REPORT ON THE DESIGN FOR IMPLEMENTATION OF IRRIGATION FACILITIES AND LAND CONSOLIDATION AT KASETSART UNIVERSITY

January 1981

Japan International Cooperation Agency

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PREFACE

In response to a request of the Government of the Kingdom of Thailand concerning the Development Project of Kasetsart University, the Government of Japan has been extending grant aid cooperation since 1978. While the Central Laboratory and Greenhouse Complex were already constructed under the Project, Agricultural Machinery and Equipment Center and National Agricultural Extension and Training Service Center are expected to be completed in June of this year.

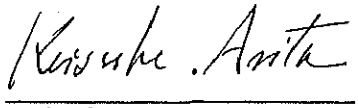
Along with progress of the Project, the Government of Thailand made a further request for technical cooperation in the field of vegetable seeds production and fermentation at the University. The Government of Japan has decided to comply with the request and signed the Record of Discussions to extend the cooperation through Japan International Cooperation Agency (JICA).

Thus JICA sent a survey team headed by Mr. Kazuo Kawakami of Ministry of Agriculture, Forestry and Fisheries from October 30 to November 11, 1980 to formulate detailed designs of the experimental farm field, and to carry out a preparatory study for designing the two testing fields for agricultural machineries as well as for agricultural extension training.

This report embodies the results of the field survey and discussions with the officials concerned of Kasetsart University.

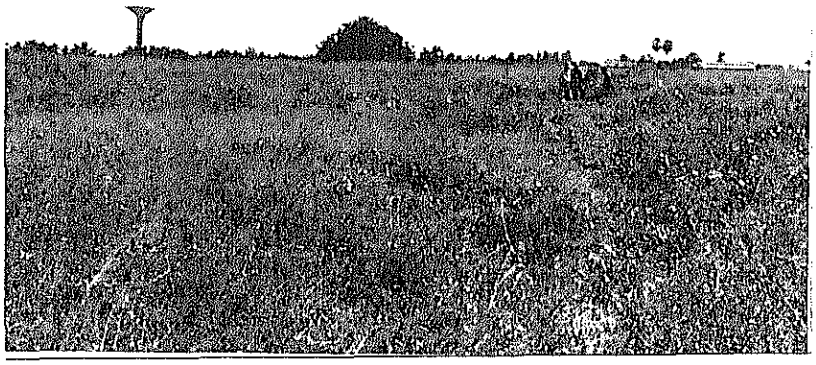
I sincerely hope that this report will prove to be useful to promote the various activities of agricultural research and education.

I wish to express my deep appreciation to the officials concerned of the Government of the Kingdom of Thailand and of Kasetsart University tended to the survey team.

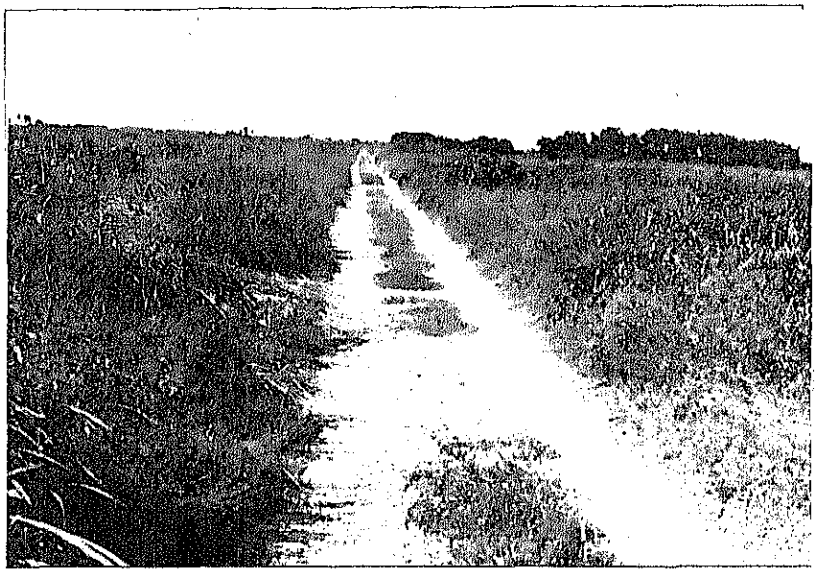


January 1981

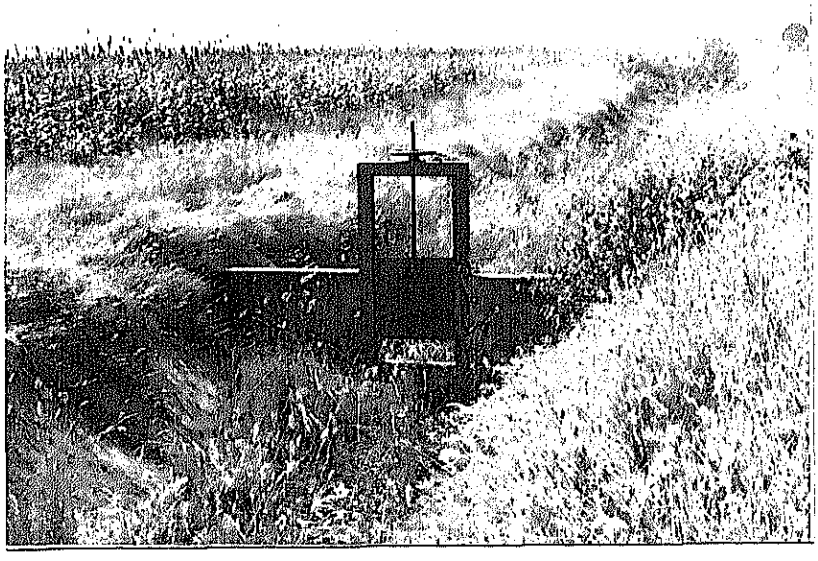
Keisuke Arita
President
Japan International
Cooperation Agency



