

(1) Irrigation area

Irrigation area consists of (i) irrigation field, (ii) runoff plots and (iii) a part of land use demonstration field. Total irrigation area will be about 6.8 ha.

(2) Reservoir

Storage capacity of existing reservoir has been surveyed to be about 6,000 c.m. Additional storage capacity from the excavation has been estimated at about 21,000 c.m. Therefore, the reservoir will have a capacity of 27,000 c.m. This capacity is not enough to irrigate whole irrigation area during the dry season.

(3) Water supply system

Pumping system has been planned, because the reservoir is located at the lowest portion of the Farm area. In this system, installation of water tank is desirable, especially for the upland irrigation. With this consideration, the water tank has been planned on the highest portion of the Farm.

(4) Water distributing system

In order to utilize the pumped irrigation water and

water head effectively, the closed type pipeline system has been planned.

(5) Irrigation method

Perforated pipe irrigation method would be suitable, taking account of effective head and operation and maintenance.

4. Home Office Work

Home Office Work will be undertaken by the Detailed Design Survey Team for about one month in succession for the field survey. The contents of the Home Office Work are described in this chapter.

4.1 Detailed Design and Drawings

Major items of detailed design and drawings will be as follows:

(1) General layout of the Farm (containing locations of all facilities)
(2) Layout of land consolidation
(3) Estimation of water requirement
(4) Reservoir designing
(5) Pump and pupm station designing
(6) Water tank designing
(7) Water supply and distributing pipeline designing
(8) Drainage canal designing
(9) Farm road designing
(10) Field loboratory, survey and storage house and machinery store-house designing
(11) Dry yard designing
(12) Runoff plots for measuring soil loss and runoff water designing.

4.2 Construction Plan and Cost Estimation

Appropriate construction plan will be formulated in accordance with the site conditions based on the Survey. Construction cost estimation will be carried out based on the unit cost of labour, materials and machinery applicable to the site, being clarified through the Survey. Final construction cost will be decided by the JICA.

4.3 Tentative Contract Documents

Following tentative contract documents will be prepared in English as a basis of placing the order:

(1) FORM OF CONTRACT
(2) TERMS AND CONDITIONS OF CONTRACT
(3) TECHNICAL SPECIFICATIONS

(4) BILL OF QUANTITIES

4.4 Report

The draft final report will be explained to the JICA at the end of the Home Office Work, the middle decade of March, 1990.

The Final Report will be submitted within 20 days after the explanation of the draft final report, the last decade of March, 1990.

ANNEX-2

COLLECTED DATA

1. Soil

1.1 "Outline of Soils of the Northeast Plateau Thailand", Technical Paper No.1, ADRC, December 1986.

1.2 "Upland Soil of Thailand, Their Characterization and Capability Evaluation", ADRC, March 1986.

1.3 "Compilation Report on Soil Fertility in Northeast Thailand", Technical Paper No.2, ADRC, April 1987.

1.4 "Improvement of the Soil Moisture Regime for the Stabilization of Field Crop Production in Thailand", Tropical Agriculture Research Center, MAFF and Department of Agriculture, MOAC, February 1983.

2. Geology

2.1 "Geological Map of Thailand 1:500,000", Northeastern Sheet, 1983 Edition.

3. Meteorology

3.1 "Climatological Data of Thailand, 30-year Period (1956-1985)", Meteorological Department, Ministry of Communications.

3.2 "Meteorological Data of Khon Kaen Meteorological Stations", Meteorological Department, Ministry of Communications, 1983-1988.

3.3 "Monthly Report of Weather Station", ADRC, 1985-1989.

3.4 Monthly Rainfall, Nam Pong, 1976-1987.

4. Hydrology

4.1 "Study on Soil Erodibility by Using Rainfall Simulator", Report of Short Term Expert (15), ADRC, October 1987.

4.2 Hydrological Characteristics in Klong Yang Watershed, Nakhonratchasima Province.

5. Others

5.1 "The Study on Agricultural Land Conservation for Integrated Rural Development in the East, Progress Report (No.2)", JICA, March 1988.

5.2 "Rainfed Agriculture Pilot Project", August 1981.

5.3 "Agricultural Development Research Center in Northeast Thailand (ADRC)-Activities and Research Highlights 1984-1988", ADRC.

5.4 "Exploitation of Promising Crops in Northeast Thailand", ADRC, December 1987.

6. Technical Data

(1) Soils

(2) Soil Mechanics and Foundation

(3) Climate and Hydrology

(4) Intake Rate

(5) Bill of Quantity and Unit Cost

(1) Soils

LIST OF TABLES

NO.

Date

SOIL SURVEY

Soils of the area can be divided into four main groups.

1. Very deep loamy soils.

They occur on the top of the undulating terrain where the slopes range from 1-3 %. the A horizon is about 5-20 cm. with sandy loam texture over lying the argillic B horizon which ther is strong brown to yellowish red. or red. texture is sandy clay loam., no ironstone within 150 cm.

2. Moderately deep and deep loamy soils with sandy loam and/or loamy sand surface texture.

They occur on the upper part of the side slopes of undulating terrain., slopes range from 3-5 %, they have loamy sand and/or sandy loam surface layer. but the depth of the loamy sand is not more than 50cm. from the surface, the B horizon has a.

8mm

No.

Date

sandy clay loam texture with ironstone more than 35% of volumn between the depth of 50 - 150 cm. the color is strong brown to red.

3. Sandy over loamy : moderately deep to deep soils.

They occur on the lower part of undulating terrain and have sand or loamy sand texture between the depth of 50 - 80 cm. lower lying by the sandy clay loam texture with ironstone between the depth of 50 - 150 cm.

4. Skeletal and/or shallow soils

They occur on side slopes of undulating terrain especially where the more erosion take place. The soils have ironstone or bed rock of sandstone within 50 cm. of the surface

8mm

No.

Date

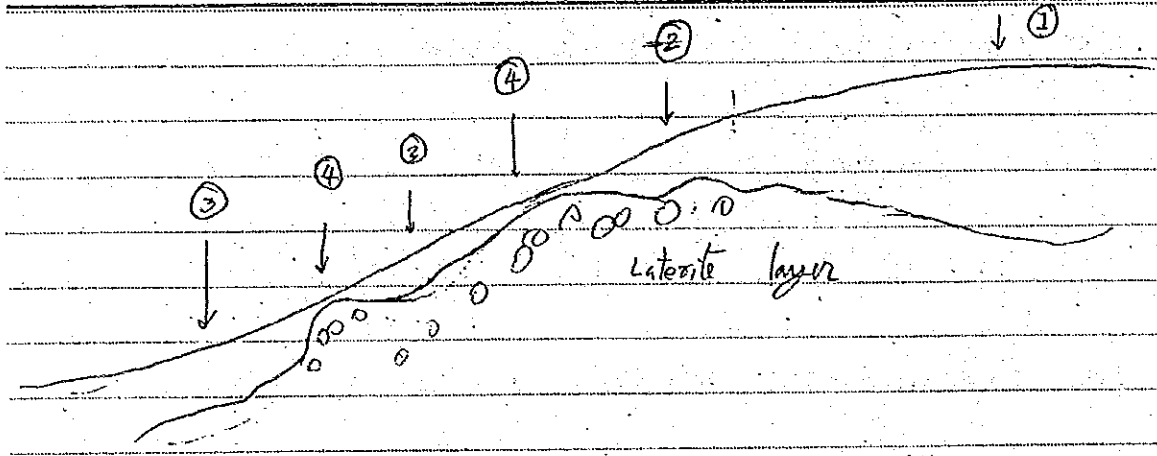


Fig. I Soils that occur along the topography of the area

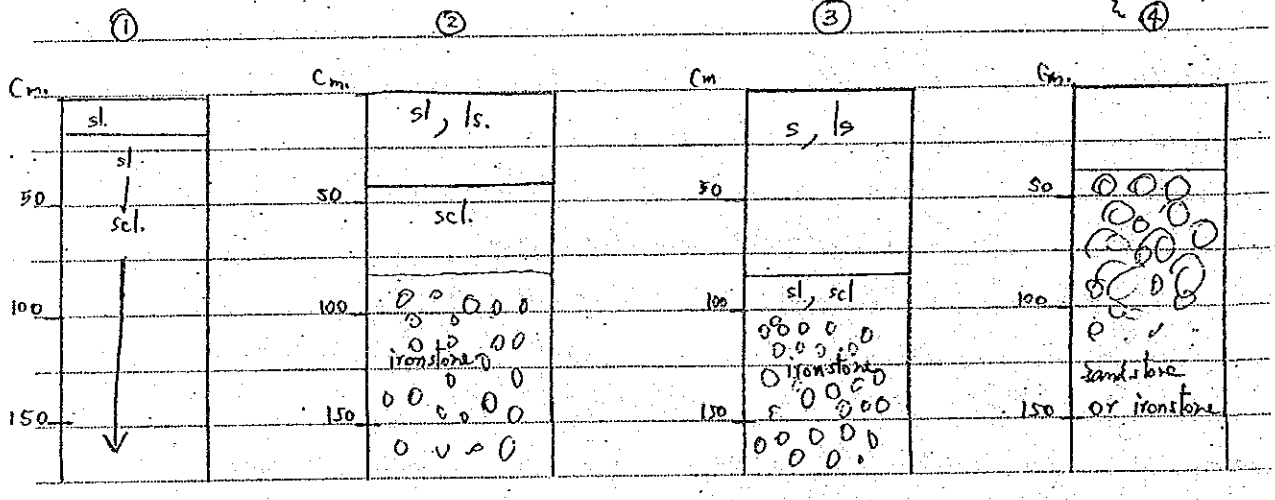


Fig. II Diagram showing the four main soil groups.

(sl = sandy loam ; ls = loamy sand ; s = sand)

8mm

TABLE S-1 SOIL PROFILE SURVEY (STP.1)

Soil Name: Yasothon -gravelly and overwash phase	Field Symbol: Yt-g-ow	PROFILE CODE No. STP.1	FIELD No.

Described by: Junthotai, K.	Area: Demonstration Farm for Proper land use Project.		
	Ban: Khum Sombat	Tambon: Khae Suan Kwang	
	Amphoe: Khum Suan Kwang	Changwat: Khon Kaen	
Date: December, 13, 1979	Sheet Name of Topography Map: Amphoe Nam Sa-at	No.	Coord. 703118
	Air Photo Mission	Strip.	No.

Classification (National)		(USDA)	Oxic Paleustults	Parent Material	old alluvium
Physiography	Higher terrace	Relief: Undulating	Slope: 4-5 %	Elevation	~ 260 m.
Drainage	well drained.	Permeability: rapid	Runoff: very medium	Ground Water Depth	> 2m.
Flooding: Depth	—	Duration: —		Frequency	—
Climate Type	Koppen "Aw"	Annual Rainfall: ~ 1,196.7 mm/y		Mean Temperature	26.8° C
Natural Vegetation or Land Use	used for cassava plantation.				
Other					

Lab. No.	Horizon	Depth (cm.)	Description
	Ap_1	0-15/20.	Dark grayish brown (10YR4/2) loamy sand; weak fine subangular blocky structure breaking to single grains; nonsticky, nonplastic; common fine roots; medium acid (field pH 6.0); gradual, wavy boundary.
	Ap_2	15/20-40	Dark grayish brown (10yr4/2) and light brown (7.5YR6/4) loamy sand; weak fine subangular blocky structure breaking to single grains; nonsticky, nonplastic; few fine roots; medium acid (field pH 6.0); gradual, smooth boundary.
	Bw	40-58/63	Strong brown (7.5YR5/6) sandy loam; weak fine subangular blocky structure, nonsticky, nonplastic; patchy thin clay coatings in pores; few fine roots; strongly acid (field pH 5.5); clear, wavy boundary.
	Btc_1	58/63-78/100	Yellowish red (5YR5/8) very gravelly sandy clay loam; few thin clay coatings in pores; very few fine roots; gravels composed of quartzite and ironstone diameter about >0.2-2 cm and have about 60% by volum; strongly acid (field pH 5.5); gradual, wavy boundary.
	Btc_2	78/100-140	Red (2.5YR5/8) very gravelly clay loam; common moderately thick clay coatings in pores; gravels is the same kind of the above horizon about 70% by volume; very strongly acid (field pH 5.0).

TABLE S-2 SOIL PROFILE SURVEY (STP. 2)

Soil Name: Yasothon - gravelly phase	Field Symbol: Yt-g	PROFILE CODE No.: STP.2	FIELD No.:
Described by: Junhotai, K.	Area: ADRC Field Experiment Project.		
	Ban: Khum Sombat	Tambon: Khao Suan Kwang	
	Amphoe: Khao Suan Kwang	Changwat: KHON KAEN	
Date: 12/14/89	Sheet Name of Topography Map: Amphoe Nam Sa-at	No.: 5542 I	Coord.: 7e2621
	Air Photo Mission:	Strip:	No:
Classification (National):	(USDA): Oxic Paleustults.	Parent Material: old alluvium.	
Physiography: higher terrace	Relief: undulating	Slope: ~ 5-6 %	Elevation: ~ 200 m.
Drainage: well drained.	Permeability: moderate	Runoff: rapid	Ground Water Depth: > 2 m.
Flooding: Depth: —	Duration: —		Frequency: —
Climate Type: Koppen Aw	Annual Rainfall: 1176.7		Mean Temperature: 26.2°C
Natural Vegetation or Land Use: old cassava field.			
Other:			

Lab. No.	Horizon	Depth (cm.)	Description.
	A_{p_1}	0-26	Dark brown (10YR3/3) sandy loam; weak fine subangular blocky structure breaking to single grains; friable; nonsticky, nonplastic; many fine roots; strongly acid (field pH 5.5); gradual, smooth boundary.
	A_{p_2}	26-36	Dark brown (10YR3/2) and yellowish brown (10YR5/4) sandy loam; weak fine subangular blocky breaking to single grains; friable, nonsticky, nonplastic; common fine roots; strongly acid (field pH 5.5); gradual, smooth boundary.
	B_1	36-47	Strong brown (7.5YR5/6) sandy clay loam; weak fine subangular blocky structure; friable, slightly sticky slightly plastic; few fine roots; very strongly acid (field pH 5.5); gradual, smooth boundary.
	B_t	47-59/70	Yellowish red (5YR5/8) coarse sandy clay loam; moderate fine and medium subangular blocky structure; friable, sticky; plastic; patchy thin clay coatings on ped faces and in pores; few fine roots; very strongly acid (field pH 5.0); clear, wavy boundary.
	Bt_c	59/70-120	Red (2.5YR5/8) very gravelly clay loam; common moderately thick clay coatings in pores; few fine roots; gravels are quartzite (diameter ~1-2 cm) and ironstone about 70-80 % by volume; very strongly acid (field pH 5.0)

TABLE S-3
RESULTS OF SOIL ANALYSIS รายงานผลการวิเคราะห์ดิน

ฝ่ายวิเคราะห์ดิน สำนักงานพัฒนาที่ดินเขต 5

ชื่อตัวอย่าง ..... ชื่อโครงการ .....

