BEIJING VEGETABLE RESEARCH CENTRE PROJECT
IN
THE PEOPLE'S REPUBLIC OF CHINA

DETAILED DESIGN REPORT
ON
MODEL INFRASTRUCTURE IMPROVEMENT WORKS

JUNE 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

BEIJING VEGETABLE RESEARCH CENTRE PROJECT

IN

THE PEOPLE'S REPUBLIC OF CHINA

DETAILED DESIGN REPORT

ON

MODEL INFRASTRUCTURE IMPROVEMENT WORKS

JUNE 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

This project has started since January 1, 1988 in accordance with the Record of Discussions signed on September 29, 1987. The aim of the Project is to contribute a stable vegetable supply through a year of being pushed as the important matter of the Beijing Municipality, by means of strengthening the function of the Beijing Vegetable Research Centre. Thus, for establishing and developing technology, concerned with a stable supply, varieties and improvement of quality of vegetables.

Among the necessary facilities for the Project activity, the equipment and materials for the studies will be improved by the Grand Aid Cooperation. Mr. Osamu Seino, a technical cooperation officer and the team leader in charge for this project, is highly connected with the International Cooperation Division, Economic Bureau, Ministry of Agriculture Forestry and Fisheries. The Study Team had been dispatched and carried out the detailed design of the needed irrigation facilities from March 30 until May 3, 1988 because the improvement of the irrigation facilities is insufficient in the experimental farm.

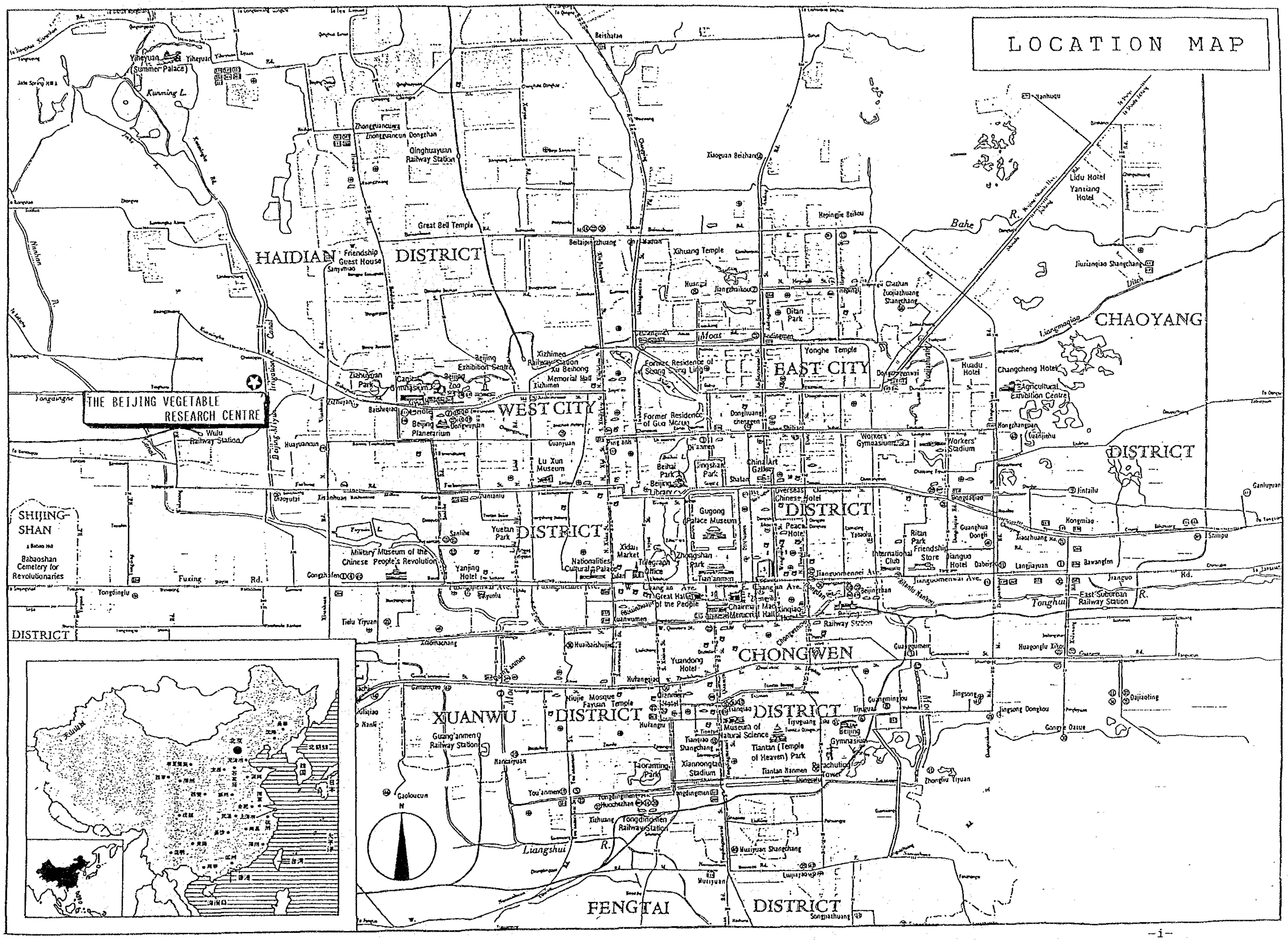
The result of the field survey and domestic work was organized on this report. I hope that this report will serve as a guide for putting up the scheduled Model Infrastructure Works into practice.