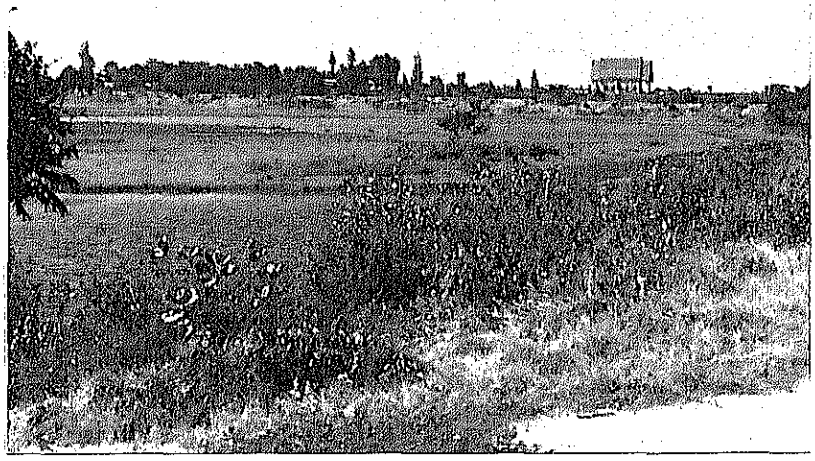
Site of vegetable testing field



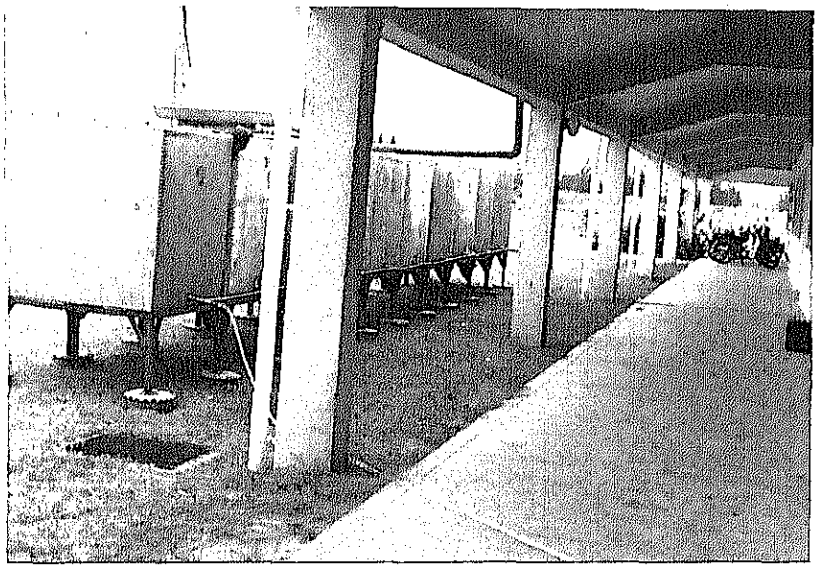
Site of vegetable testing field



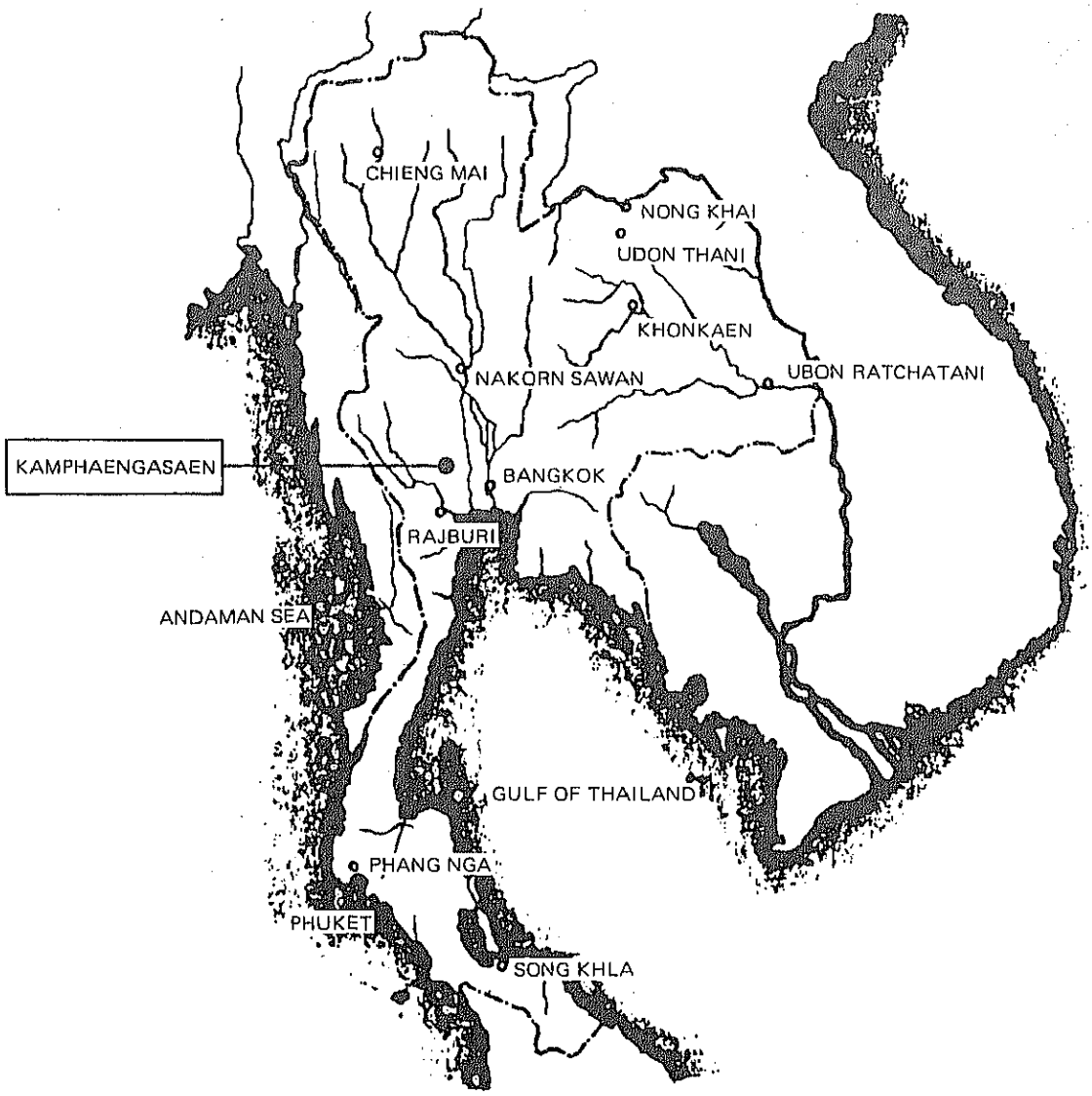
Canal around the testing field



Reservoir situated to northwest of campus



Rainwater tank near the Central Laboratory



MAP OF THAILAND

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CHAPTER I. DESPATCH OF IMPLEMENTATION DESIGN TEAM

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I-1 Details of and Purpose for Despatch of the Survey Team

Kasetsart University is one of the four major universities of the Kingdom of Thailand, and since its separation from the Ministry of Agriculture, has developed into a university with a Faculty of Agriculture whose facilities and contents are the best in the country.

Being requested by Thailand, Japan guaranteed in fiscal 1978 a total of ¥1,300 million in financial aid to the Kamphaengsaen Campus of the university and constructed the Central Laboratory and the Green-house Complex. In addition, in fiscal 1979, with a total grant of ¥2,300 million, the Agricultural Machinery Center and the Agricultural Extension and Training Center are currently being constructed. (To be completed in June 1981)

Meanwhile, in April 1980, a 5-man consultation and implementation team headed by Mr. Keizaburo Kawaguchi was despatched to begin technological cooperation at the Central Laboratory. (The Japanese technical corporation for the research and development project in Kasetsart University. Record of discussion concluded on April 10, 1980. Cooperation period to be for five years.) The areas of cooperation for this project cover two fields of study; the production of vegetable seeds suitable to Thailand, and fermentation and energy production.

This team was despatched to make designs for implementation of a testing field capable of year-round cultivation, a testing field for the Agricultural Machinery Center and the Agricultural Extension and Training Center, etc., because of a strong request for establishing testing fields with irrigation facilities in order to foster the said Project, and also because of the report from the Implementation and Consultation Team stating that such fields are urgently needed for the study cooperation in effective production of vegetable seeds.

I-2 Composition of Survey Team

Team Leader:	Mr. Kazuo Kawakami Deputy Director Irrigation and Drainage Division Agricultural Structure Improvement Bureau Ministry of Agriculture, Forestry and Fisheries
Irrigation:	Mr. Asao Yamada Taiheiyo Consultants Co., Ltd.
	Mr. Nobuyoki Suzuki Taiheiyo Consultants Co., Ltd.
Planning & Coordination:	Mr. Shiro Nabeya Livestock Development Division Agricultural Development Cooperation Department, JICA

1-3 Thai Authorities Concerned

We met following authorities and obtained their cooperation:

Department of Technical and Economic Cooperation (DTEC)

Mr. Kasem Unahasuvan	Deputy Director-General

Kasetsart University

Prof. Dr. Phaitoon Ingkasuwan	Rector
Prof. Dr. Krisna Chutima	Vice-Rector for Academic Affairs
Asst. Prof. Dr. Chongrak Prichananda	Vice-Rector for Business Affairs
Assoc. Prof. Porn Suwanvajok-kasikij	Director of Extension and Training Office
Assoc. Prof. Dr. Khumpol Adulavidhaya	Director of Research and Development Institute
Assoc. Prof. Dr. Sam-arng Srinilta	KU-Japan Project Coordinator
Asst. Prof. Poom Khumgliang	Deputy Director of Extension and Training Office
Asst. Prof. Dr. Thira Sutabutra	Deputy Director of Research and Development Institute
Mr. Banchaw Phaholyothin	Head of Department of Agricultural Engineering
Dr. Jaroon Kumnaunta	Leader of Fermentation for Energy Resources Project

Asst. Prof. Dr. Anothai Choomsai	Leader of Seed Production Project Member, Seed Production Project
Dr. Neungpanich Sinchaisri	Liaison Officer
Mrs. Saikasem Trivisavavet	Liaison Officer
Mr. Wattana Swanyatipat	Extension and Training Center
Asst. Prof. Dr. M.L.A. Choomsai	Deputy of Horticulture, Kasetsart Uni.
Mr. Kriuk Naritoom	Head of Maintenance, Central Laboratory
Asst. Prof. Dr. Pote Boonruang	Deputy Vice Rector for Kamphaeng-saen Campus
Mr. Vicha Sukgij	Reistrar
Miss Treetip Ratanapaisarn	Liaison Officer

I-4 Survey Period and Itinerary

The survey period was from October 30, 1980 to November 11, but two members, Mr. Yamada and Mr. Suzuki, continued to carry out the survey/design at Kamphaengsaen until December 18. The itinerary was as follows:

Day	Date	Program
1st	Oct. 30	Left Narita, arrived Bangkok.
2nd	" 31	Visited Japanese Embassy and JICA office. Courtesy call to DTEC.
3rd	Nov. 1	Discussion among members.
4th	" 2	Holiday
5th	" 3	Visited Kasetsart University (Bankhen Campus). Inspection tour of Kamphaengsaen Campus. Testing field surveyed.
6th	Nov. 4	Kamphaengsaen Campus testing field surveyed. Discussion (Kamphaengsaen)
7th	" 5	Contents of implementation design discussed (Bankhen).
8th	" 6	Discussion among members. Study tour of Thailand Irrigation Project
9th	" 7	Contents of implementation design discussed (Bankhen).

Day	Date	Program
10th	Nov. 8	Discussion among members. Data arranged.
11th	" 9	
12th	" 10	Reported to Embassy and JICA office.
13th	" 11	Leader Kawakami and Mr. Nabeya, member, left Bangkok and arrived Tokyo.

Two members, Messrs. Yamada and Suzuki continued field surveys and returned to Japan on November 18.

CHAPTER II. OUTLINE OF DISCUSSION

II-1 Progress of Discussion

II-2 Contents of Discussion

CHAPTER II. OUTLINE OF DISCUSSION

II-1 Progress of Discussion

This team visited the University on November 3 and notified them of the purpose and program for this survey. The English version of the purpose and program is the "Scope of Work" as per Attached material - ①.

During the survey period, this team received much cooperation from the University and their desire to carry out this cooperative study project was keenly felt.

In addition to the all-member conferences held twice, we had other conferences. Through these conferences, the University made requests regarding the survey contents. On the requested matters, we replied as shown under II-3.

The program for this survey was submitted on November 7 to the University in the form of a memorandum (see attached material - ②.), because the outcome of the budget for the FY 1981 model infrastructure program was not clear. Its outline is as stated below.

Meanwhile, with respect to the testing water of the Central Laboratory, the installation of new filtering facilities had been in mind from the beginning. It was, however, decided through discussion that it would be very costly to install new filtering facilities for removing salts. Therefore, it was decided this time to simultaneously study the use of a rainwater tank (see photo) suggested by the University and the use of two distillers (currently not used) made by Yamato Company (WA-715) which had been provided through financial assistance from Japan.