จำนวนตัวอย่าง 10 ตัวอย่าง ..... สถานที่ / จังหวัด Kao Suan Kwang

Soil Series ..... Date Reported .....

		STP.1				STP.2				
Lab. No. 22		24.19	24.20	24.21	24.22	24.23	24.24	24.25	24.26	24.27	24.28
Sender's Code No. KONDO		10-15/	15/30 -	40 -	58/63 -	78/100	0 - 21	26-36	36-47	47 -	59/70 -
Depth / Horizon (cm)	depth (cm)	30	40	58/63	78/100	140				59/70	120
pH (1:1 H_2O)		5.95	5.70	5.30	5.15	5.00	5.90	5.60	5.45	4.95	5.10
pH (1:1 1N KCL)											
EC (1:1) (mmho/cm)											
EC (1:5) (mmho/cm)											
ECe 25° C (mmho/cm)											
Lime Requirement (Kg/rai)											
Organic Matter (%)		0.85	0.28	0.21	0.18	0.20	0.59	0.39	0.24	0.29	0.23
Phosphorus (P), Bray II (ppm)		2.76	2.98	2.95	4.44	5.55	3.09	2.29	3.99	5.19	6.94
	K (ppm)										
	Ca (ppm)										
	Al^{+++} (me/100g)	0.049	0.049	0.195	0.976	2.14	0.196	0.488	0.683	2.15	3.82
Exchangeable Cations	Na^{+} (me/100g)	0.034	0.035	0.029	0.041	0.043	0.043	0.051	0.038	0.039	0.042
	K^{+} (me/100g)	0.092	0.075	0.071	0.062	0.154	0.073	0.052	0.070	0.099	0.236
	Ca^{++} (me/100g)	1.28	0.88	0.54	0.55	0.74	0.93	0.75	0.89	0.78	0.48
	Mg^{++} (me/100g)	0.31	0.26	0.24	0.34	0.37	0.81	0.28	0.33	0.31	0.37
CEC by NH_4OAC 1N pH 7.0 (me/100g)		2.09	1.40	1.05	2.09	4.19	1.54	1.54	2.05	3.42	6.21
Base Saturation Percentage											
Seturation Percentage											
C/N ratio											
Particle Size	Sand ø 2.00-0.05 mm (%)	83.41	82.46	78.40	67.85	61.75	83.89	79.09	74.50	68.89	57.02
	Silt ø 0.05-0.002 mm (%)	13.50	13.46	15.70	15.08	8.45	11.73	16.11	13.78	8.02	6.18
	Clay ø <0.002 mm (%)	3.21	4.08	5.89	17.08	29.80	4.39	4.80	11.72	23.10	36.80
Textural Cluss		LS	LS	LS	SL	SCL	LS	LS	SL	SCL	SCL
Moisture Retention	1/10 bar (%)										
	1/3 bar (%)										
	3 bar (%)										
	15 bar (%)										
Permeability Coefficient (K) cc/hr											

(2) Soil Mechanics and Foundation

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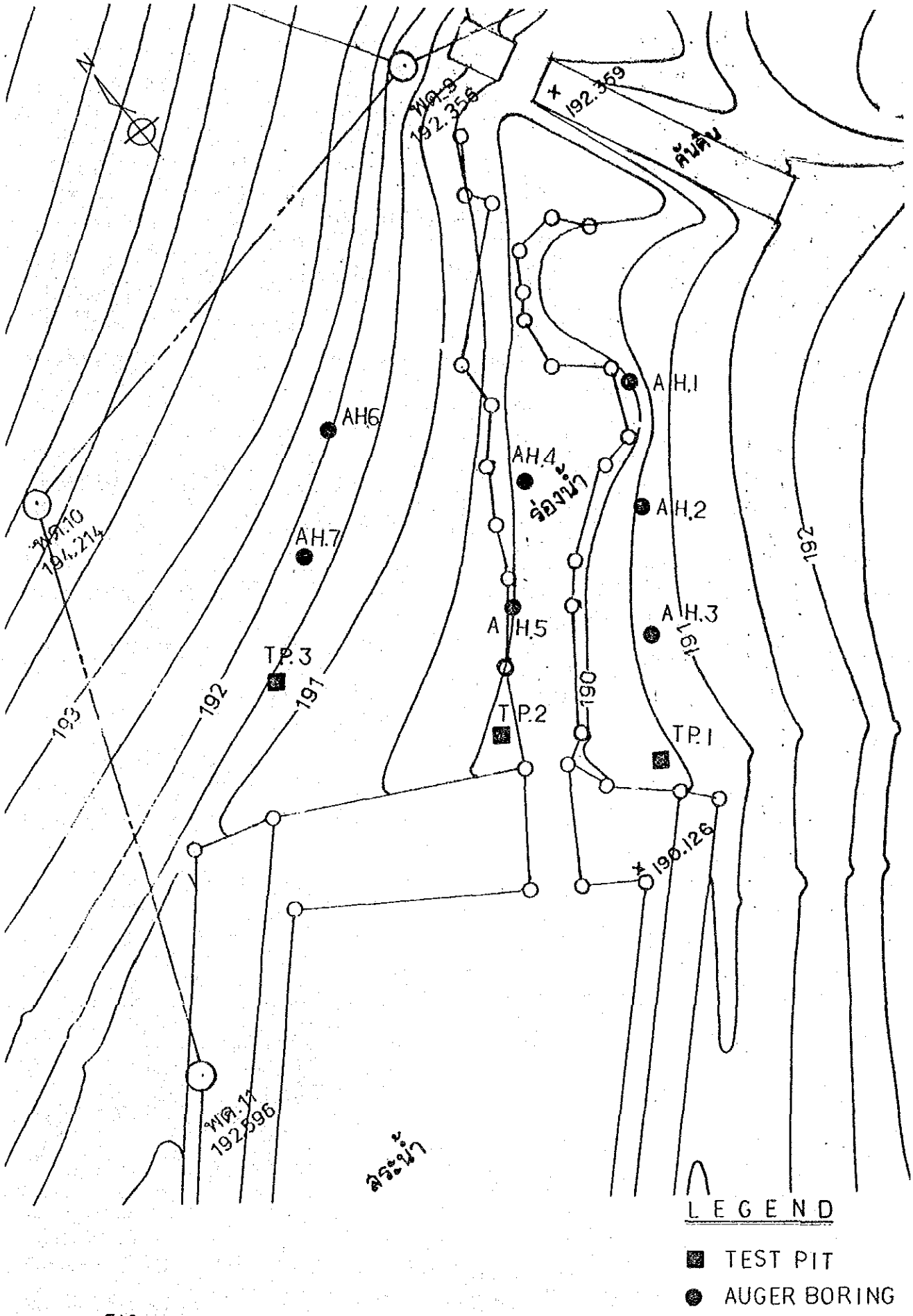

FIG. F-1
LOCATION OF TEST PIT AND AUGER BORING
(SCALE 1:1000)

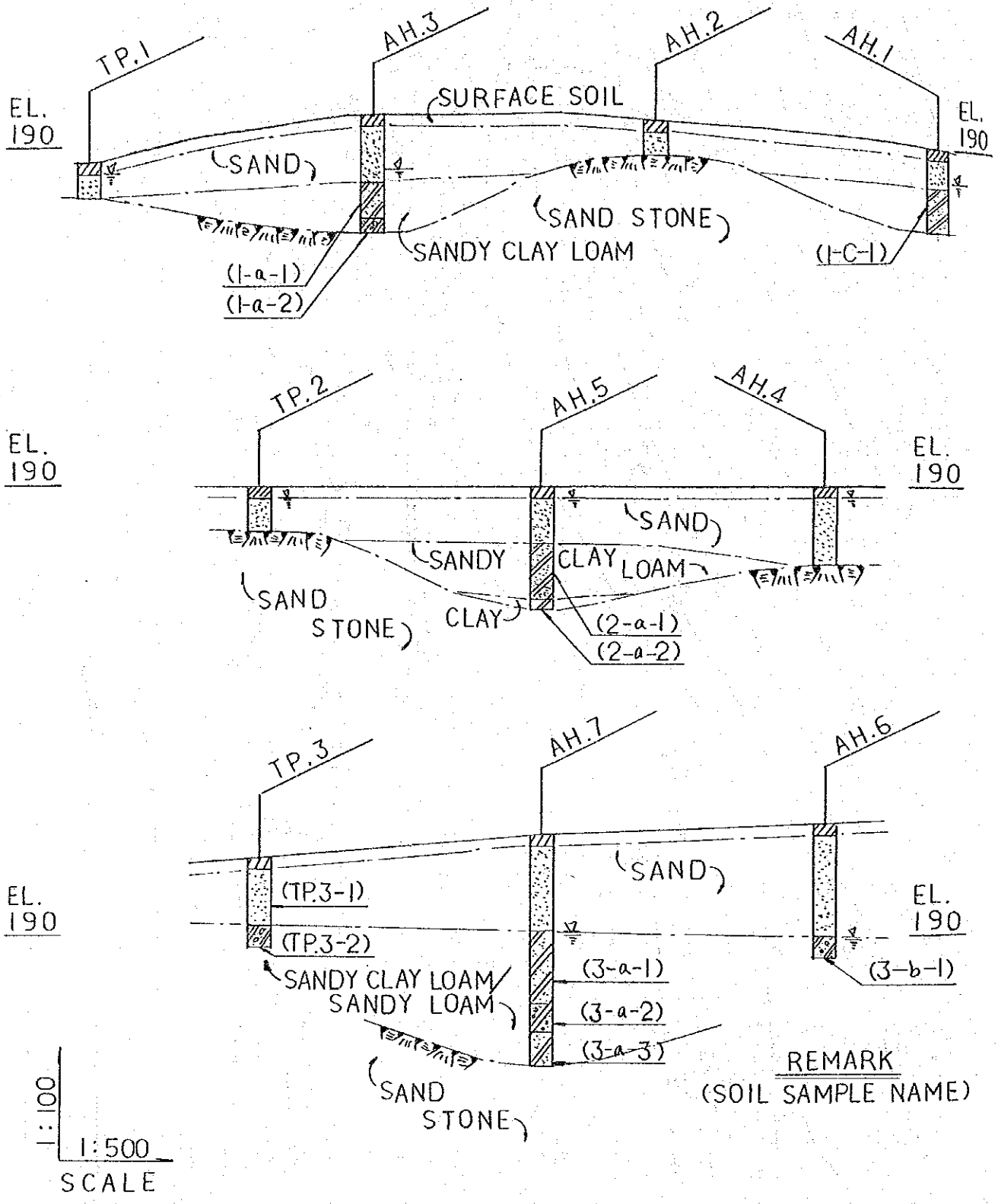

FIG. F-2 GROUND CONDITION AT RESERVOIR SITE

TABLE F-1
RESULTS OF MECHANICAL ANALYSIS

รายงานผลการวิเคราะห์ดิน
ฝ่ายวิเคราะห์ดิน สำนักงานพัฒนาที่ดินเขต 5

ผู้ส่งตัวอย่าง ..... ชื่อโครงการ .....
จำนวนตัวอย่าง ..... สถานที่ / จังหวัด Kao Suan Kwang
Soil Series ..... Date Reported .....

Lab. No.	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417
Sender's Code No. KONDO	1-A-(1)	1-A-(2)	1-B-(1)	2-A-(1)	2-A-(2)	TP.3-(1)	TP.3-(2)	3-A-(1)	3-A-(2)	3-A-(3)
Depth / Horizon (cm)										
Extractable by NH_4OAC 1N pH 7.0 — K (ppm)										
Ca (ppm)										
Mg (ppm)										
S (ppm)										
Exchangeable Cations — Na^+ (me/100g)										
K^+ (me/100g)										
Ca^{++} (me/100g)										
Mg^{++} (me/100g)										
CEC by NH_4OAC 1N pH 7.0 (me/100g)										
Base Saturation Percentage										
Seturation Percentage										
Soluble Cations — Na^+ (me/l)										
K^+ (me/l)										
Ca^{++} (me/l)										
Mg^{++} (me/l)										
Sodium Adsorption Ratio (SAR)										
Exchangeable Sodium Percentage (ESP)										
Soluble Anion — Cl^- (me/l)										
NO_3^- (me/l)										
HCO_3^- (me/l)										
$CO^=$ (me/l)										
$SO_4^=$ (me/l)										
Particle Size — (Sand+silt+clay) in total (%)	82.51	74.51	94.80	99.86	96.10	90.39	55.95	97.51	99.77	98.15
Sand ø 2.00-0.05 mm (%)	66.50	71.94	70.61	66.82	50.57	84.20	79.16	72.06	69.21	76.06
Silt ø 0.05-0.002 mm (%)	6.14	6.79	7.07	11.25	18.83	12.98	12.58	11.69	5.04	7.90
Clay ø <0.002 mm (%)	14.25	21.27	12.32	21.94	30.61	2.82	8.25	16.87	25.75	16.04
Gravel in total (%)	12.13	26.28	5.20	0.14	3.90	9.61	44.05	2.43	20.13	1.85
Moisture Retention — 1/10 bar (%)										
1/3 bar (%)										
3 bar (%)										
15 bar (%)										
Permecbility Coefficient (K) cc/hr										
Specific gravity	2.65	2.64	2.64	2.65	2.64	2.64	2.64	2.64	2.63	2.63
Moisture Content (%-by weight)	16.8	15.5	18.7	20.2	12.7	4.4	4.2	12.0	10.5	12.3
Maximum of Gravel Diameter (mm)	12,17	10,15	10, 17	2, 6	10, 18	2, 10	28,40	8, 13	10, 20	7, 11

รายงานผลการวิเคราะห์ดิน

ฝ่ายวิเคราะห์ดิน สำนักงานพัฒนาที่ดินเขต 5

ผู้ส่งตัวอย่าง ..... ชื่อโครงการ .....

จำนวนตัวอย่าง ..... สถานที่ / จังหวัด .....

Soil Series ..... Date Reported .....