Lastly, I wish to express my sincere appreciation to the officials concerned of the Government of the People's Republic of China for their close cooperation extended to this Study.

June, 1988

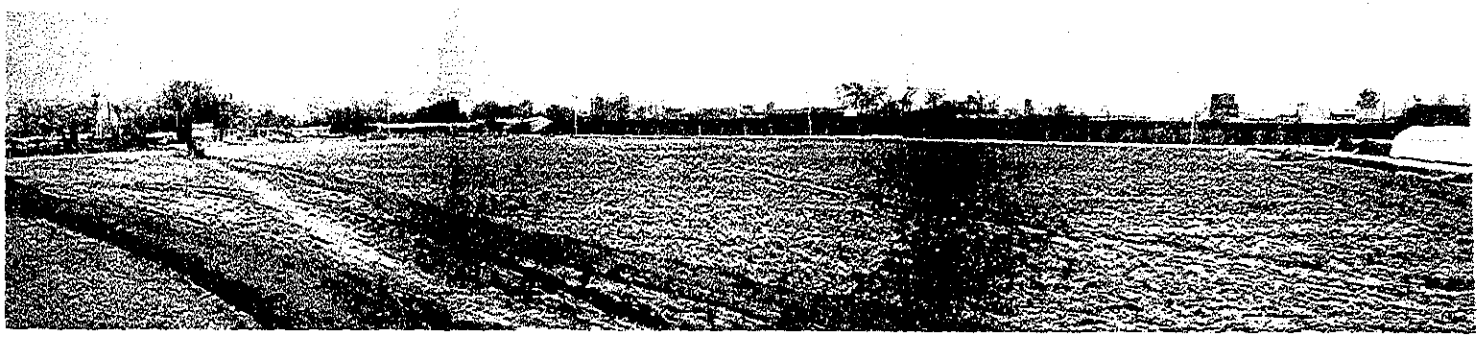
Kazumi Miyamoto
Director
Agricultural Development Cooperation Department,
Japan International Cooperation Agency

LOCATION MAP



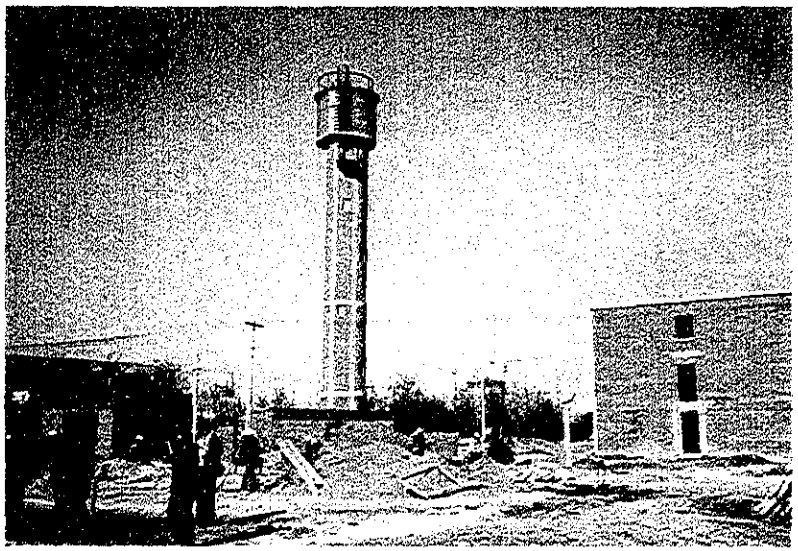
PHOTOGRAPHS

No. 1 New Experimental Farm



No. 2 Existing Experimental Farm

No. 3 Irrigation Facilities (Outlet of Pipeline)



No. 4 Existing Elevated Water Tank

DETAILED DESIGN REPORT

ON

MODEL INFRASTRUCTURE IMPROVEMENT WORKS

FOR

BEIJING VEGETABLE RESEARCH CENTRE PROJECT IN CHINA

TABLE OF CONTENTS

CHAPTER 1 OBJECTIVES OF THE STUDY

CHAPTER 1 OBJECTIVES OF THE STUDY

1.1 Description of the People's Republic of China

1.1.1 General Conditions

The People's Republic of China (hereinafter referred to as "China") is located between the eastern and central part of Asian Continent (between latitude 18°50' and 53°33' north, between longitude 79°50' and 134°45' east), and covers an area of 9,600,000 km^2.