II-2 Contents of Discussion

1) On location and irrigation facilities of the vegetable testing field. (See attached chart)

i. Area of the testing field

It shall cover approx. 10 rai (approx. 1.6 ha).

ii. Location of the testing field

It shall be located to the west of the Agricultural Machinery Center currently under construction.

iii. Method of irrigation

First of all, installation of drip irrigation over the testing field of 1.6 ha is to be studied. Then, if likely to

be feasible on the model infrastructure budget, partial installation of sprinklers to be studied.

iv. Water source

As the result of survey and study, use of ground water shall be the primary concern, and the drilling of a well shall be studied. Its depth shall be 100 - 150m, and the drilling site shall be in the testing field west of the campus. Water to be brought from the well to the field by installing a piping or by utilizing an exsisting canal. (see photo.) Problems of water source and conveyance were decided to be re-studied after the survey.

v. Irrigation area

The irrigation area shall cover 6 blocks, each covering approx. 30a.

2) On the testing field for the Central Laboratory, the Agricultural Machinery Center and the Agricultural Extension and Training Center.

i. On the area of the testing field: 15 ha

At the beginning, 5 ha had been in mind for the testing field to be used by the Agricultural Machinery Center and the Agricultural Extension and Training Center. However, the University expressed their desire to have the testing field serving the three centers studied, since the sharing and use of the field had been still uncertain and the extension of the Vegetable Seed Testing Field had also been planned. Therefore, we decided on an area of 15 ha.

ii. Location

The location shall be to the west of the Machinery Center under construction.

Further, we explained that Japan's cooperation in the improvement work of this field was unclear at that moment. And this explanation was acknowledged.

CHAPTER III. FUTURE PLAN

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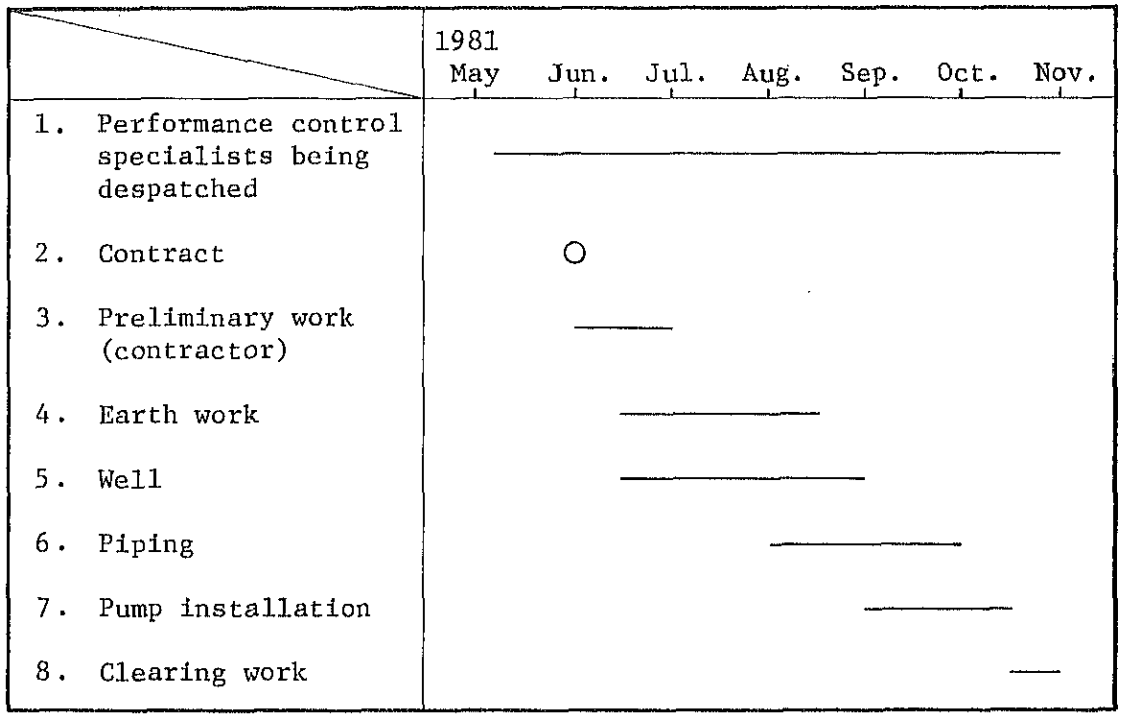
One dry season has already elapsed since the study cooperation was started. Therefore, in order to make cooperation effective, it is necessary to complete the work without fail in October 1981 before the next dry season. The following work schedule is thus desirable under the Thai-Japan cooperation:

- o Work period: 5 months
- o Preparation for contract and design changing: 1 month
- o Total period needed: 6 months

Work Schedule



CHAPTER IV. DESIGN PLAN

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IV-1 Outline of Work

1) Main types of work and quantities to be carried out under the present project are listed below:

a.	Under drain pipe	2,585 m
b.	Road	1,254 m
c.	Drainage canal	1,572 m
d.	Culvert (concrete pipe)	13 each
e.	Well	1 "
f.	Concrete reservoir	1 "
g.	Irrigation pump	1 LS
h.	Irrigation pipe	1 "
i.	Fence	747 m
j.	Sprinkler	2 set

2) Prerequisites

Through discussions in Japan and with the University authorities, the following matters are confirmed: (They are listed up here as the basic conditions for design)

(1) The test field shall be 70m^2 per section. 1 block shall be consisted of 32 sections. 6 blocks shall be arranged.

(2) Necessary water shall be obtained by newly installing a well.

(3) The salt density of the water is expected to be as high as 600 ppm, but this shall be coped with by fully equipping the drip irrigation and leaching facilities.

(4) The power line shall be installed by the University to the drilling site of the well.

(5) Cultivation of the testing field shall be made by the University after completion of the whole work.

(6) Field for three centers shall be the remaining portion of the same block as the seed producing field, and shall be designed to include the section demarcation, roads, drainage canals, etc. The estimated cost of work shall also be computed.

IV-2 Work Schedule

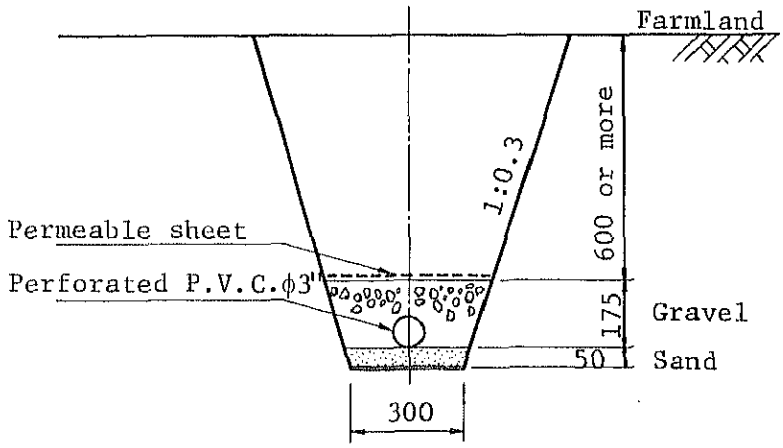
Types of Work	1st month	2nd month	3rd month	4th month	5th month	6th month
Preparation for contract						
Culvert drainage work						
Road work						
Drainage work						
Road crossing work						
Well drilling						
Water tank work						
Water sending pump						
Piping for irrigation						
Fence work						
Sprinkler						
Clearance						

IV-3 Design Plan

Next, design plans by type of work are stated below.

1) Culvert drainage work

60 cm or more earth covering shall be secured according to the section plan of the work.



Culvert shall be buried in at 10m intervals, and the slope shall be 2%.

2) Road work

7m of the land be secured for road. The road shape shall be remodelled in a section plan as shown on Chart No. 19, and the road shall be paved with gravel called ratelite. The depth of pavement shall be 15 cm and the width 3m. As for the access road, light asphalt pavement as thick as 2.5 cm shall be applied on the ratelite pavement.

3) Drainage work

There is a canal with concrete lining on the west side of a lot designated as the testing field, and an unarmored drainage canal is under construction on the south side. The slope of the land descends from north to south. Therefore, an unarmored irrigation canal of the same type as the existing irrigation canal shall be installed on three sides (unnecessary on the north side) of the testing field to have surface waste water and leaching water flow thereinto and lead them to the existing drainage canal. The total length of the drainage canals shall be 786m.

4) Road crossing work

As shown on Charts No. 8, 9 and 10, the road crossing work shall be installed for the purpose of draining the wastewater from the testing field to the drainage canal across the peripheral roads. The quantity of drain is small, but concrete pipes of ϕ300 shall be used. And the catch basin shall be a vertically buried concrete pipe of ϕ500.