Lab. No.		33241									
Sender's Code No.		3-b-(1)									
Depth / Horizon (cm)											
Extractable by NH_4OAC 1N pH 7.0	K (ppm)										
	Ca (ppm)										
	Mg (ppm)										
	S (ppm)										
Exchangeable Cations	Na^+ (me/100g)										
	K^+ (me/100g)										
	Ca^{++} (me/100g)										
	Mg^{++} (me/100g)										
CEC by NH_4OAC 1N pH 7.0 (me/100g)											
Base Saturation Percentage											
Seturation Percentage											
Soluble Cations	Na^+ (me/1)										
	K^+ (me/1)										
	Ca^{++} (me/1)										
	Mg^{++} (me/1)										
Sodium Adsorption Ratio (SAR)											
Exchangeable Sodium Percentage (ESP)											
Soluble Anion	Cl^- (me/1)										
	NO_3^- (me/1)										
	HCO_3^- (me/1)										
	$CO^=$ (me/1)										
	$SO_4^=$ (me/1)										
	(Sand+silt+clay) in total (%)	83.70									
Particle Size	Sand ø 2.00-0.05 mm (%)	83.42									
	Silt ø 0.05-0.002 mm (%)	12.36									
	Clay ø <0.002 mm (%)	4.22									
	Gravel in total (%)	16.30									
Moisture Retention	1/10 bar (%)										
	1/3 bar (%)										
	3 bar (%)										
	15 bar (%)										
Permecbility Coefficient (K) cc/hr											
Specific gravity		2.60									
Moisture content (% by weight)		5.9									
Maximum of Gravel diameter		22.32									

(3) Climate and Hydrology

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FIG. M-1

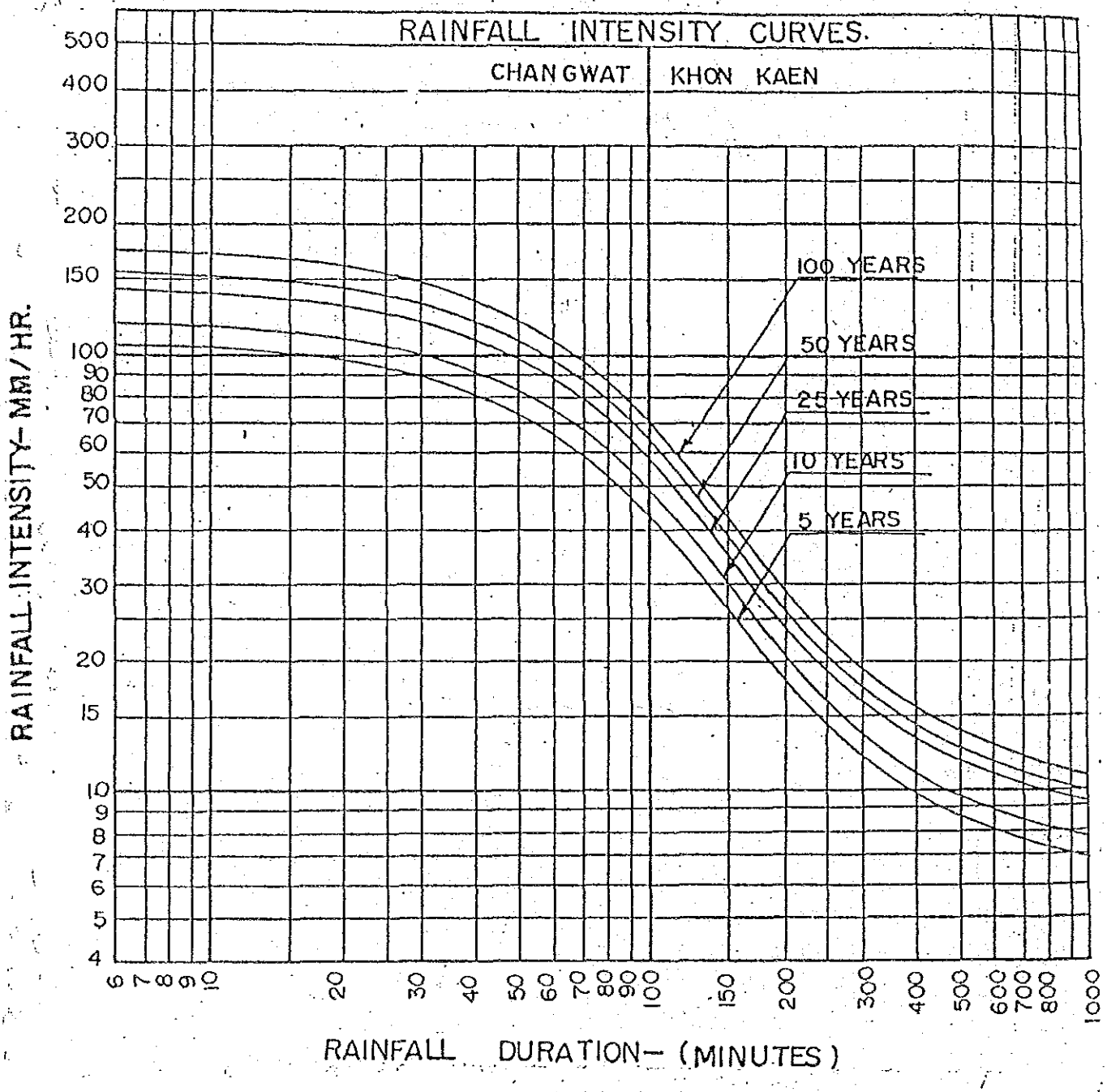
RAINFALL INTENSITY CURVES.
CHANGWAT KHON KAEN
100 YEARS
50 YEARS
25 YEARS
10 YEARS
5 YEARS
RAINFALL INTENSITY- MM/HR.
500
400
300
200
150
100
90
80
70
60
50
40
30
20
15
10
9
8
7
6
5
4
6 7 8 9 10 20 30 40 50 60 70 80 90 100 150 200 300 400 500 600 700 800 1000
RAINFALL DURATION- (MINUTES)

FIG. M-2

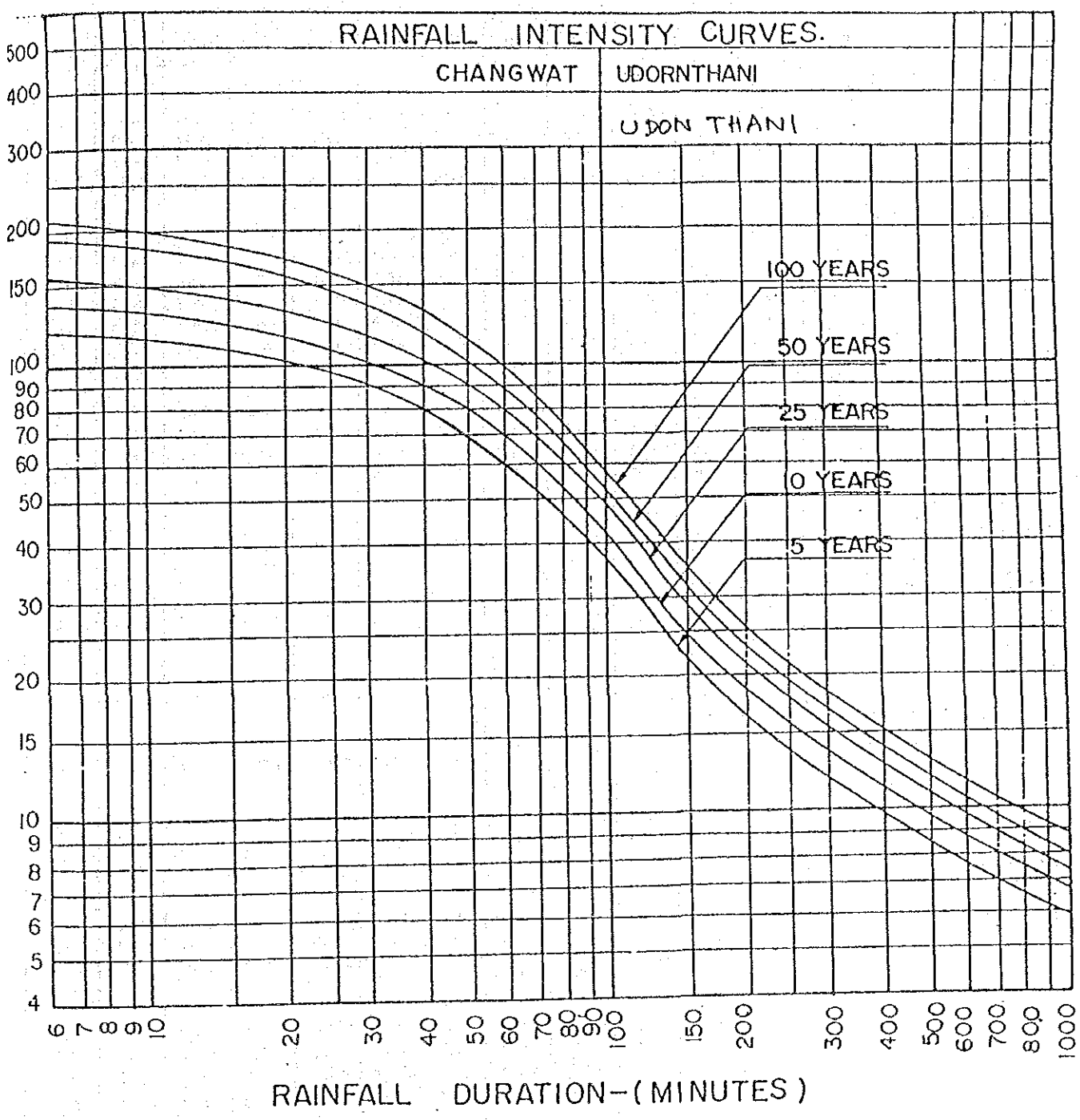
RAINFALL INTENSITY CURVES.
CHANGWAT UDORNTHANI
UDON THANI
100 YEARS
50 YEARS
25 YEARS
10 YEARS
5 YEARS
500
400
300
200
150
100
90
80
70
60
50
40
30
20
15
10
9
8
7
6
5
4
6 7 8 9 10 20 30 40 50 60 70 80 90 100 150 200 300 400 500 600 700 800 1000
RAINFALL DURATION-(MINUTES)

TABLE M-1 CLIMATOLOGICAL DATA FOR THE PERIOD 1956 - 1985

Station KHON KAEN
Index Station 48381
Latitude 16° 26' N.
Longitude 102° 50' E.

Elevation of station above MSL 165 meters
Height of barometer above MSL 166 meters
Height of thermometer above ground 1.25 meters
Height of wind vane above ground 10.55 meters
Height of raingauge 1.00 meters

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Pressure (+1000 or 900 mbs.)													
Mean	14.10	11.68	09.72	07.97	06.48	05.21	05.17	05.14	07.23	10.68	13.28	14.52	09.27
Ext. Max.	28.13	24.72	24.74	21.68	14.90	13.70	12.62	13.92	15.46	19.70	23.77	25.08	28.13
Ext. Min.	02.51	00.56	99.98	97.40	97.40	94.92	95.03	95.58	94.32	01.87	04.18	03.44	94.32
Mean daily range	5.57	5.93	5.97	5.68	5.12	4.23	4.04	4.11	4.56	4.71	4.78	5.11	4.98
Temperature (°C)													
Mean	22.8	25.6	28.7	30.1	29.2	28.6	28.0	27.6	27.0	26.3	24.8	22.8	26.8
Mean Max.	30.3	32.7	35.5	36.3	34.8	33.3	32.6	32.0	31.3	31.3	30.8	29.9	32.6
Mean Min.	15.7	19.1	22.2	24.4	24.7	24.7	24.2	24.1	23.6	22.3	19.3	16.3	21.7
Ext. Max.	37.2	41.0	41.8	42.8	41.2	39.4	38.0	38.0	35.9	35.4	35.4	35.8	42.8
Ext. Min.	5.7	10.4	10.3	16.4	19.8	20.7	20.2	20.8	19.3	14.0	9.4	5.6	5.6
Relative Humidity (%)													
Mean	63.9	62.4	59.3	63.0	72.0	75.4	77.4	79.7	82.0	77.1	70.5	66.5	70.8
Mean Max.	85.9	82.9	80.4	82.2	88.0	89.1	90.4	91.6	93.5	91.4	88.8	87.3	87.6
Mean Min.	41.4	40.8	38.6	42.5	52.8	58.7	61.1	64.0	65.6	58.8	49.4	44.1	51.5
Ext. Min.	11.0	10.0	10.0	14.0	26.0	33.0	34.0	37.0	45.0	26.0	21.0	15.0	10.0
Dew Point (°C)													
Mean	15.0	17.0	19.1	21.3	23.0	23.6	23.5	23.6	24.3	21.9	18.6	15.7	20.6
Evaporation (mm.)													
Mean - Pan	154.2	161.4	211.7	216.6	196.3	171.4	165.3	150.0	137.0	152.3	151.0	152.4	2020.0
Cloudiness (0-10)													
Mean	3.0	3.4	3.6	3.0	6.9	8.0	8.0	8.5	7.8	5.7	4.2	3.5	5.6
Sunshine Duration (hr.)													
Mean	285.3	252.8	255.2	252.5	244.6	186.1	182.4	159.5	165.2	236.6	262.3	283.3	2766.0
Visibility (km.)													
0700 L.S.T.	5.3	5.0	5.0	6.6	8.3	8.9	9.0	8.7	8.4	8.8	7.5	6.4	7.3
Mean	7.1	8.4	6.9	7.5	9.1	6.9	9.7	9.4	9.3	9.4	9.0	8.1	8.6
Wind (knots)													
Prevailing wind	NE	NE	NE	SW	SW	SW	SW	SW	NE	NE	NE	NE	-
Mean wind speed	2.0	2.1	2.4	2.4	2.4	2.7	2.8	2.6	1.8	2.4	2.4	2.4	-
Max. wind speed	33 NE	33 N,S SW,NW	40 NE	46 W	47 SW, WNW	49 E, SSE,NW	55 W	40 E	33 N,NE SW,W	34 NE	33 NE	35 NE	55 W
Rainfall (mm.)													
Mean	4.6	13.2	31.1	60.7	167.7	176.9	163.4	192.7	262.0	87.2	13.9	3.3	1176.7
Mean rainy days	0.9	2.6	3.8	6.9	13.6	14.4	15.7	17.7	18.2	9.3	1.7	0.7	105.5
Greatest in 24 hr.	29.2	63.4	51.8	65.7	87.7	133.4	92.8	134.8	146.6	124.5	81.0	26.6	146.6
Day/Year	24/69	3/66	2/82	6/65	5/71	26/83	26/63	12/78	7/82	26/69	10/74	20/71	7/82
Number of days with													
Haze	22.5	23.5	26.5	18.3	2.4	0.0	0.1	0.0	0.2	2.1	7.0	14.3	116.9
Fog	0.3	0.4	0.2	0.1	0.0	0.0	0.0	0.1	0.0	0.4	0.1	0.4	2.0
Hail	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Thunderstorm	0.2	1.7	4.8	11.8	18.6	14.7	14.0	13.1	14.4	6.3	0.5	0.1	100.2
Squall	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1