5) Well drilling

The pumping test is being carried on at two sites in the compound. Their test results are as follows:

Chart 1 Location Chart

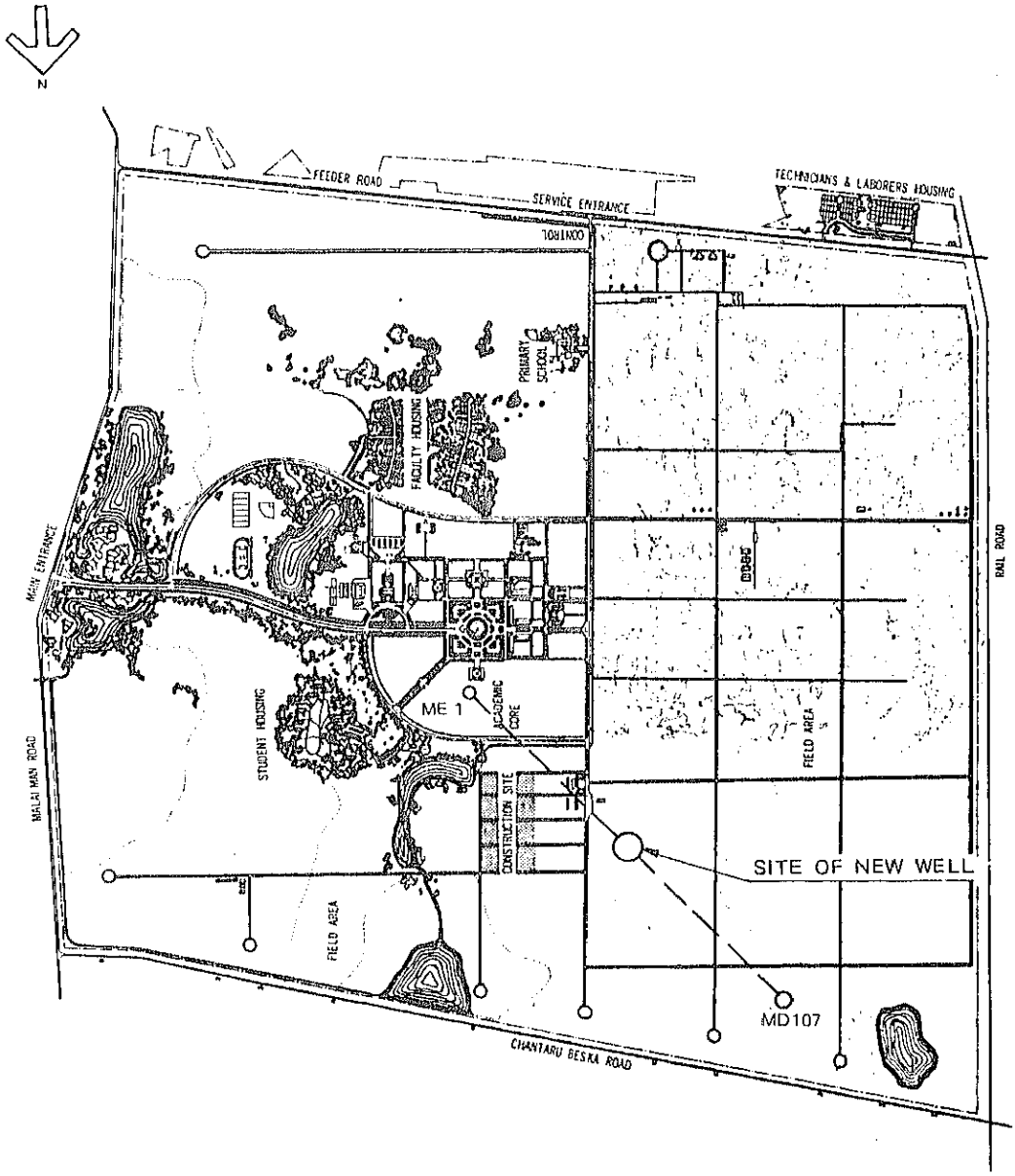


Chart 2 Results of Pumping Tests

By Ground Water Division

No.	Depth of drilling (m)	Diameter and length of casing (m)	Location of sleeve pipe (m)	Groundwater level (m)	Yield of water pumped up through test (m^3/min.)	Lowered amount of water level (m)	Proper potential yield of water to be pumped up (m^3/min.)
MD 107	129	0.2 92	55.5 - 58.5 66.0 - 69.0 87.0 - 90.0	7.1	0.553	35.1	0.379
ME 1	180	0.2 92	33.0 - 36.0 69.0 - 75.0 84.0 - 90.0	4.4	0.962	15.1	1.514

MD 107

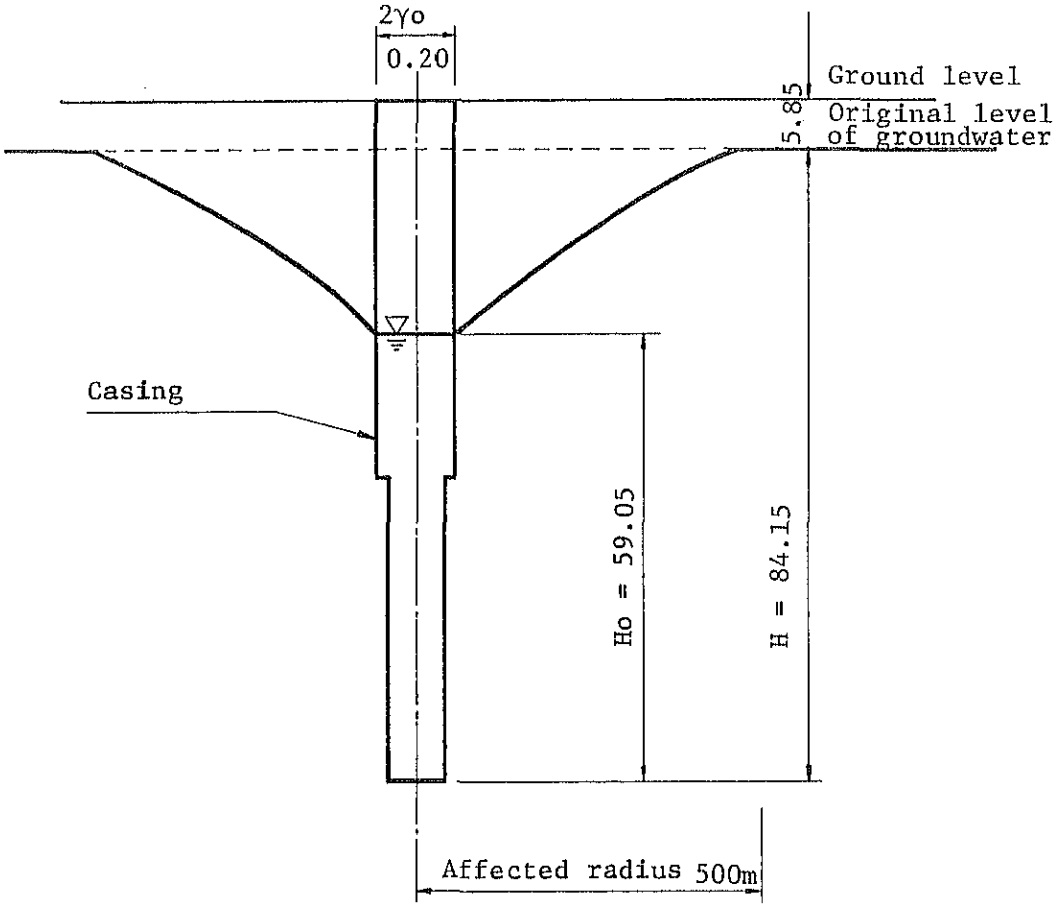
Depth	430 feet
	185 - 195 feet
Perforation	200 - 230 feet
	290 - 300 feet
S.W.L.	23.61 feet
Yield	146 gpm
Drawdown	115.24 feet
Clay	0 - 5 feet
Sand	5 - 15 feet
Clay	15 - 105 feet
Clay	105 - 175 feet
Gravel	175 - 195 feet
Gravel & Clay	195 - 220 feet
Gravel	220 - 240 feet
Clay & Sand	240 - 255 feet
Clay & Sand	255 - 295 feet
Pebble	295 - 310 feet
Sand & Clay	310 - 360 feet
Clay & Sand	360 - 390 feet
Sand & Clay	390 - 425 feet
Sand	425 - 430 feet

ME 1

Depth	600 feet
	110 - 120 feet
Perforation	230 - 250 feet
	280 - 300 feet
S.W.L.	14.70 feet
Yield	254.19 gpm
Drawdown	49.38 feet
Clay	0 - 25 feet
Sand	25 - 60 feet
Clay	60 - 85 feet
Sand	85 - 245 feet
Clay	245 - 290 feet
Sand	290 - 320 feet
Clay	320 - 480 feet
Gravel	480 - 600 feet

As clearly seen on Chart 1, this testing field is located at about the midpoint on the straight line connecting the two drilling sites. Therefore, our design shall be based upon the averaged data ob both sites.

Considering that the necessary yield is $0.4m^3/min.$, a well as shown below shall be made.



6) Water tank work

(1) In order to make sprinkling possible when the power is out, the capacity of the tank shall accommodate two days' need ($162m^3$) in consideration of the University's request. The dimensions of the tank were settled at 10m(W) × 10m(L) × 1.62m(D).

Thickness of material and reinforcing steel:

Since the maximum bending moment of the side wall is 0.972 t·m, the wall thickness shall be 20 cm and the steel bar shall be of ϕ12 @250.

Since the maximum bending moment of the slab upper surface is 2.276 t·m, the slab thickness shall be 30 cm and the steel bar shall be of ϕ12 @125.

(2) Capacity of reservoir

The capacity of reservoir shall accommodate two days' sprinkling.

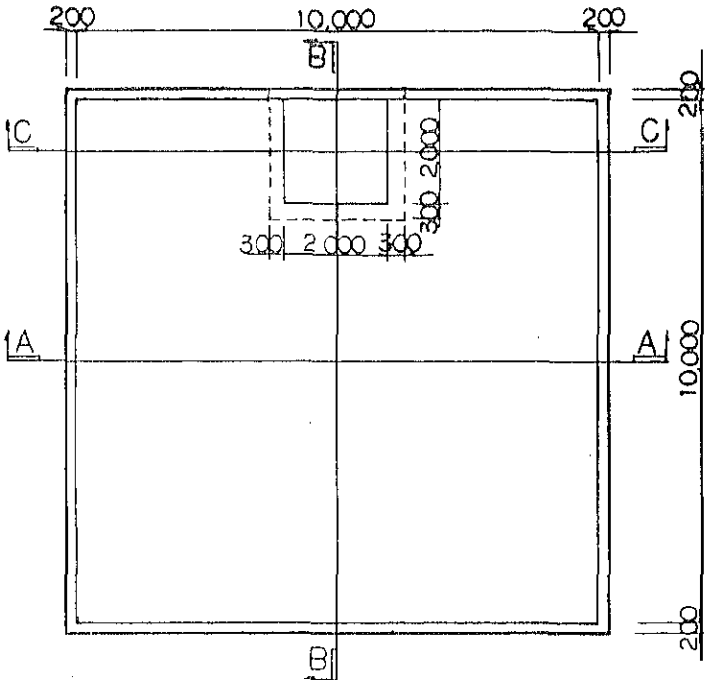
5mm/day × 13,440m^3 × 2 days = 134.4 m^3

if 20% allowance is included:

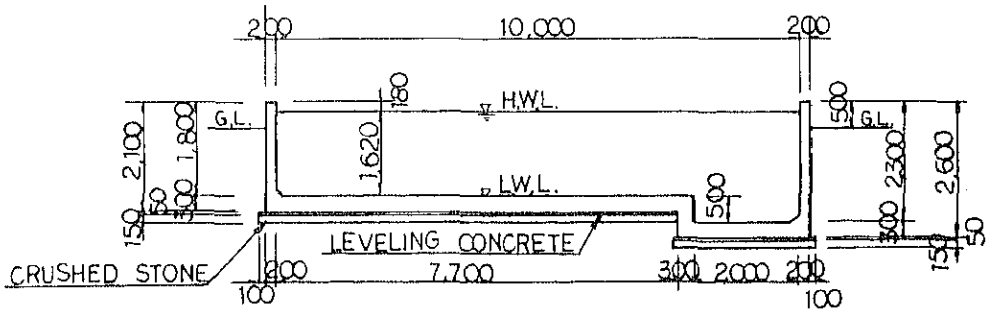
134.4 × 1.2 = 161.28m^3

Therefore, the capacity shall be 162.0m^3, and the shape and dimensions shall be as follows:

PLAN OF RESERVOIR



SECTION B-B



7) Water sending pump

In order to make water sending possible even when the power is off, a generator shall be supplied. Its output shall correspond to the pump capacity. A pump house shall be built to protect this equipment. Its size shall be 2.80m(W) × 2.80m(L) × 1.80m(H).

Pumping height	H = 27.07m
Yield	Q = 430 ℓ/min.

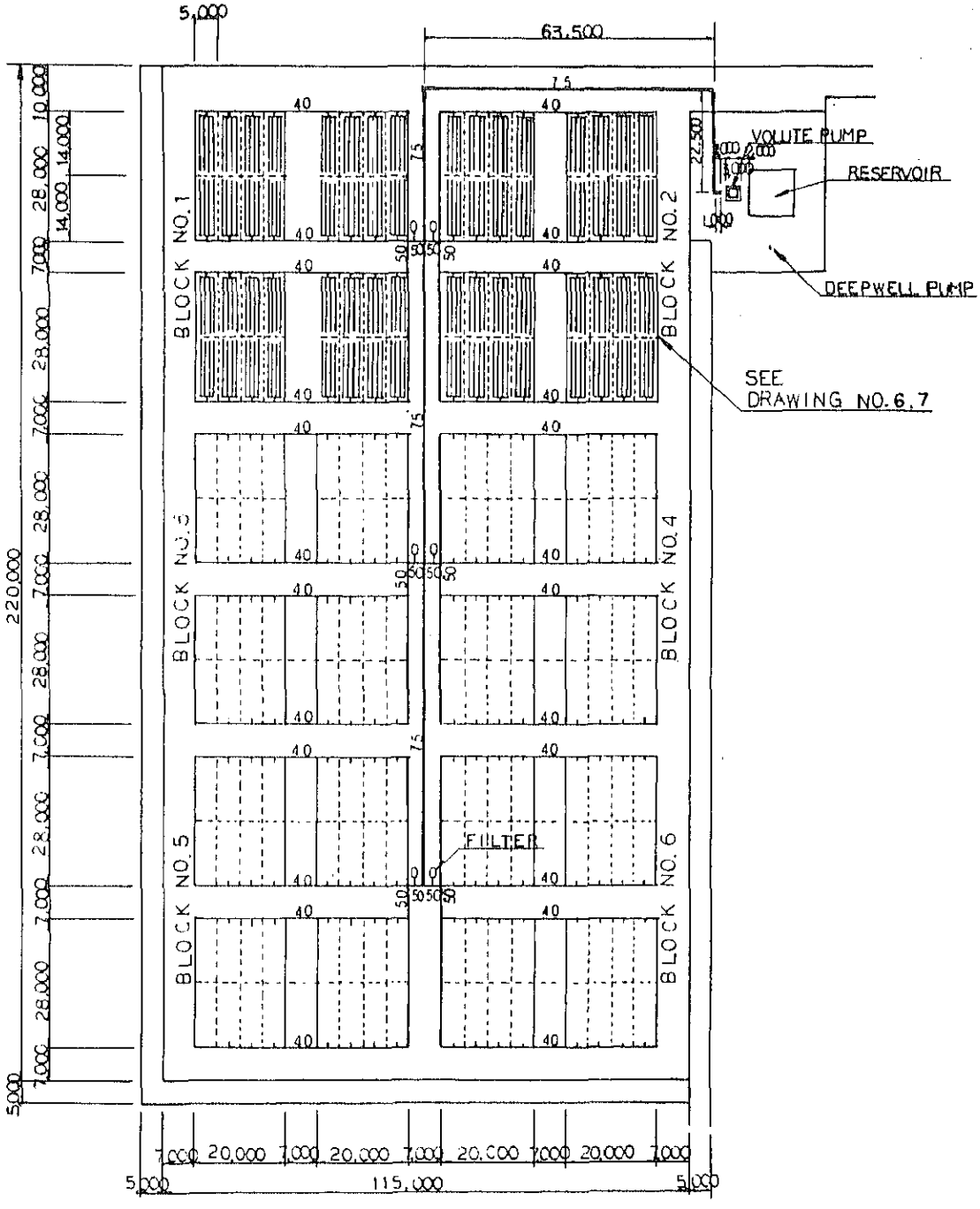
For details, see "Calculations for water pump and irrigation piping" below.

8) Irrigation piping

(1) Drip irrigation

Irrigation shall be made by piping drip hoses. The piping shall be done as shown on the following chart:

LAY-OUT OF IRRIGATION PIPE



(2) Calculation for water pump and irrigation piping

a. Layout of well and water tank

PLAN OF PUMP STATION

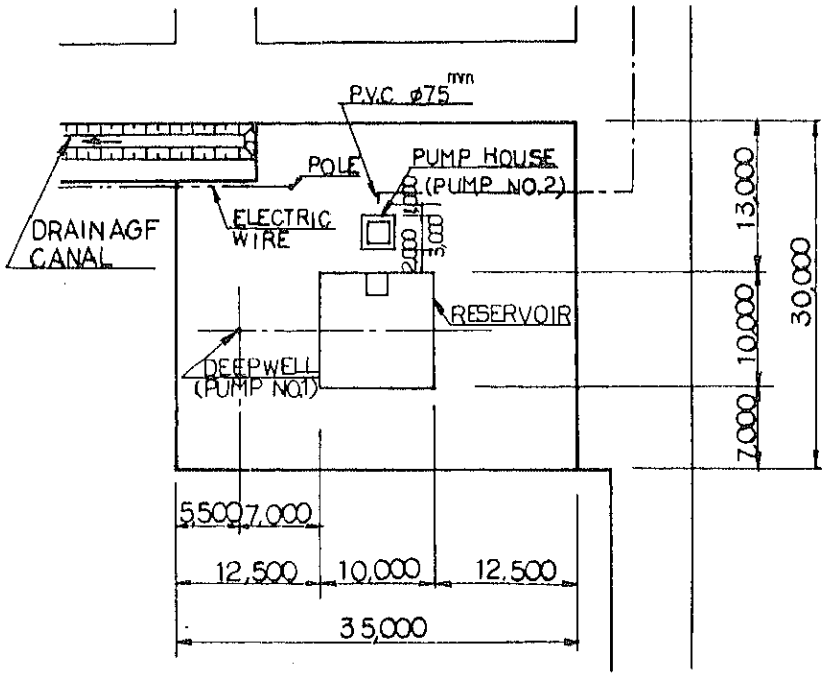


TABLE OF PUMP SPECIFICATION

PUMP NO.	TYPE	TOTAL HEAD	CAPACITY
PUMP NO.1	DEEPWELL PUMP	60.0 m	0.40 m³/min
PUMP NO.2	VOLUTE PUMP	27.07 m	0.43 m³/min

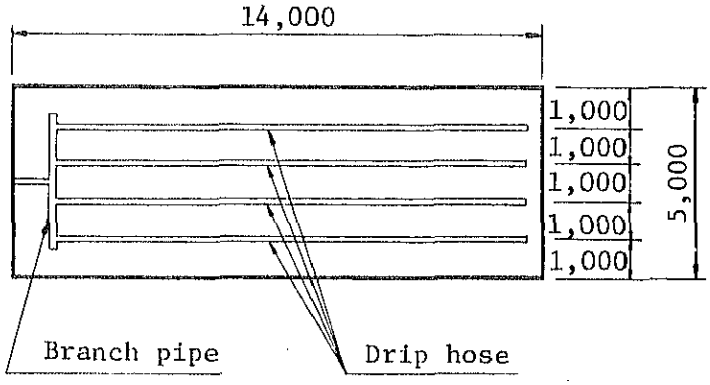
b. Testing field

Size

1 testing section	$5 \times 14 = 70m^2$
1 block (32 testing sections)	$70m^2 \times 32 = 2,240m^2$
Testing field (6 blocks)	$2,240m^2 \times 6 = 13,440m^2$

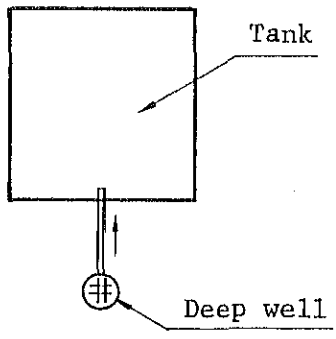
Conditions of pipe installation

4 rows of pipe shall be installed per 5m front.