Remark : 1. Sunshine Duration 1957 - 1985
2. Evaporation 1962 - 1985

(4) Intake Rate

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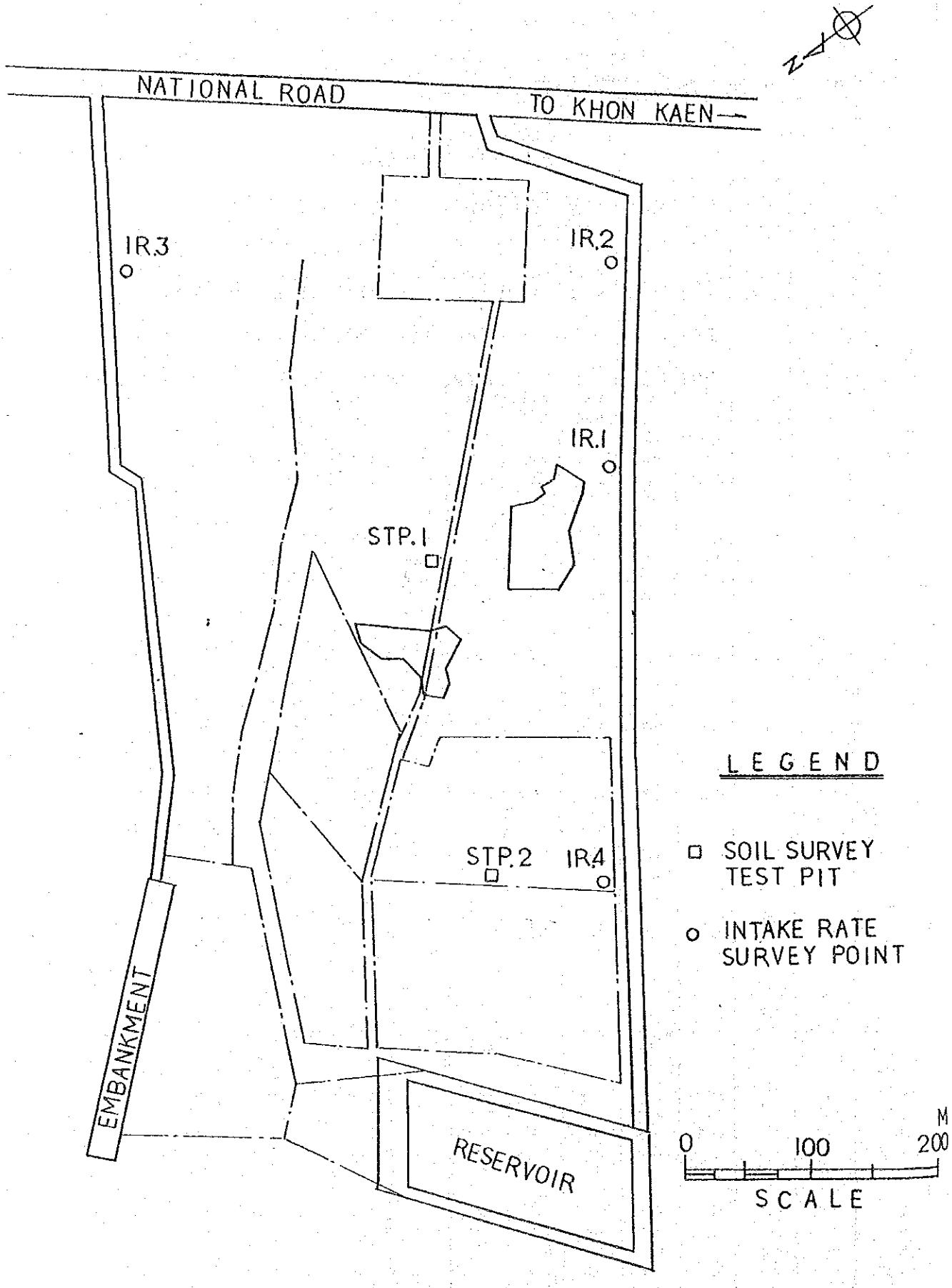