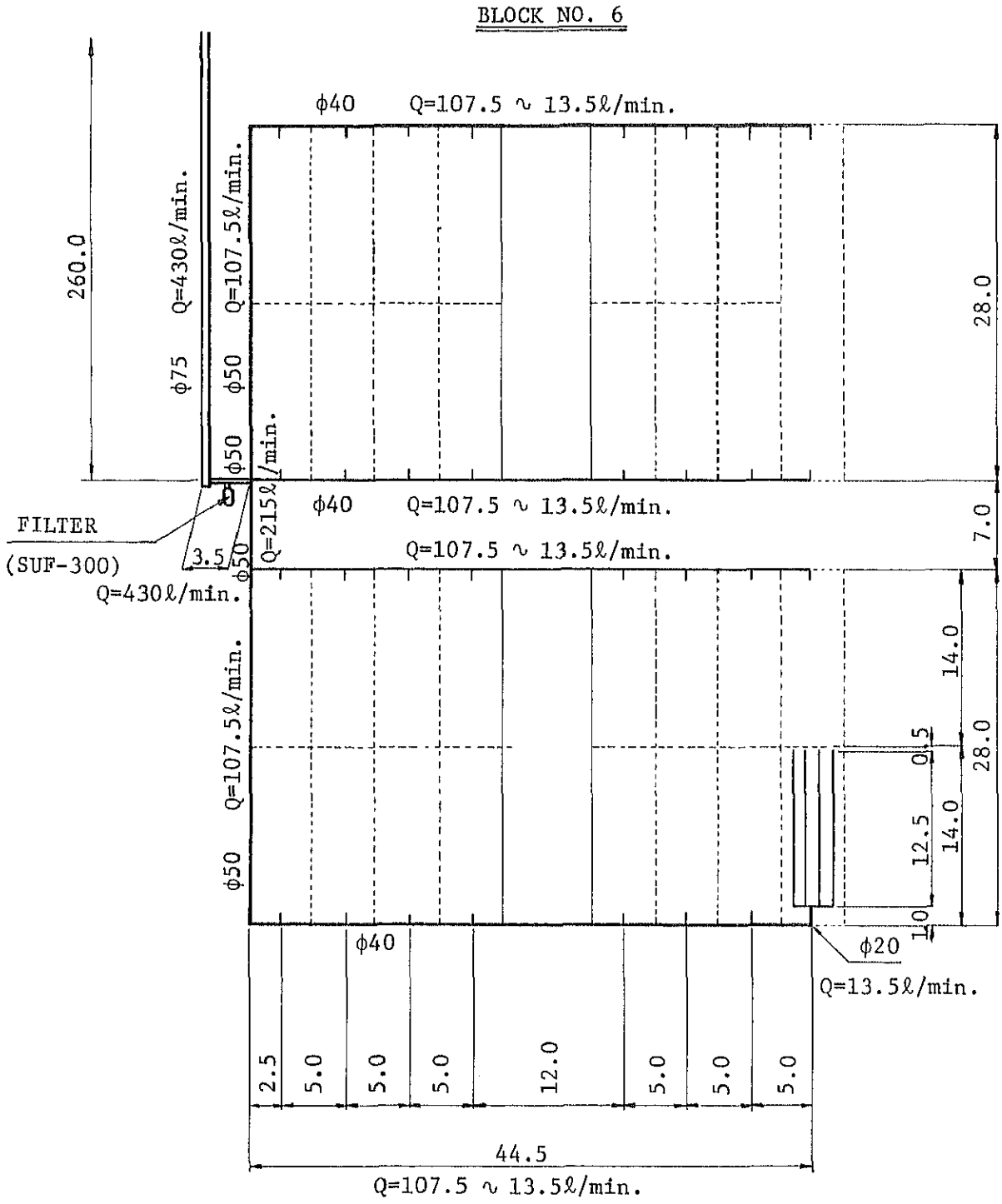


Water source

A deep well shall be drilled, water shall be pumped up therefrom and led into the tank.



c. Piping chart to the furthest block



d. Irrigation conditions

Interval days

Since irrigation shall be made on a 1 block per day basis, there shall be 6 day intervals.

Irrigating yield

The irrigating yield shall be 5mm/day, since it will be necessary to make tests with a variety of irrigating yields because this is a testing field.

Irrigating hose

Specially separated double pipe type hose for drip irrigation shall be used.

Irrigation efficiency

The irrigation efficiency will be 100% because of the drip system.

Irrigating yield

Per block: 5mm/day × 2,240m^2 = 11,200ℓ/day

Since interval is 6 days: 11,200 × 6 days = 67,200ℓ/day

Irrigation intensity (hi)

$$hi = \frac{60.q}{A} \text{ (mm/hr)}$$

q: irrigation amount: 0.2(ℓ/min·m) × 14m × 4 rows = 11.2(ℓ/min.)

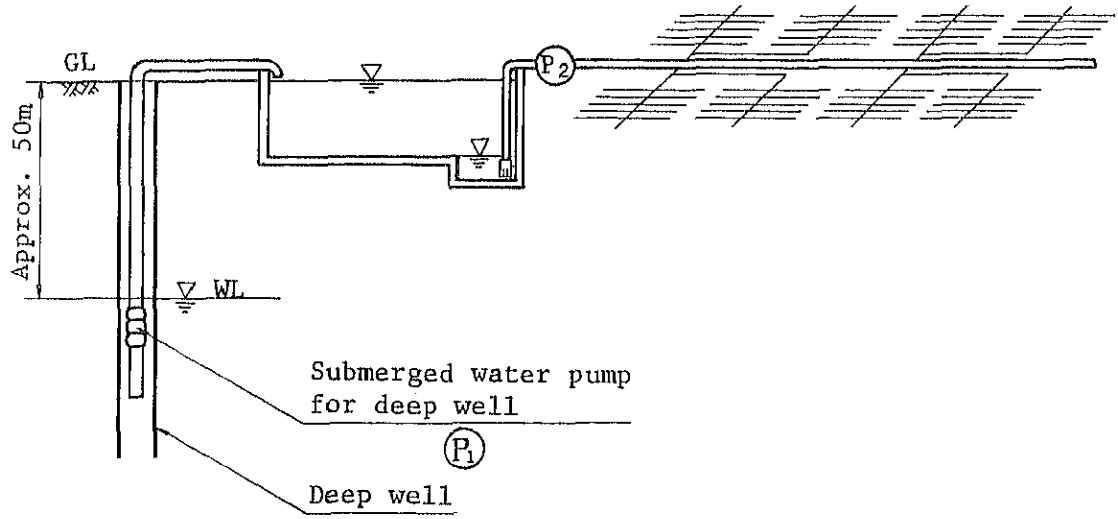
A: irrigation area: 5 × 14 = 70(m^2)

$$\therefore hi = \frac{60 \times 11.2}{70} = 9.6 \text{(mm/hr)}$$

Irrigation time (T)

$$T = \frac{5\text{mm} \times 6 \text{ days}}{9.6} = 3.125 \text{ (hr)}$$

e. Pump data P_2



o Pump yield

Since there is simultaneous irrigation throughout one block,

14m × 4 rows × 32 sections = 1,792m

1,792m × 0.2ℓ/min. m = 358.4ℓ/min
(needed irrigation yield)

Pump yield shall include 20% allowance over the needed irrigation yield:

Q = 358.4 × 1.2 = 430ℓ/min.

(3) Pumping height computation of the water sending pump (P_2)

Waterhead loss of trunk lines

ϕ75 0.034 × (260m + 10m pump installed)	= 9.18m
ϕ50 0.24 (3.5 + 1.6m filter installed)	= 1.22

Waterhead loss of branch lines

ϕ50 0.07 × 7.0	= 0.49
ϕ50 0.02 × 28.0	= 0.56
ϕ40 0.028 × 44.5	= 1.25
ϕ20 0.05 × (1.0 + 0.8)	= 0.09
Sub total	12.79m

Waterhead loss of branch pipes (10% of sub total)	
12.79 × 0.10	= 1.28m
Waterhead loss of filter	4.00m
Waterhead needed of drip hose	5.00m
Net suction height	4.00m
Total	27.07m

9) Fence and gate

The field shall be surrounded by a fence. Poles of ready-made concrete (ℓ=2.10m, above ground 1.4m, under ground 0.7m) shall be erected at 2.0m intervals, and barbed wires shall be fixed in four steps at 40 cm intervals.

The gate shall be provided with two leaves of 1.5m each (total width 3.0m), and be made locally of wood.

10) Sprinkler

The University side requested the installation of sprinklers in the testing field. This time, the Japanese side insisted that irrigation by sprinklers would be unsuitable because the water contains a lot of salt and the water supply was rather short. Finally, however,

for the sake of partial comparison, the provision of two sets of sprinklers shall be included in the budget for this work.

Specifications of the set are as follows:

Submerged pump: 3HP 380V 3 phases 2 sets

Sprinkler: 360° rotation 2.8 kg/cm^2 1 m^3/Hr 8 sets

Wheel base: 8 sets

Nylon hose: ϕ2" 100m

IV-4 Drip Irrigation

1) Introduction

(1) Down through the centuries, conventional furrow irrigation has served mankind well.

In recent decades, in order to bring more and more land under cultivation, sprinkler irrigation has come into increasing use.

In recent years, a more efficient and water-saving irrigation methods have been developed and utilized increasingly. These are the so-called Drip Irrigation Systems. The principal feature of these method is that the water is applied through hoses laid on the ground near the roots of the plants. The water is applied through emitters or orifices in the hose.

The drip hose is an improved version of the drip system. The principal feature is a special dual chamber pipe hose that affords two major advantages: 1) improved uniformity of irrigated water and 2)
sloping fields with gradient as high as 6:100.

(2) Water Permeation

The drip hose irrigates in the form of drops at a controlled rate. The water permeates into the soil by relatively slow capillary action. Thus, compared with conventional furrow and sprinkler irrigation, it saves on water consumption.

Fig. 1 shows water permeation by the three principal types of irrigation. The shaded areas indicate the wetted zones. The smaller wetted zone of drip irrigation indicates substantial saving of water; some 50%.

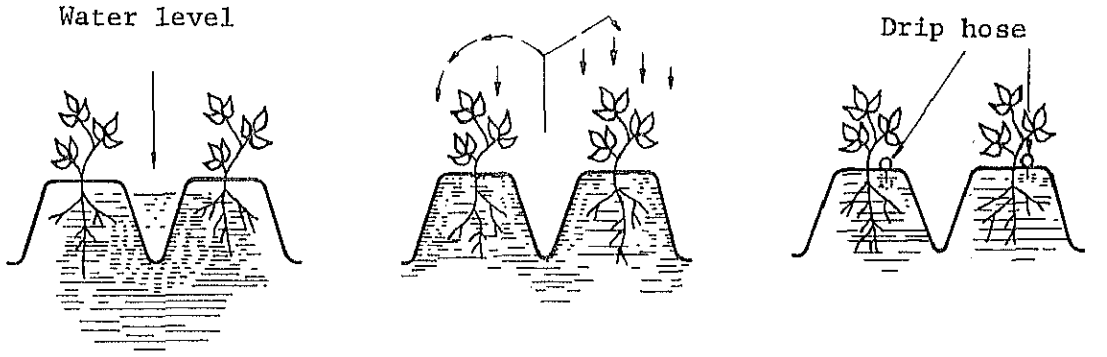


Fig. 1 Permeations of Water in Different Irrigation Systems

Drip irrigation of water having a saline content does not result in conventional saline accumulation in the soil. This is because the "V" shaped wetted area of conventional furrow irrigation presents a relatively large wetted surface area, moting the accumulation of saline. On the other hand, the shape of the wetted area in drip irrigation is more like an inverted "V" pattern. Thus the wetted surface area is relatively small, thereby reducing the amount of saline accumulation.

In addition, in the case of drip irrigation, a small amount of water is continuously and regularily dripped into soil, which keep the root area constantly wet. Thus, salt contained in soil of the wetted zone is dissolved in the water and moves to the boundary of the wet and dry zones through capillary permeation. Therefore, soil contamination in the wetted zone is lowered.

2) Features of the drip hose

(1) Improved uniformity of irrigation

In conventional hose irrigation systems, the pressure of the water in the hose gradually drops over the length of the hose.

The drip hose incorporates a special dual chamber construction that maintains a relatively uniform pressure throughout the full length of the hose. This is also applicable in the case of slopes of gradients as high as 6:100. The drip hose is the only irrigation hose that has this outstanding feature.

(2) Automatic application of liquid fertilizers can be made with use of the injector device.

(3) Generally work such as harvesting, weeding, etc. can be conducted during irrigating. This is normally not possible in the cases of furrow and sprinkler irrigation.

(4) Inhibits plant diseases

The drip hose prevents plants from diseases by overwetting such as rotting and fungus.

(5) Longhose length

The installation of the hose and resulting relatively high uniformity of irrigating water throughout the whole length of hose permit use of hose up to some 150 meters long. Conventional houses are limited to about 20 meters length due to the inherent pressure drop over the whole length of hose.

(6) Easy of installing and recovery of hose

The drip hose is supplied prewound on strong, plastic reels. It can be easily installed by tractor and the like at the time of ploughing and mulching with films. Recovery of the hose involves merely the reverse process of removing the nipples and stoppers and then reeling in the hose.

(7) Strong and durable

The drip hose is especially strong and durable. It is made from block-colored polyethylene which inhibits the degradation and the growth of algae in the hose. The hose is serviceable over the wide temperature range of -5°C to +70°C (23°F to 158°F). Normal operating pressure is 0.5 to 1.0 kg/cm^2 (7.1 to 14.2 psi); maximum operating pressure is up to 6 kg/cm^2 (85.3 psi).

Table 1. The drip hose Specifications

Item	Specifications
Material	Low-density polyethylene (black)
Hose diameter	20 mm
Spacing of distributing orifices	30 mm (special type: 20 cm)
Maximum operating pressure	6 kg/cm^2
Shipping form	200 m/reel (plastic corrugated board reel)

3) Theory of the drip hose

The drip hose is divided by partitions into two water passages; one is a supply passage, the other a distributing passage. The water from the supply passages passes into the distributing passage through supply orifices in the wall separating the two passages. The distributing passage is divided into segments by deformed partitions.

The special dual structure affords uniform irrigation over long distance (up to 150 meters) and on slopes (up to 6:100).

(1) Effective for long distance

For uniform irrigation over the whole length of hose, either water pressure should be high or discharge rate low to keep pressure loss at a low level. But, increased operating pressure tends to discharge water in a spray beyond the target area. For keeping the discharge rate at a low level, it is necessary that the number of orifices or the diameter of orifices is made smaller. But the number of orifices cannot usually be decreased unlimitedly, for the minimum distance of 30 cm is generally required between orifices to ensure effective water coverage. Likewise, the diameter of orifices cannot be made too small as it would bring about the problem of clogging. Approximately 0.5 mm is considered the minimum diameter of orifices.

The dual structure of the hose solves these problems.

The water pressure in the supply passage is reduced by flowing through the supply orifices in the partitions. However, pressure loss of supplied water is kept at a low level because of the limited number of distribution orifices. Thus water pressure in the supply passage can be maintained at relatively uniform pressure over the whole length of hose.

Water pressure is reduced when water flows into the distribution passage through the supply orifices and is further reduced as water is discharged from distribution orifices. This enables water dripping at low pressure.

(2) Effective for use on slopes

When ordinary type drip hose is used on a sloping field, the amount of irrigated water varies at high and low portion and occasionally no water is irrigated at high portion, leaving the upper part with little or no water. This lack of even discharge of water occurs on account of the great difference of water pressure in the hose between the high and low portions. However, it is impossible to increase water pressure to force water to reach a high level because this would affect the adequate dripping rate at the lower parts of the hose.

In the case of dual chamber hose, the supply passage is little affected by inclination or declination of the ground because water is supplied at high pressure through the passages and loss of water pressure is lower than in the case of an ordinary type hose. However, the distribution passage is affected by gradient because water flows at low pressure.

The distribution passage of the hose is divided into segments by deformed partitions at certain intervals and these separate segments enable even and uniform irrigation.

In the case of the separate segments, the influence of the slope is limited to each segment independently, not the whole length of the distribution passage. The point is to ensure low pressure at the bottom of each segment, which will enable water to reach the top of each segment. In order to achieve this, a solution exists in limiting water pressure loss at the top of a segment by decreasing the number of distribution orifices. However, specific spacing between holes must be maintained. The other solution is to shorten the length of the segments, and thus decrease the number of orifices for each segment. Thus, difference between water pressures at the bottom and top of each segment can be maintained at a low level.

Thus, the dual chamber hose solves the problems of slopes. The hose of a special design can supply water on slopes of gradients as high as 6:100.

Table 2. Maximum/Minimum Discharge Ratio on Slopes

Hose		Qmax/Qmin		
Segment	Number of distribution orifices	Horizontal (= 0)	= 2:100	= 6:100
None	168	1.0	No discharge at upper part	
7.2 m	24	1.0	1.2	2.5
2.4 m	8	1.0	1.1	1.2

The hose 50 m, feed water pressure 0.5 kg/cm^2, interval between discharge orifices 30 cm.

ATTACHED MATERIAL-1

The Detailed Designing Team for Irrigation Facilities and Land Consolidation at Kasetsart University

Scope of Work

The project for the transfer of technology concerning fermentation and vegetable seed production as well as for the training of research workers at Kasetsart University started on April 10, 1980 with the signing of the Record of Discussions between Kasetsart University and Japan International Cooperation Agency.

The project is now being implemented by Kasetsart University's staff with the technical cooperation of a Japanese expert at Kamphaengsaen Campus of Kasetsart University, on the basis of its Master Plan and Implementation Plan set up by both sides.

The Agricultural Extension and Agricultural Machinery Project will start in 1981 at the two centers now under construction.