FIG. I-1
LOCATION MAP OF SURVEY POINT

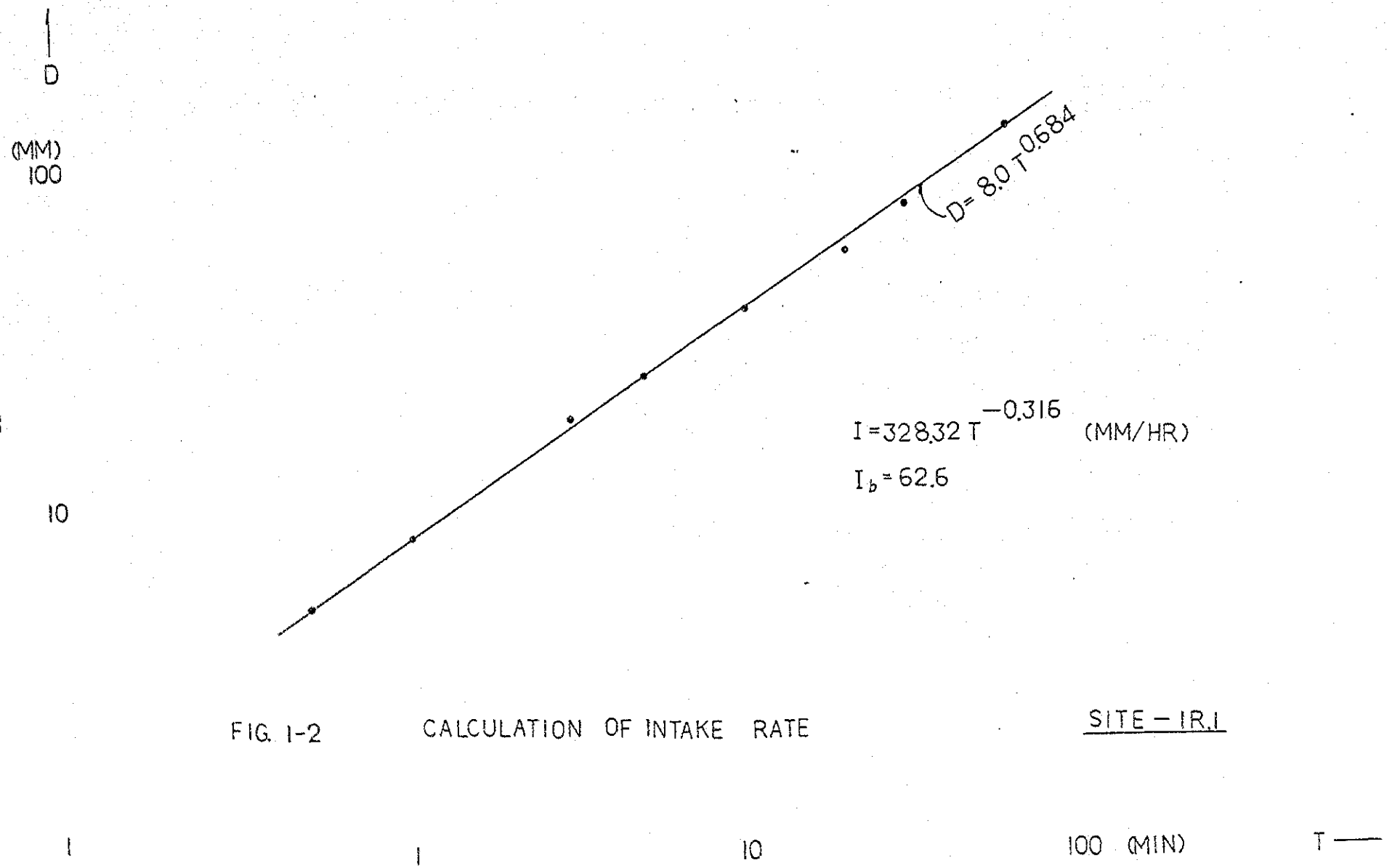

FIG. 1-2 CALCULATION OF INTAKE RATE

SITE – IR.1

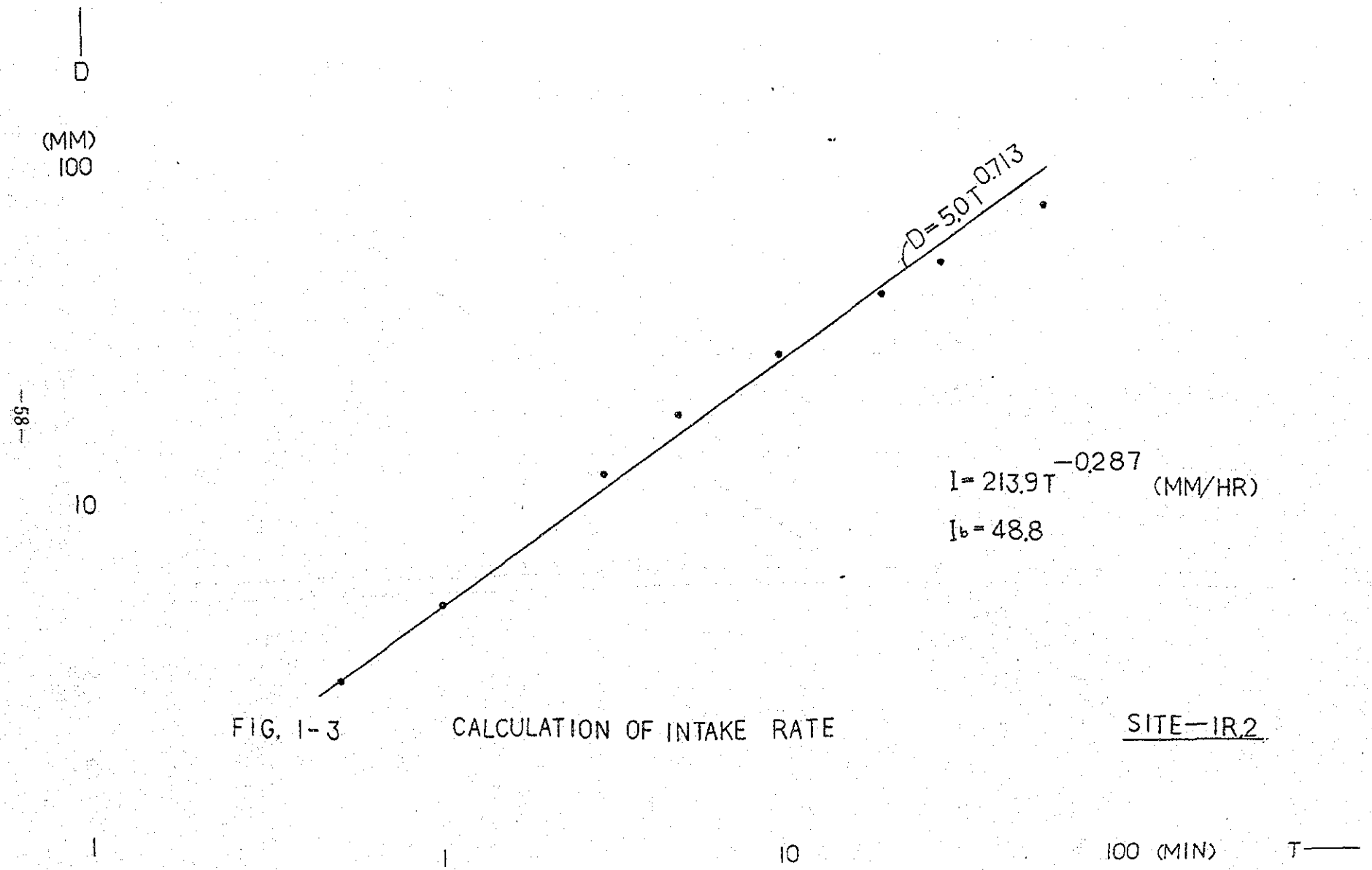

FIG. 1-3 CALCULATION OF INTAKE RATE SITE—IR.2

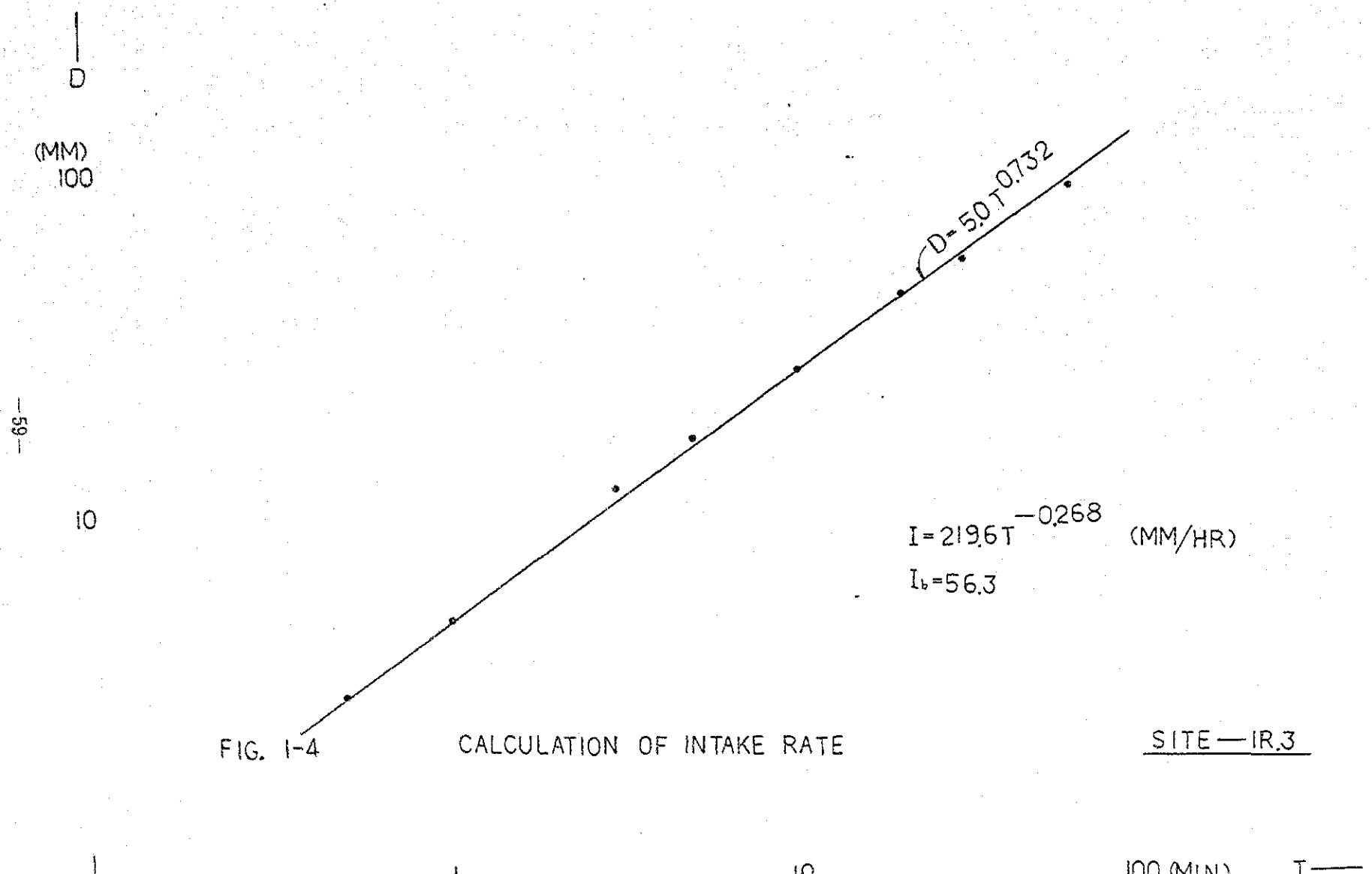

FIG. I-4 CALCULATION OF INTAKE RATE

SITE — IR.3

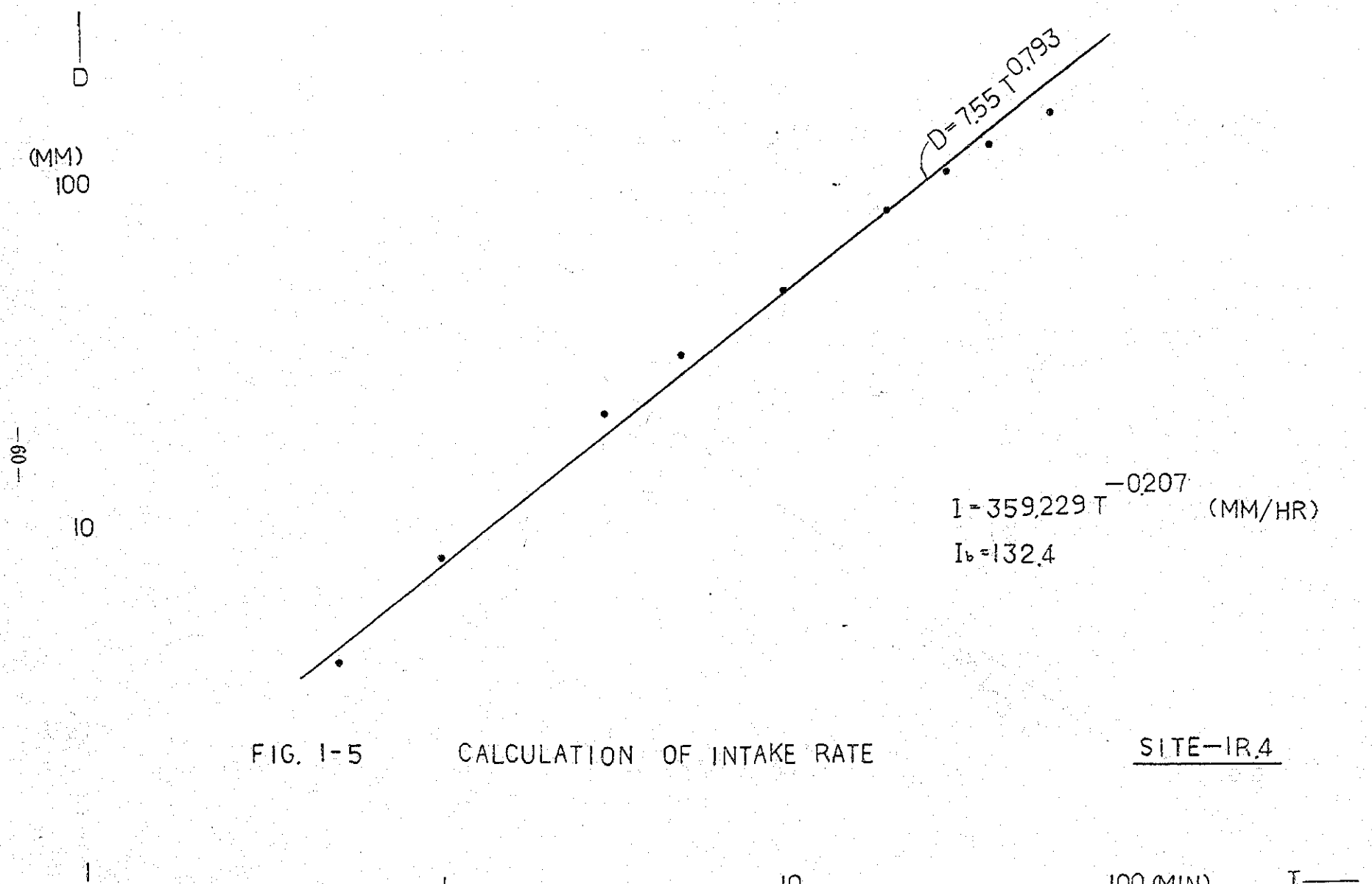

FIG. 1-5 CALCULATION OF INTAKE RATE

SITE-IR.4

(5) Bill of Quantity and Unit Cost

BILL OF QUANTITIES

	Description	Unit	Quantity	Unit Price	Price ฿	Remark
[1]	Reservoir					
	1. Excavation and Transportation					
1-1	Excavating and Pushing (Sandy soil)	cum	2,770	32.1	88,917	by Bulldozer
1-2	- ditto - (Clay)	cum	2,500	38.5	96,250	- ditto -
1-3	Gathering, Loading and Transporting (Sandy Soil)	cum	2,500	50.4	151,200	D = 150 m
1-4	Excavating, Loading and Transporting (Clay)	cum	4,000	38.3	153,200	D = 150 m
1-5	- ditto -	cum	3,118	41.8	130,332	D = 550 m
1-6	Excavating and Loading (Rock)	cum	4,109	35.1	144,226	
1-7	Transporting	cum	5,870	22.9	134,423	D = 550 m
1-8	Spreading in Spoil-bank	cum	19,497	9	175,473	
	Sub-total				1,074,021	
	2. Dam Works					
2-1	Banking Work	cum	1,726.8	-	-	Contain in Item 1
2-2	Compacting	cum	1,726.8	12.3	21,240	
2-3	Protecting Face of Slope					
	Upper side	sqm	570	12.7	7,239	
	Down side	sqm	468	50.9	23,821	
	Sub-total				52,300	

BILL OF QUANTITIES

	Description	Unit	Quantity	Unit Price	Price ฿	Remark
	3. Spillway					
3-1	Concrete	cum	146	1,235.9	180,441	
3-2	Wooden Form	sqm	274	266.3	72,966	
3-3	Iron Bar	kg	7,300	20.6	150,380	
3-4	Gate Board	cum	0.11	6,500	715	
3-5	Steel Channel	kg	46.8	20	936	9.36kg/m x 5 m
3-6	Water Stop	m	16	340	5,440	
3-7	Wire Box for Gabionade (Type I)	pc	29	1,974.9	57,272	
3-8	Pump Drainage	day	30	284.8	8,544	
	Sub-total				476,694	
	Total				1,603,015	
[2]	Drainage Canal					
	1. Main Canal (B-Line)					
1-1	B-1 Line, L 70 m					
	Excavation (by Machine)	cum	110.6	19.5	2,157	
	- ditto - (by Manpower)	cum	12.8	75.2	963	
	Smoothing Face of Slope	sqm	221.2	4.2	929	
	Protecting Face of Slope	sqm	140	50.9	7,126	
	Wire Box for Gabionade (Type I)	pc	25	1,974.9	49,373	
	Sub-total				60,548	

BILL OF QUANTITIES

	Description	Unit	Quantity	Unit Price	Price B	Remark
1-2 B-2	Line, L 170 m					
	Excavation (by Machine)	cum	1,145.8	19.5	22,343	
	- ditto - (by Manpower)	cum	25.8	75.2	1,940	
	Smoothing Face of Slope	sqm	751.4	4.2	3,156	
	Protecting Face of Slope	sqm	340	50.9	17,306	
	Wire Box for Gabionade (Type II)	pc	45	2,228.1	100,265	
	Sub-total				145,010	
1-3 B-3	Line, L 150 m					
	Excavation (by Machine)	cum	718.5	19.5	14,011	
	- ditto - (by Manpower)	cum	17.8	75.2	1,339	
	Smoothing Face of Slope	sqm	711.0	4.2	2,986	
	Protecting Face of Slope	sqm	300	50.9	15,270	
	Wire Box for Gabionade (Type I)	pc	24	1,974.9	47,398	
	- ditto - (Type II)	pc	24	2,228.1	53,474	
	Sub-total				134,478	
	Middle-total				340,036	
2.	Branch Drainage Canal (D-Line)					
2-1 D-1	Gentle Slope, L 75 m					
	Excavation (by Machine)	cum	50.0	19.5	995	
	- ditto- (by Manpower)	cum	-	-	-	
	Smoothing Face of Slope	sqm	189	4.2	794	
	Protecting Face of Slope	sqm	150	50.9	7,635	
	Wire Box for Gabionade	-	-	-	-	
	Sub-total				9,424	

BILL OF QUANTITIES

	Description		Unit	Quantity	Unit Price	Price B	Remark
	D-1 Chute, L 26 m						
	Excavation	(by Machine)	cum	14.8	19.5	289	
	- ditto-	(by Manpower)	cum	4.9	75.2	368	
	Smoothing Face of Slope		sqm	49.1	4.2	206	
	Protecting Face of Slope		sqm	52	50.9	2,647	
	Wire Box for Gabionade (Type I)		pc	8	1,974.9	15,799	
		Sub-total				19,309	
2-2	D-2 L 85 m						
	Excavation	(by Machine)	cum	54.5	19.5	1,063	
	- ditto -	(By Manpower)	cum	3.1	75.2	233	
	Smoothing Face of Slope (Gentle Slope)		sqm	138.6	4.2	582	
	Smoothing Face of Slope (Chute)		sqm	31.9	4.2	134	
	Protecting Face of Slope		sqm	170	50.9	8,653	
	Wire Box for Gabionade (Type I)		pc	5	1,974.9	9,875	
		Sub-total				20,540	
3.	Branch Drainage Canal, A-Line						
3-1	A-1 L 101 m						
	Excavation	(by Machine)	cum	104	19.5	2,028	
	- ditto -	(by Manpower)	cum	8.5	75.2	639	
	Smoothing Face of Slope		sqm	271.7	4.2	1,141	
	Protecting Face of Slope		sqm	202	50.9	10,282	
	Wire Box for Gabionade (Type I)		pc	16	1,974.9	31,598	
		Sub-total				45,688	

	Description		Unit	Quantity	Unit Price	Price ฿	Remark
3-2	A-2 L 64 m						
	Excavation	(by Machine)	cum	92.2	19.5	1,798	
	- ditto -	(by Manpower)	cum	6.9	75.2	519	
	Smoothing Face of Slope		sqm	212.5	4.2	893	
	Protecting Face of Slope		sqm	128	50.9	6,515	
	Wire Box for Gabionade (Type I)		pc	13	1,974.9	25,674	
		Sub-total				35,399	
4.	Branch Drainage Canal, E-Line						
4-1	E-1 L 95 m						
	Excavation	(by Machine)	cum	64.6	19.5	1,260	
	- ditto -	(by Manpower)		-		-	
	Smoothing Face of Slope		sqm	239.4	4.2	1,005	
	Protecting Face of Slope		sqm	190	50.9	9,671	
	Wire Box for Gabionade			-		-	
		Sub-total				11,936	
4-2	E-2 L 90 m						
	Excavation	(by Machine)	cum	57.9	19.5	1,129	
	- ditto -	(by Manpower)	cum	3.1	75.2	233	
	Smoothing Face of Slope (Gentle Slope)		sqm	151.2	4.2	635	
	- ditto -	(Chute)	sqm	56.7	4.2	238	
	Protecting Face of Slope		sqm	180	50.9	9,162	
	Wire Box for Gabionade (Type I)		pc	5	1,974.9	9,875	
		Sub-total				21,272	

BILL OF QUANTITIES

	Description		Unit	Quantity	Unit Price	Price ฿	Remark
5.	Branch Drainage Canal, So-Line L 155 m						
	Excavation	(by Machine)	cum	111.6	19.5	2,176	
	- ditto -	(by Manpower)		-		-	
	Smoothing Face of Slope		sqm	390.6	4.2	1,641	
	Protecting Face of Slope		sqm	310	50.9	15,779	
	Wire Box for Gabionade			-		-	
		Sub-total				19,596	
		Middle-total (Branch D.C.)				183,164	
6.	West Side Drainage Canal, C-Line						
6-1	C-1 L 185 m						
	Excavation	(by Machine)	cum	190.6	19.5	3,717	
	- ditto-	(by Manpower)	cum	12.2	75.2	917	
	Smoothing Face of Slope		sqm	497.7	4.2	2,090	
	Protecting Face of Slope		sqm	370	50.9	18,833	
	Wire Box for Gabionade (Type I)		pc	23	1,974.9	45,423	
		Sub-total				70,980	
6-2	C-2 L 115 m						
	Excavation	(by Machine)	cum	165.6	19.5	3,229	
	- ditto-	(by Manpower)	cum	9.5	75.2	714	
	Smoothing Face of Slope		sqm	381.8	4.2	1,604	
	Protecting Face of Slope		sqm	230	50.9	11,707	
	Wire Box for Gabionade (Type I)		pc	18	1,974.9	35,548	
		Sub-total				52,802	

Description	Unit	Quantity	Unit Price	Price B	Remark
6-3 C-3 L 119 m					
Excavation (by Machine)	cum	197.5	19.5	3,851	
- ditto- (by Manpower)	cum	12.7	75.2	955	
Smoothing Face of Slope	sqm	238	50.9	12,114	
Wire Box for Gabionade (Type I)	pc	24	1,974.9	47,398	
Sub-total				66,132	
Middle-total (West Side Line)				189,914	
Total				713,114	
[3] Farm Road					
1. Main Road A-Line, L 434 m, W 5 m					
Banking by Machine	cum	542.5	14.6	7,921	
Arrangement of Road Face	sqm	3,914.7	2.9	11,352	
Laterite	cum	325.5	100	32,550	
Spreading of Laterite	sqm	2,821	4.0	11,284	
Compacting of Road-bed	sqm	3,472	0.7	2,430	
Sub-total				65,537	
2. Branch Road D-Line, L 195 m, W 4 m					
Banking by Machine	cum	136.5	14.6	1,993	
Arrangement of Road Face	sqm	1,177.8	2.9	3,416	
Laterite	cum	87.8	100	8,780	
Spreading of Laterite	sqm	585	4	2,340	
Compacting of Road-bed	sqm	780	0.7	546	
Sub-total				17,075	