In order to design irrigation facilities and land consolidation for the above two projects and to have discussions with Thai officials concerned, JICA despatched to Thailand from October 30 to November 11,1980 a Detailed Designing Team headed by Mr. Kazuo Kawakami.

The purposes of the Team are:

1. To design irrigation facilities on pilot farm for the production of vegetable seeds;

2. To survey and design land for the Agricultural Extension and Agricultural Machinery Project which will start in 1981;

3. To discuss the facilities to produce water for the experimentation at Central Laboratory

November, 1980

Detailed Designing Team

Japan International Cooperation Agency

ATTACHED MATERIAL-2

Memorandum of the Meeting

between

Kasetsart University Officials

and

The Japanese Survey Team for Planning of Experimental Fields

1980, 11. 7
at Kasetsart University,
Bangkhen Campus

1. Location and Type to be implemented for the experimental field of vegetable seed production project.

   1) Acreage : about 10 rai

   2) Location : west side of Agricultural Machinery Center (now under construction)

   3) Type of Irrigation:

      i) Drip irrigation or ii) drip irrigation and sprinkler irrigation

   4) Source of water:

      1) Well (to be constucted newly)

         Depth : 100-150m (west of the Campus)

      2) Delivery of water:

         Length : 2-2.5 km

         Piping or open canal

         We should survey the above points.

   5) Acreage to be irrigated

      30 a ⁄ 6 = 180 a

2. Place for testing land of three centers

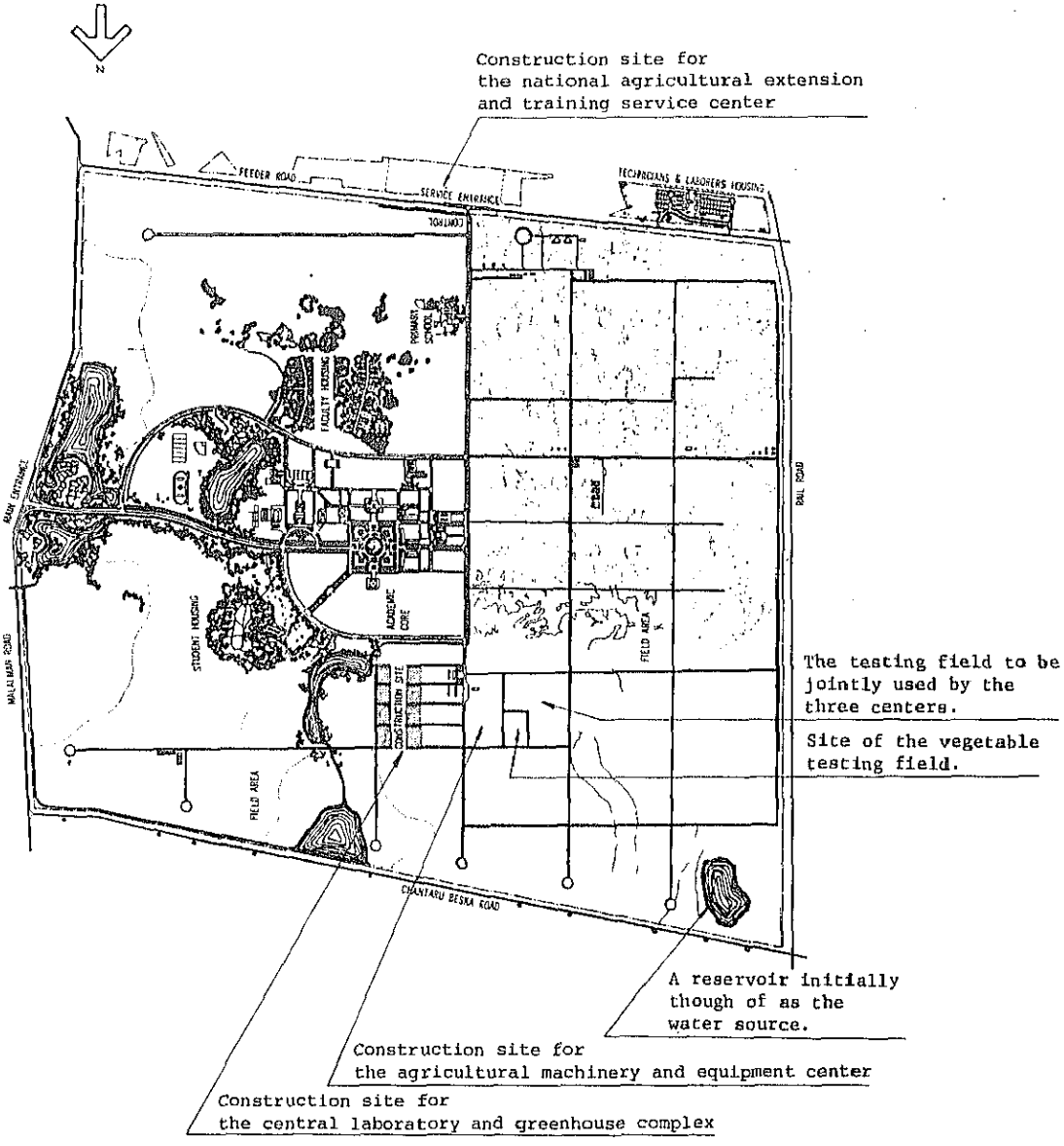
   1) Acreage : 15 ha

   2) Location : west side of Agricultural Machinery Center (now under construction)

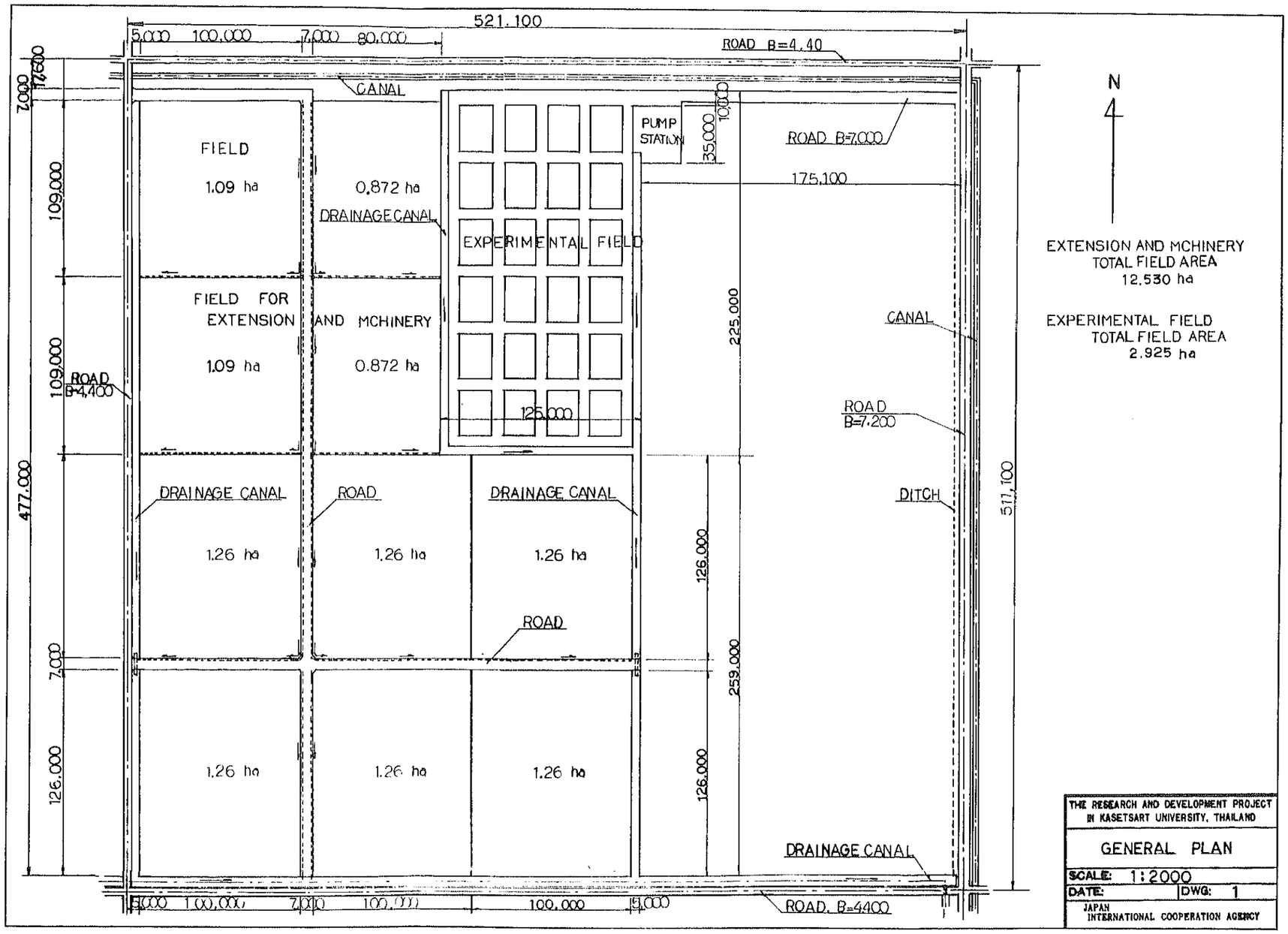
      We will survey, design and estimate the construction cost of the above points.

ATTACHED CHART

KASETSART UNIVERSITY
KAMPHAENGSAEN CAMPUS
LOCATION OF EXPERIMENTAL FIELD



ATTACHED DRAWING-1



ATTACHED DRAWING-2