BILL OF QUANTITIES

	Description	Unit	Quantity	Unit Price	Price ฿	Remark
3.	Branch Road E-Line, L 190 m, W 4 m					
	Banking by Machine	cum	133	14.6	1,942	
	Arrangement of Road Face	sqm	1,147.6	2.9	3,328	
	Laterite	cum	85.5	100	8,550	
	Spreading of Laterite	sqm	570	4	2,280	
	Compacting of Road-bed	sqm	760	0.7	532	
	Sub-total				16,632	
4.	Branch Road F-Line, L 135 m, W 4 m					
	Banking by Machine	cum	94.5	14.6	1,380	
	Arrangement of Road Face	sqm	815.4	2.9	2,365	
	Laterite	cum	60.8	100	6,080	
	Spreading of Laterite	sqm	405	4	1,620	
	Compacting of Road-bed	sqm	540	0.7	378	
	Sub-total				11,823	
5.	Branch Road G-Line, L 115 m, W 4 m					
	Banking by Machine	cum	80.5	14.6	1,175	
	Arrangement of Road Face	sqm	694.6	2.9	2,014	
	Laterite	cum	51.8	100	5,180	
	Spreading of Laterite	sqm	345	4	1,380	
	Compacting of Road-bed	sqm	460	0.7	322	
	Sub-total				10,071	

BILL OF QUANTITIES

	Description	Unit	Quantity	Unit Price	Price ฿	Remark
6.	Branch Road H-Line, L 400 m, W 4 m					
	Banking by Machine	cum	537.5	14.6	7,848	
	Arrangement of Road Face	sqm	2,896	2.9	8,398	
	Laterite	cum	180	100	18,000	
	Spreading of Laterite	sqm	1,200	4	4,800	
	Compacting of Road-bed	sqm	1,600	0.7	1,120	
	Sub-total				40,166	
7.	West Side Branch Road C-Line, L 658 m, W 4 m					
	Banking by Machine	cum	1,058	14.6	15,447	
	Arrangement of Road Face	sqm	3,683	2.9	10,681	
	Laterite	cum	-		-	
	Spreading of Laterite	sqm	-		-	
	Compacting of Road-bed	sqm	2,632	0.7	1,842	
	Wire Box for Gabionade (Type I)	pc	15	1,974.9	29,624	
	Sub-total				57,594	
	Middle-total				218,898	
8.	Crossover of Canal, 5 places					
	Concrete (Lean mixed)	cum	17.2	1,011.3	17,394	
	Cobblestones for Bed	cum	69.1	542.3	37,473	
	Wire Box for Gabionade (Type II)	pc	4	2,228.1	8,912	
	Sub-total				63,779	
	Total				282,677	

BILL OF QUANTITIES

Description			Unit	Quantity	Unit Price	Price ฿	Remark
[4] Finishing of Field			sqm	60,000	1.9	114,000	
[5] Irrigation Facilities							
1. Pipe Arrangement							
1-1 Pumping up Line							
	Draft Hose	ø80	m	26.3	250	6,575	25 m x 1.05
	Pumping up Pipe	ø80, steel	m	556.5	1,540/6	142,835	530 m x 1.05
	Dresser	ø80	pc	3	360	1,080	
	Coupling	ø80	pc	100	300	30,000	
	Bend	ø80	pc	3	300	900	
		Sub-total				181,390	
1-2 Distributing Line, PVC Pipe							
1)	Distributing pipe,	ø125	m	157.5	1,472/4	57,960	150 m x 1.05
	- ditto -	ø 125	m	126.0	1,472/4	46,368	120 m x 1.05
	- ditto -	ø75	m	94.5	600/4	14,175	90 m x 1.05
	Tee	125 → 50	pc	1	1,000	1,000	t-1
	- ditto -	125 → 75	pc	1	1,000	1,000	t-2
	Bend	ø125	pc	1	700	700	b-2
	- ditto -	ø75	pc	1	180	180	b-3
	- ditto -	ø50	pc	1	80	80	b-6
		Sub-total				121,463	
2)	Water-supply District, D - E						
	Water-supply Pipe	ø100	m	121	965/4	29,191	110 m x 1.1
	Reducer	125 → 100	pc	1	850	850	r-1
	Bend	ø100	pc	1	350	350	
	Water-supply Valve		pt	5	11,436	57,180	
		Sub-total				87,571	

BILL OF QUANTITIES

	Description		Unit	Quantity	Unit Price	Price B	Remark
3)	Water-supply District, E - F						
	Water-supply Pipe	ø75	m	99	600/4	14,850	90 m x 1.1
	Reducer	100 → 75	pc	1	500	500	r-2
	Water-supply Valve		pt	4	7,453	29,812	
	Sand-flash Pipe	ø75	m	31.5	600/4	4,725	30 m x 1.05
	Sand-flash Valve		pt	1	7,153	7,153	
		Sub-total				57,040	
4)	Water-supply District, A - B						
	Water-supply Pipe	ø75	m	170.5	600/4	25,575	155 m x 1.1
	Bend	ø75	pc	1	180	180	b-5
	Water-supply Valve		pt	7	7,453	52,171	
		Sub-total				77,926	
5)	Water-supply District, B - C						
	Water-supply Pipe	ø65	m	93.5	430/4	10,051	85 m x 1.1
	Reducer	75 → 65	pc	1	300	300	r-3
	Water-supply Valve		pt	4	6,829	27,316	
	Sand-flash Pipe	ø65	m	31.5	430/4	3,386	30 m x 1.05
	Sand-flash Valve		pt	1	6,023	6,023	
		Sub-total				47,076	
6)	Water-supply District, K - L						
	Water-supply Pipe	ø50	m	176	260/4	11,440	160 m x 1.1
	Water-supply Valve		pt	9	4,795	43,155	
	Sand-flash Pipe	ø50	m	31.5	260/4	2,048	30 m x 1.05
	Sand-flash Valve		pt	1	4,823	4,823	
		Sub-total				61,466	
		Middle-total				633,932	

BILL OF QUANTITIES

Description		Unit	Quantity	Unit Price	Price B	Remark
2. Pipe Setting, L 1,580 m						
Excavation by Machine		cum	1,011.2	19.5	19,718	0.64 m^3 x 1,580
Back Hilling	(by Machine)	cum	809	10.5	8,495	1,011.2 x 0.8
- ditto -	(by Manpower)	cum	202.2	50.3	10,171	1,011.2 x 0.2
Setting	(Steel)	m	530	29.3	15,529	
- ditto -	(PVC)	m	1,050	11	11,550	
	Sub-total				65,463	
3. Other Facilities						
3-1 Water Tank						
Concrete		m^3	29.9	1,235.9	36,953	
Cobble Stones for Bed		m^3	6	542.3	3,254	
Iron Bar		kg	1,494.9	20.6	30,795	
Wooden Form		sqm	128.8	266.3	34,299	
	Sub-total				105,301	
3-2 Pump House		set	1		56,000	
3-3 Water Pump		set	1		200,000	
	Sub-total				361,301	
	Total				1,060,696	
[6] Run-off Plot						
1. Foundation Work		cum	800	14.6	11,680	20 x 0.5 ÷ 2 x 160
2. Land Grading		sqm	6,400	1.9	12,160	160 x 40
3. Run-off Plot		set	18	10,202	183,636	ref. Unit Cost No. 21
	Total				207,476	

BILL OF QUANTITIES

Description		Unit	Quantity	Unit Price	Price B	Remark
[7] Buildings						
1. Field Laboratory		set	1		1,063,000	
2. Survey and Storage House		set	1		1,189,000	
3. Machinery Store House		set	1		154,000	
	Sub-total				2,406,000	
4. Dry Yard						
Concrete		cum	21.6	1,235.9	26,695	
Iron Bar ø6 m/m,	12 m x 90	kg	251.7	20.6	5,185	
- ditto -	18 m x 90	kg	251.7	20.6	5,185	
Cobble Stones for Bed		cum	21.6	542.3	11,714	
	Sub-total				48,779	
	Total				2,454,779	

UNIT COST of LABOUR

December, 1989

No.	Item	Unit	Perdiem
			Baht
1.	Labour	md	90
2.	Foreman	md	300
3.	Operator (Heavy Equipment)	md	280
4.	Assistant of Operator	md	200
5.	Steel Worker	md	250
6.	Mechanician	md	250
7.	Carpenter	md	250
8.	Masonry	md	250
9.	Driver	md	220

UNIT COST of MATERIALS

December, 1989

No.	Item	Unit	Cost	Remark
			(Baht)	
1.	Aggregate			
	Sand	m^3	350	
	Gravel	m^3	300	
2.	Cobble-stone	m^3	300	
3.	Cement	bag	90	1 bag = 50 kg
4.	Iron Bar	kg	15	
5.	Wire for Binding	kg	20	
6.	Nail	kg	20	
7.	Laterite	m^3	100	
8.	Fuel			
	Gasoline	liter	8.80	
	Diesel	liter	6.50	
9.	Block			
	(90 x 190 x 390)	PC	5.50	
	(70 x 190 x 390)	PC	3.50	
10.	Brick	PC	0.40	
11.	Lumber	m^3	7,800.-	for frame
12.	Timber	m^3	12,400.-	
13.	Plywood	m^2	240.-	thickness 6 mm
14.	Log	m^3	6,500.-	
15.	Wire Mesh	m^2	120.-	space 2", #11
16.	Concrete pipe (ϕ300)	PC	160.-	lit. = 1.0 m
17.	Concrete pipe (ϕ500)	PC	300.-	lit. = 1.0 m
18.	Steel pipe (ϕ800)	m	1,540/6	
19.	PVC pipe (ϕ125)	m	1,472/4	
20.	PVC pipe (ϕ100)	m	965/4	
21.	PVC pipe (ϕ75)	m	600/4	
22.	PVC pipe (ϕ65)	m	430/4	
23.	PVC pipe (ϕ50)	m	260/4	

No. 1

UNIT COST OF

Excavation by Manpower (Sand with Gravel)

75.2 B/m^3

Calculated by 1 m^3

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Workers					
Labour	0.56	md	90	50.4	
Foreman	0.06	md	300	18	
Sub-total				68.4	
2. Temporary Works and Others	10	%		6.8	
Total				75.2	

Explanation

No. 2	UNIT COST OF Banking by Manpower			33.8 B/m^3 Calculated by 10 m^3		Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks	
1. Workers						
Labour	2.55	md	90	229.5	Not include compacting	
Foreman	0.26	md	300	78		
Sub-total				307.5		
2. Temporary Works and Others	10	%		30.8		
Total				338.3		
			1 m^3 =	33.8		

No. 3

UNIT COST
OF

Smoothing Face of Slope
(For Banking Slope)

12.7 B/m²

Calculated by 10 m²

Explanation

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Workers					
Labour	0.95	md	90	85.5	Include tamping
Foreman	0.1	md	300	30.0	
Sub-total				115.5	
2. Temporary Works and Others	10	%		11.6	
Total			1 m² =	127.1	

No. 3-1	UNIT COST OF Smoothing Face of Slope (For Cutting Slope)			4.2 B/m^2 Calculated by 10 m^2		Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks	
1. Workers						
Labour	0.325	md	90	29.3		
Foreman	0.03	md	300	9		
Sub-total				38.3		
2. Temporary Works and Others	10	%		3.8		
Total				42.1		
			1 m^2 =	4.2		

No. 4	UNIT COST OF Arrangement of Road Face			2.9 B/m^2 Calculated by 100 m^2	Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Workers					
Labour	2.25	md	90	202.5	
Foreman	0.2	md	300	60	
Sub-total				262.5	
2. Temporary Works and Others	10	%		26.3	
Total				288.8	
			1 m^2 =	2.9	

No. 4-1

UNIT COST
OF

Spreading by Manpower
(for Ballasting)

4.0 ₿/m²

Calculated by 100 m²

Explanation

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Workers					
Labour	3.0	md	90	270	
Foreman	0.3	md	300	90	
Sub-total				360	
2. Temporary Works and Others	10	%		36	
Total				396	
			1 m² =	4.0	

No. 5	UNIT COST OF Back Hilling by Manpower			50.3 B/m^3 Calculated by 10 m^3		Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks	
1. Workers						
Labour	3.75	md	90	337.5		
Foreman	0.4	md	300	120.-		
Sub-total				457.5		
2. Temporary Works and Others	10	%		45.8		
Total				503.3		
			1 m^3 =	50.3		

No. 6	UNIT COST OF Sod Facing			50.9 ₱/m^2 Calculated by 10 m^2		Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks	
1. Workers						
Labour	1.7	md	90	153		
Foreman	0.2	md	300	60		
Sub-total				213		
2. Materials						
Sod	10	m^2	25	250		
3. Temporary Works and Others	10	%		46.3		
Total				509.3		
			1 m^2 =	50.9		

No. 7

UNIT COST
OF

Compacting by Manpower
(Compactor 90 kg)

22.5 ฿/m^3

Calculated by 10 m^3

Item	Quantity	Unit	Unit Cost	Cost	Remarks	Explanation
1. Workers						
Labour	1.1	md	90	99		
Foreman	0.1	md	300	30		
Sub-total				129		
2. Operation Cost						
Operator	0.15	md	250	37.5		
Fuel	0.75	liter	8.8	6.6		5 lit/day x 0.15
Others	0.15	%		1.0		
Sub-total				45.1		
3. Depreciation	0.15	d	200	30.0		200 ฿/day
4. Temporary Works and Others	10	%		20.4		
Total				224.5		
			1 m^3 =	22.5		

No. 8

UNIT COST
OF

Hauling by Manpower

l = 60 m

Explanation

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Sand	0.44	md	90	39.6	per m^3
2. Gravel	0.54	md	90	48.6	per m^3
3. Cobble Stone	0.54	md	90	48.6	per m^3
4. Wood	0.21	md	90	18.9	per m^3
5. Cement and Others	0.26	md	90	23.4	per ton

No. 9	UNIT COST OF Reinforced Concrete (Mixed by Portable Mixer)			1,235.9 ฿/m^3 Calculated by 10 m^3		Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks	
1. Materials						
Cement (325 kg/m^3)	65	bag	90	5,850		
Hauling cost	3.25	t	23.4	76.1		
Sand	3	m^3	350	1,050		
Hauling cost	3	m^3	39.6	118.8		
Aggregate	6.1	m^3	300	1,830		
Hauling cost	6.1	m^3	48.6	296.5		
Sub-total				9,221.4		
2. Workers						
Labour	3.9	md	90	351		
Foreman	0.4	md	300	120		
Mechanician	2.4	md	250	600		
Sub-total				1,071		
3. Operation Cost						
Fuel (Mixer)	3.3	liter	8.8	29.0		
Others	20	%		5.8		
Fuel (Vibrator)	0.3	liter	8.8	2.6		
Others	20	%		0.5		
Sub-total				37.9		

No. 9 (continued)	UNIT COST OF Reinforced Concrete (Mixed by Portable Mixer)			1,235.9 ₿/m³ Calculated by 10 m³		Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks	
4. Depreciation Cost						
Mixer	0.66	d	540	356.4		
Vibrator	0.89	d	68	60.5		
Sub-total				416.9		
5. Temporary Works and Others				1,612.1	(1+2+3+4) x 0.15	
Total				12,359.3		
			1 m³ =	1,235.9		

No. 10	UNIT COST OF Plain Concrete (Mixed by Portable Mixer)			1,143.1 B/m^3 Calculated by 10 m^3		Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks	
1. Materials						
Cement (275 kg/m^3)	55	bag	90	4,950		
Hauling cost	2.75	t	23.4	64.4		
Sand	3	m^3	350	1,050		
Hauling cost	3	m^3	39.6	118.8		
Aggregate	6.4	m^3	300	1,920		
Hauling cost	6.4	m^3	48.6	311.0		
Sub-total				8,414.2		
2. Workers				1,071	Refer to No. 9.	
3. Operation Cost				37.9	"	
4. Depreciation Cost				416.9	"	
5. Temporary Works and Others	15	%		1,491		
Total				11,431		
			1 m^3 =	1,143.1		

No. 11	UNIT COST OF Lean-mix Concrete (Mixed by Portable Mixer)			1,011.3 ₿/m^3 Calculated by 10 m^3		Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks	
1. Materials						
Cement (200 kg/m^3)	40	bag	90	3,600		
Hauling cost	2.0	t	23.4	46.8		
Sand	3.3	m^3	350	1,155		
Hauling cost	3.3	m^3	39.6	130.7		
Aggregate	6.7	m^3	300	2,010		
Hauling cost	6.7	m^3	48.6	325.6		
Sub-total				7,268.1		
2. Workers				1,071	Refer to No. 9.	
3. Operation Cost				37.9	"	
4. Depreciation Cost				416.9	"	
5. Temporary Works and Others	15	%		1,319.1		
Total				10,113.0		
			1 m^3 =	1,011.3		

No. 12	UNIT COST OF Mortar (1:3) (Mixed by Manpower)			1,719.8 ₺/m^3 Calculated by 1 m^3		Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks	
1. Materials						
Cement	0.53	ton	1,800	954		
Hauling cost	0.53	ton	23.4	12.4		
Sand	1.05	m^3	350	367.5		
Hauling cost	1.05	m^3	39.6	41.6		
Sub-total				1,375.5		
2. Workers						
Labour	1.0	md	90	90		
Foreman	0.1	md	300	30		
Sub-total				120		
3. Temporary Works and Others	15	%		224.3		
Total				1,719.8		

No. 13	UNIT COST OF Processing and Assembling of Reinforced Iron Bar			20.6 B/kg Calculated by 1 ton		Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks	
1. Materials						
Reinforced I.B.	1.03	ton	15,000	15,450		
Wire for binding	7	kg	20	140		
Sub-total				15,590		
2. Processing and Assembling						
Steel worker	5.9	md	250	1,475		
Labour	5.9	md	90	531		
Foreman	1.2	md	300	360		
Sub-total				2,366		
3. Temporary Works and Others	15	%		2,693.4		
Total				20,649.4		
			1 kg =	20.6		

No. 14

UNIT COST OF

Wooden Form

266.3 B/m^2

Calculated by 10 m^2

Item	Quantity	Unit	Unit Cost	Cost	Remarks	Explanation
1. Sheeting						
Wooden plate	0.196	m^3	6,500	344	1,274 x 27%	
Wooden frame	0.113	m^3	6,500	198.3	734.5 x 27%	
Iron nail	3	kg	20	60		
Sub-total				702.3		
2. Support						
Square timber	0.339	m^3	7,800	423.1	2,644.2 x 16%	
Log	0.154	m^3	6,500	160.2	1,001 x 16%	
Nail	1.1	kg	20	22		
Wire	0.8	kg	20	16		
Oil	1.5	liter	50	75		
Sub-total				696.3		
3. Other Materials	3	%		42.0		(1+2) x 0.03
4. Workers						
Carpenter	2.24	md	250	560		
Labour	2.07	md	90	186.3		
Foreman	0.43	md	300	129		
Sub-total				875.3		
5. Temporary Works and Others	15	%		347.4		
Total				2,663.3		
			1 m^2 =	266.3		

No. 15

UNIT COST
OF

Wire Box for Gabionade
(Type I)

1,974.9 Bset

Calculated by 1 set

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Workers					
Labour	2.61	md	90	234.9	
Foreman	0.3	md	300	90	
Sub-total				324.9	
2. Materials					
2-1 Wire mesh	6.21	m^2	120	745.2	Space 2" ø3.05 (#11)
Selvedge and binding wire	10	%		74.5	
Sub-sub-total				819.7	
2-2 Cobble stone	0.73	m^3	300	219	
Hauling cost	0.73	m^3	48.6	35.5	
Sub-sub-total				254.5	
2-3 Iron bar	3	piece	70	210	ø25, L = 1.2
PVC pipe	3	piece	20	60	ø100, L = 0.5
Mortar	0.028	m^3	1,719.8	48.2	0.1x 0.1 xπ÷4 x 1.2x3
Sub-sub-total				318.2	
Sub-total				1,392.4	
3. Temporary Works and Others	15	%		257.6	(1+2) x 0.15
Total				1,974.9	

Explanation

Area of wire mesh
0.45 x 0.9 x 2 = 0.81
0.9 x 2.0 x 2 = 3.60
0.45 x 2.0 x 2 = 1.80
Total 6.21 m^2

Capacity of wire box
0.45 x 0.9 x 2.0
= 0.81 m^3

Volume of cobble stone
0.81 x 0.9 = 0.73 m^3

Constructing
of wire box 0.3 md
Setting 1.03 md
Packing stones 1.28 md
Total 2.61 md

No. 16

UNIT COST OF

Wire Box for Gabionade (Type II)

2,228.1 B/set

Calculated by 1 set

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Workers					
Labour	2.93	md	90	263.7	
Foreman	0.3	md	300	90	
Sub-total				353.7	
2. Materials					
2-1 Wire mesh	7.29	m^2	120	874.8	Space 2", ø3.05 (# 11)
Selvedge and binding wire	10	%		87.5	
Sub-sub-total				962.3	
2-2 Cobble stone	0.87	m^3	300	261	
Hauling cost	0.87	m^3	48.6	42.3	
Sub-sub-total				303.3	
2-3 Iron bar	3	piece	70	210	ø25, L = 1.2
PVC pipe	3	piece	20	60	ø100, L = 0.5
Mortar	0.028	m^3	1,719.8	48.2	0.1x 0.1 xπ÷4 x 1.2x3
Sub-sub-total				318.2	
Sub-total				1,583.8	
3. Temporary Works and Others	15	%		290.6	(1+2) x 0.15
Total				2,228.1	

Explanation

Area of wire mesh
0.45 x 0.9 x 2 = 0.81
0.9 x 2.4 x 2 = 4.32
0.45 x 2.4 x 2 = 2.16
Total 7.29 m^2

Capacity of wire box
0.45 x 0.9 x 2.4
= 0.972

Volume of cobble stone
0.972 x 0.9 = 0.87 m^3

Constructing of
wire box 0.3 md
Setting 1.05 md
Packing stones 1.58 md
Total 2.93 md

No. 17	UNIT COST OF Cobblestones for Bed			542.3 ₿/m^3 Calculated by 1 m^3		Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks	
1. Workers						
Labour	0.63	md	90	56.7		
Foreman	0.06	md	300	18		
Sub-total				74.7		
2. Materials						
Cobblestone	1	m^3	300	300		
Gravel	0.2	m^3	300	60		
Hauling cost	1.2	m^3	48.6	58.3		
Sub-total				418.3		
3. Temporary Works and Others	10	%		49.3		
Total				542.3		

No. 18

UNIT COST OF

Setting PVC Pipe

11 ฿/m

Calculated by 10 pieces (40 m)

Explanation

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Workers					
Piping man	0.4	md	250	100	
Labour	1.75	md	90	157.5	
Foreman	0.2	md	300	60	
Sub-total				317.5	
2. Materials					
Adhesives	0.55	kg	150	82.5	
3. Temporary Works and Others	10	%		40	
Total				440	
			1 m =	11	

No. 19

UNIT COST
OF

Setting Steel Pipe

29.3 B/m

Calculated by 10 pieces (40 m)

Explanation

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Workers					
Piping man	1.03	md	250	257.5	
Labour	6.48	md	90	583.2	
Foreman	0.75	md	300	225	
Sub-total				1,065.7	
2. Temporary Works and Others	10	%		106.6	
Total				1,172.3	
			1 m =	29.3	

No. 20

UNIT COST
OF

Masonry

72.6 B/m^2

Calculated by 10 m^2

Explanation

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Workers					
Mason	0.6	md	250	150	
Labour	4	md	90	360	
Foreman	0.5	md	300	150	
Sub-total				660	
2. Temporary Works and Others	10	%		66	
Total				726	
			1 m^2 =	72.6	

No. 21

UNIT COST OF

Run-off Plot

10,202 B/set

Calculated by per 1 set

Explanation

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Materials					
Block (70 x 190 x 390)	100	pc	3.5	350	
- ditto - (90 x190 x390)	175	"	5.5	962.5	
Brick	64	"	4.0/10	26	
Concrete	2.76	cum	1,143.1	3,154.9	
Cobblestones for Bed	2.76	"	542.3	1,496.7	
Mortar	0.23	"	1,719.8	395.6	
Iron Bar	24.5	kg	20.6	494.4	
Sub-total				6,880.1	
2. Labour					
Banking	20	cum	33.8	676	
Masonry	23.7	sqm	72.6	1,805.4	
Finishing by Mortar	28	"	30	840	
Sub-total				3,321.4	
Total				10,201.5	
			≒	10,202	

No. 22-1

UNIT COST
OF

Water Supply Valve (ϕ 25)

4,795 B/pt

Explanation

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Materials					
Concrete Pipe ϕ 300	0.5	m	160	80	
Concrete	0.06	m^3	1,011.3	61	
Vertical Pipe ϕ 25	0.8	m	101/4	20	
Tee	1	pc	152	152	
Angle Valve	1	pc	4,200	4,200	
Adhesive	0.082	kg	150	12	
2. Workers					
Labour	3	md	90	270	
Total				4,795	

No. 22-2

UNIT COST
OF

Water Supply Valve (ϕ 50)

6,829 ฿/pt

Explanation

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Materials					
Concrete Pipe ϕ 300	0.5	m	160	80	
Concrete	0.06	m^3	1,011.3	61	
Vertical Pipe ϕ 50	0.8	m	260/4	52	
Tee	1	pc	950	950	
Angle Valve	1	pc	5,400	5,400	
Adhesive	0.107	kg	150	16	
2. Workers					
Labour	3	md	90	270	
Total				6,829	

No. 22-3

UNIT COST OF

Water Supply Valve (ϕ 65)

7,453 ฿/pt

Explanation

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Materials					
Concrete Pipe ϕ 300	0.5	m	160	80	
Concrete	0.06	m^3	1,011.3	61	
Vertical Pipe ϕ 65	0.8	m	430/4	86	
Tee	1	pc	408	408	
Angle Valve	1	pc	6,530	6,530	
Adhesive	0.123	kg	150	18	
2. Workers					
Labour	3	md	90	270	
Total				7,453	

No. 22-4

UNIT COST
OF

Water Supply Valve (ϕ 80)

11,436 ฿/pt

Explanation

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Materials					
Concrete Pipe ϕ 300	0.5	m	160	80	
Concrete	0.06	m^3	1,011.3	61	
Vertical Pipe ϕ 80	0.8	m	600/4	120	
Tee	1	pc	880	880	
Angle Valve	1	pc	10,000	10,000	
Adhesive	0.164	kg	150	25	
2. Workers					
Labour	3	md	90	270	
Total				11,436	

No. 23-1

UNIT COST
OF

Sand-flash Valve (ϕ 50)

4,823 ฿/pt

Explanation

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Materials					
Concrete Pipe ϕ 500	1	m	300	300	
Concrete	0.04	m^3	1,011.3	41	
Check Valve ϕ 50	1	pc	4,200	4,200	
Adhesive	0.082	kg	150	12	
2. Workers					
Labour	3	md	90	270	
Total				4,823	

No. 23-2

UNIT COST
OF

Sand-flash Valve (ϕ 65)

6,023 B/pt

Explanation

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Materials					
Concrete Pipe ϕ 500	1	m	300	300	
Concrete	0.04	m^3	1,011.3	41	
Check Valve ϕ 65	1	pc	5,400	5,400	
Adhesive	0.082	kg	150	12	
2. Workers					
Labour	3	md	90	270	
Total				6,023	

No. 23-3

UNIT COST OF

Sand-flash Valve (ϕ 75)

7,153 B/pt

Explanation

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Materials					
Concrete Pipe ϕ 500	1	m	300	300	
Concrete	0.04	m^3	1,011.3	41	
Check Valve ϕ 75	1	pc	6,530	6,530	
Adhesive	0.082	kg	150	12	
2. Workers					
Labour	3	md	90	270	
Total				7,153	

No. 24	UNIT COST OF Drainage by Pump			284.8 ฿/day calculated by 1 day		Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks	
1. Gasoline	7.6	lit	8.8	66.9		
Others	15	%		10		
Sub-total				76.9		
2. Workers						
Labour	0.3	md	90	27		
Mechanician	0.3	md	250	75		
Sub-total				102		
3. Depreciation	1	day		80		
4. Temporary Works and Otheres	10	%		25.9		
Total				284.8		

Eq No. 1-1

UNIT COST
OF

Excavation by Bulldozer
(11 ton)

D = 20 m

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Operation Cost	1	day		4,831.8	
2. Temporary Works and Others	10	%		483.2	
Total				5,315.0	
					Production per day
Sandy soil	1	m^3		14.6	52.0 x 7 = 364 m^3
Clay	1	m^3		17.5	43.4 x 7 = 303.8 m^3

Explanation

$$Q = \frac{60q \times f \times E}{Cm}$$

60q = 80.64
f = 1
E = 0.60 (Sandy soil)
Cm = 0.034 x 20 + 0.25
= 0.93

$$Q = \frac{80.64 \times 1 \times 0.6}{0.93}$$

= 52.0 m^3/hr

E = 0.5 (Clay)

$$Q = \frac{80.64 \times 1 \times 0.5}{0.93}$$

= 43.4 m^3/hr

Eq No. 1-2

UNIT COST
OF

Excavation by Bulldozer
(11 ton)

D = 60 m

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Operation Cost	1	day		4,831.8	
2. Temporary Works and Others	10	%		483.2	
Total				5,315.0	
					Production per day
Sandy soil	1	m^3		36.0	21.1 x 7 = 147.7 m^3
Clay	1	m^3		43.1	17.6 x 7 = 123.2 m^3

Explanation

$Q = \frac{60q \times f \times E}{Cm}$

60q = 80.64
f = 1
E = 0.60 (Sandy soil)
Cm = 0.034 x 60 + 0.25
= 2.29

$Q = \frac{80.64 \times 1 \times 0.6}{2.29}$
= 21.1 m^3/hr

E = 0.5 (Clay)

$Q = \frac{80.64 \times 1 \times 0.5}{2.29}$
= 17.6 m^3/hr

Eq No. 1-3

UNIT COST
OF

Excavation by Bulldozer
(15 ton)

D = 20 m

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Operation Cost	1	day		5,781.7	
2. Temporary Works and Others	10	%		578.2	
Total				6,359.9	
					Production per day
Sandy soil	1	m^3		13.1	69.6 x 7 = 487.2 m^3
Clay	1	m^3		15.7	58.0 x 7 = 406 m^3
Rock	1	m^3		32.0	28.4 x 7 = 198.8 m^3

Explanation

$Q = \frac{60q \times f \times E}{Cm}$

$60q = 107.88$

$Cm = 0.034 \times 20 + 0.25 = 0.93$

Rock
$f = 0.7,\ E = 0.35$

$Q = \frac{107.88 \times 0.7 \times 0.35}{0.93}$

$= 28.4\ m^3/hr$

Sandy
$f = 1.0,\ E = 0.60$

$Q = \frac{107.88 \times 1 \times 0.6}{0.93}$

$= 69.6\ m^3/hr$

Clay
$f = 1.0,\ E = 0.5$

$Q = \frac{107.88 \times 1 \times 0.5}{0.93}$

$= 58\ m^3/hr$

Eq No. 1-4

UNIT COST
OF

Excavation by Bulldozer

D = 60 m

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Operation Cost	1	day		5,781.7	
2. Temporary Works and Others	10	%		578.2	
Total				6,359.9	
					Production per day
Sandy soil	1	m^3		32.1	28.3 x 7 = 198.1 m^3
Clay	1	m^3		38.5	23.6 x 7 = 165.2 m^3

Explanation

$$Q = \frac{60q \times f \times E}{Cm}$$

60q = 107.88
f = 1.0
Cm = 0.034 x 60 + 0.25
= 2.29

Sandy
E = 0.60

$$Q = \frac{107.88 \times 1 \times 0.6}{2.29}$$

= 28.3 m^3/hr

Clay
E = 0.5

$$Q = \frac{107.88 \times 1 \times 0.5}{2.29}$$

= 23.6 m^3/hr

Eq No. 2-1

UNIT COST
OF

Excavation by Back Hoe
(0.35 m^3)

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Operation Cost	1	day		3,769.9	
2. Temporary Works and Others	10	%		377.0	
Total				4,146.9	
					Production per day
Sandy Soil	1	m^3		19.5	30.4 x 7 = 212.8 m^3

Explanation

$$Q = \frac{3600 \times q \times f \times E}{Cm}$$

q = qo x K
= 0.35 x 0.9 = 0.315

f = 1, E = 0.75
Cm (ø90°) = 28 sec

$$Q = \frac{3600 \times 0.315 \times 1 \times 0.75}{28}$$

= 30.4 m^3/hr

Eq No. 2-2

UNIT COST
OF

Excavation by Back Hoe (0.75 m^3)

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Operation Cost	1	day		6,787.2	
2. Temporary Works and Others	10	%		678.7	
Total				7,465.9	
					Production per day
Sandy soil	1	m^3		16.4	65.1 x 7 = 455.7
Clay	1	m^3		18.9	56.4 x 7 = 394.8
Rock	1	m^3		35.1	30.4 x 7 = 212.8

Explanation

$$Q = \frac{3600 \times q \times f \times E}{Cm}$$

$q = qo \times K$
$= 0.75 \times 0.9 = 0.675$

$Cm = 0.054ø + 23$

$ø90° \rightarrow Cm$ 28 sec

Rock
$f = 0.7,\ E = 0.5$

$$Q = \frac{3600x0.675x0.7x0.5}{28}$$

$= 30.4\ m^3/hr$

Sandy
$f = 1, E = 0.75$

$$Q = \frac{3600x0.675x1x0.75}{28}$$

$= 65.1\ m^3/hr$

Clay
$f = 1, E = 0.65$

$$Q = \frac{3600x0.675x1x0.65}{28}$$

$= 56.4\ m^3/hr$

Eq No. 3-1

UNIT COST
OF

Spreading by Bulldozer
(11 ton)

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Operation Cost	1	day		4,831.8	
2. Temporary Works and Others	10	%		483.2	
Total				5,315.0	
					Production per day
Cost per m^3 (D = 0.15)	1	m^3		10.5	72.4 x 7 = 506.8
Cost per m^3 (D = 0.30)	1	m^3		9	84.8 x 7 = 593.6

Explanation

Q = 10E (11D + 8)

E = 0.75
D = 0.15

Q = 10 x 0.75(11x0.15+8)
= 72.375
≒ 72.4

D = 0.30

Q = 10x0.75 (11x0.3+8)
= 84.8

Eq No. 3-2

UNIT COST
OF

Spreading by Bulldozer
(15 ton)

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Operation Cost	1	day		5,781.7	
2. Temporary Works and Others	10	%		578.2	
Total				6,359.9	
					Production per day
Cost per m^3 (D = 0.15)	1	m^3		11.2	81 x 7 = 567
Cost per m^3 (D = 0.30)	1	m^3		9.6	94.5 x 7 = 661.5

Explanation

Q = 10E (12D + 9)

E = 0.75
D = 0.15

Q = 10 x 0.75(12x0.15+9)
= 81 m^3/hr

D = 0.30

Q = 10x0.75 (12x0.3+9)
= 94.5

Eq No. 4-1

UNIT COST
OF

Compacting by Bulldozer
(11 ton)

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Operation Cost	1	day		4,831.8	
2. Temporary Works and Others	10	%		483.2	
Total				5,315.0	
					Production per day
I. Cost per m^3	1	m^3		7.9	95.6 x 7 = 669.2
II. Cost per m^2	1	m^2		2.4	318.5 x 7 = 2,229.5

Explanation

I. $Q = \frac{VxWxDxE}{N} (m^3/h)$

V = 3,500 m/h
W = 0.7 m
D = 0.3 m
E = 0.65
N = 5

$Q = \frac{3500x0.7x0.3x0.65}{5}$

$= 95.6\ m^3/h$

II. $A = \frac{V \times W \times E}{N}$

$= \frac{3500x0.7x0.65}{5}$

$= 318.5\ m^2/hr$

Eq No. 4-2

UNIT COST
OF

Compacting by Bulldozer
(15 ton)

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Operation Cost	1	day		5,781.7	
2. Temporary Works and Others	10	%		578.2	
Total				6,359.9	
					Production per day
I. Cost per m^3	1	m^3		8.3	109.2 x 7 = 764.4
II. Cost per m^2	1	m^2		2.5	364 x 7 = 2,548

Explanation

I. $Q = \frac{VxWxDxE}{N} (m^3/h)$

V = 3,500 m/h
W = 0.8 m
D = 0.3 m
E = 0.65
N = 5

$Q = \frac{3500x0.8x0.3x0.65}{5}$

$= 109.2\ m^3/h$

II. $A = \frac{V \times W \times E}{N}$

$= \frac{3500x0.8x0.65}{5}$

$= 364\ m^2/hr$

Eq No. 5-1

UNIT COST
OF

Field Arrangement by Bulldozer
(11 ton)

1.9 B/m^2

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Operation Cost	1	day		4,831.8	
2. Temporary Works and Others	10	%		483.2	
Total				5,314.0	
					Production per day
Cost per m^2	1	m^2		1.9	403.2x7 = 2,822.4 m^2

Explanation

S = So x E (m^2/hr)

So = 520.2 x W

W = B - 0.30
= 3.40 - 0.30 = 3.10

E = 0.25

S = 520.2 x 3.10 x 0.25
= 403.2

Eq No. 5-2	UNIT COST OF Field Arrangement by Bulldozer (15 ton)			2.1 B/m^2	
Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Operation Cost	1	day		5,781.7	
2. Temporary Works and Others	10	%		578.2	
Total				6,359.9	
					Production per day
Cost per m^2	1	m^2		2.1	429.2x7 = 3,004.4 m^2

Explanation

S = So x E (m^2/hr)

So = 520.2 x W

W = B - 0.30
= 3.6 - 0.3 = 3.3

E = 0.25

S = 520.2 x 3.3 x 0.25
= 429.2

Eq No. 6

UNIT COST
OF

Loading by Tractor Shovel
(1.2 m^3)

20.8 ฿/m^3

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Operation Cost	1	day		4,385.9	
2. Temporary Works and Others	10	%		438.6	
Total				4,824.5	
					Production per day
Cost per m^3	1	m^3		17.9	38.5 x 7 = 269.5 m^3

Explanation

$$Q = \frac{3600 \times q \times f \times E}{Cm}$$

q = qo x K = 1.2 x 0.73
= 0.876
f = 1
E = 0.55
Cm = 45

$$Q = \frac{3600 \times 0.876 \times 0.55}{45}$$

= 38.5 m^3/hr

Eq No. 7

UNIT COST
OF

Hauling by Dump Truck

Calculated by 150 m, 550 m

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Operation Cost	1	day		3,288.9	
2. Temporary Works and Others	10	%		328.9	
Total				3,617.8	
					Production per day
Cost per m^3 (L = 150)	1	m^3		19.4	26.7 x 7 = 186.9
Cost per m^3 (L = 550)	1	m^3		22.9	22.6 x 7 = 158.2

Explanation

$Q = \frac{60 \times q \times f \times E}{Cm}$

$q = \frac{T}{W} = \frac{8}{1.6} = 5.0$

f = 1

E = 1

Cm = 0.005L + 10.5

L = 150

Cm = 11.25

$Q = \frac{60 \times 5 \times 1 \times 1}{11.25}$

$= 26.7\ m^3/hr$

L = 550

Cm = 0.005 x 550 + 10.5

= 13.25

$Q = \frac{60 \times 5 \times 1 \times 1}{13.25}$

$= 22.6\ m^3/hr$

Eq. No. 8

UNIT COST
OF

Compacting by Tire Roller
(8 - 20 t)

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Operating Cost	1	day		3,805.6	
2. Temporary Works and Others	10	%		380.6	
Total				4,186.2	
I. For Area					Production per day
Cost per m^2	1	m^2		0.7	831.6 x 7 = 5,821.2
II. For Volume					
Cost per m^3	1	m^3		12.3	48.6 x 7 = 340.2

Explanation

I. $A = \frac{W \times V \times E}{N}$

W = 1.80, V = 4,200
E = $E_1 \times E_2$
= 1.00x0.55 = 0.55
N = 5

$A = \frac{1.8 \times 4200 \times 0.55}{5}$

= 831.76 m^2/hr

II. $Q = \frac{W \times V \times D \times E}{N}$

W = 1.80, V = 3,000
D = 0.2
E = $E_1 \times E_2$
= 1.0 x 0.45 = 0.45
N = 10

$Q = \frac{1.8 \times 3000 \times 0.2 \times 0.45}{10}$

= 48.6 m^3/hr

Op No. 1	OPERATION COST OF 11 ton Bulldozer			4,831.8 ฿/day per day	Explanation

Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Workers					
Operator	1.0	md	280	280	
Assistant	0.5	md	200	100	
Sub-total				380	
2. Fuel and Others					
Fuel	79.4	liter	6.5	516.1	0.105 x 108 x 7
Others	20	%		103.2	
Sub-total				619.3	
3. Depreciation Cost	7	hr	547.5	3,832.5	
Total				4,831.8	

Op No. 2	OPERATION COST OF 15 ton Bulldozer			5,781.7 B/day per day	Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Workers					
Operator	1.0	md	280	280	
Assistant	0.5	md	200	100	
Sub-total				380	
2. Fuel and Others					
Fuel	102.9	liter	6.5	668.9	0.105 x 140 x 7
Others	20	%		133.8	
Sub-total				802.7	
3. Depreciation Cost	7	hr	657	4,599	
Total				5,781.7	

Op No. 3	OPERATION COST OF Back-hoe (0.35 m^3)			3,769.9 B/day per day		Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks	
1. Workers						
Operator	1.0	md	280	280		
Assistant	0.5	md	200	100		
Sub-total				380		
2. Fuel and Others						
Fuel	63.6	liter	6.5	413.4	0.115 x 79 x 7	
Others	20	%		82.7		
Sub-total				496.1		
3. Depreciation Cost	7	hr	413.4	2,893.8		
Total				3,769.9		

Op No. 4	OPERATION COST OF Back Hoe (0.75 m^3)			6,787.2 ฿/day per day	Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Workers					
Operator	1.0	md	280	280	
Assistant	0.5	md	200	100	
Sub-total				380	
2. Fuel and Others					
Fuel	95.8	liter	6.5	622.7	0.115 x 119 x 7
Others	20	%		124.5	
Sub-total				747.2	
3. Depreciation Cost	7	hr	810	5,670	
Total				6,787.2	

Op No. 5	OPERATION COST OF Tractor Shovel (1.2 m^3)			4,385.9 B/day		Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks	
1. Workers						
Operator	1.0	md	280	280		
Assistant	0.5	md	200	100		
Sub-total				380		
2. Fuel and Others						
Fuel	74.9	liter	6.5	486.9	0.115 x 93 x 7	
Others	20	%		97.4		
Sub-total				584.3		
3. Depreciation Cost	7	hr	488.8	3,421.6		
Total				4,385.9		

Op No. 6	OPERATION COST OF Tier Roller (8 - 20 t)			3,805.6 B/day		Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks	
1. Workers						
Operator	1.0	md	280	280		
Assistant	-	-	-	-		
2. Fuel and Others						
Fuel	34.9	liter	6.5	226.9	0.056 x 89 x 7	
Others	20	%		22.7		
Sub-total				249.6		
3. Depreciation Cost	7	hr	468	3,276		
Total				3,805.6		

Op No. 7	OPERATION COST OF Dump Truck (8 ton)			3,288.9 ฿/day per day	Explanation
Item	Quantity	Unit	Unit Cost	Cost	Remarks
1. Workers					
Driver	1.0	md	220	220	
Assistant	-	-	-	-	
2. Fuel and Others					
Fuel	58.8	liter	6.5	382.2	0.035 x 240 x 7
Others	20	%		76.4	
Sub-total				458.6	
3. Depreciation Cost	7	hr	372.9	2,610.3	
Total				3,288.9	

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