The climate of this country is divided into three zones. They are the tropical, semitropical and temperate zones, and affected by a seasonal wind remarkably. The southeastern area is mild and wet, and the northwestern area is generally dry. The feature of the temperature is very different between south and north in winter. On the other hand, it is very high throughout the country in summer. An isotherm of 0°C in January corresponds to the line connecting Huai River and Quin-ling Mountain Range, and shows a border of freezing of river or lakes. Rain falls mostly in summer, and rainfall decreases from the southeastern part to the northwestern part. An isohyet of 800 mm corresponds to the line connecting Huai River and Quin-ling Mountain Range, and shows the boundary of wet area and semi-wet area.

A frosty season is between September and May in Dong Bei and the northern part of Xinjiang between the middle of October and the middle of March in the Yellow River Basin, and between December and February in Shi Chuan Valley. The mean annual precipitation in the country is 630 mm. The total population of China was 1,045,000,000 (1985). 63.4% of the population (663,000,000) lives in a farm area. The annual population growth rate is only about 1.0%. However, as China has more than 20% of the total world population, the population of China increases with the rate of over 10,000,000 every year.

Therefore, the population problem is one of the biggest political problems, and others are the housing problem due to the over concentration of population towards cities and also the food problem. The GNP was 778 billion Chinese yuan (1986), and its composition by sector is as follows:

Agriculture	41.4%
Industry	41.5%
Construction	5.5%
Transport	3.5%
Commerce	8.1%

The labor population is 498 million (47.6% of the total population) and its composition by sector is as follows:

Agriculture	312.0 million	(62.7%)
Industry	83.5 million	(16.8%)
Commerce	23.6 million	(4.7%)
Education	13.0 million	(2.6%)
Construction	20.7 million	(4.1%)
Others	45.3 million	(9.09%)

As energy source, petroleum, coal and electric power have been producing 131 million tons, 870 million tons and 445.5 billion kWh yearly, respectively. They are self-sufficient and a portion of petroleum are exported to Japan and other countries.

According to the Seventh National Five-year plan (1986-1990), the target economic growth rate is 6.7%, and the target growth rate for industry is 7.5%, for agriculture 4.0% and for trade 40%. Accordingly, the Government of China firstly aims at the increase of acquisition of foreign currency by means of the increase of exports.

1.1.2 Agriculture in China

Agriculture sector covers 41.4% of the national income, and 62.7% (about 300 million persons) of the total labor population. Agriculture is still main industry in China.

The cultivated area which is 11% of the total land is 1,100,000 km^2, the irrigated area 40% of the total cultivated area is 440,000 km^2, and the cultivated area by machinery 30.9% of the total is 340,000 km^2. Chemical fertilizer is used in the area of 180,000 km^2 which corresponds to 16.4% of the total cultivated area.

In recent years, the agricultural area of this country is divided into three zones based on the physical factors. They are spring-wheat zone which is located in the north of the Great Wall line and winter-wheat zone which is located in the south of the Great Wall line (dry-farming zone in the north of the Huai River) and rice farming zone which is located in the south of the Huai River.

The ratio of a dry field to a paddy field is 3 to 1. Main farm products are food crops and industrial crops. In addition, vegetables, grouds, feed crops and green manure crops are produced. The cultivated area for food crops covers almost 80% of the total cultivated area. Two major crops in the area are rice plant and wheat. The cultivated area for industrial crops, 12% of the total, increases gradually. Major crops in the area are oil and raw cotton. Vegetables classified as other crops mainly have been cultivated in the suburbs of big or middle-class cities, and their output is increasing along with industrialization and urbanization.

Agricultural output increased rapidly between 1979 and 1984 with the following reasons:

1. Introduction of responsible production system since 1979;
2. Raising of the purchase price for the major crops;
3. Increasing of the supply of the production materials, farm machinery, chemical fertilizer, etc.; and
4. Introduction of advanced agricultural technology.

As a result, the Government of China announced "the food problem in this country has been solved fundamentally" in 1984.

However, the decrease of food production in 1985 compared with that of the year before was 28.33 million tons due to the reformation of the circulating price system in agriculture products and abnormal weather. As a result, retail prices for perishable vegetables, egg and meat, and fruits increase 34.5%, 22% and 35.9%, respectively. Therefore, a retail price index was increased by 8.8% in 1985. Big deficit in terms of external trade and decrease of foreign currency reserve became the serious national problems. The increase of food, stability of food price and promotion of export have become the main subjects to reduce the deficit.

1.1.3 Agriculture in Beijing

Beijing, the capital city of China, is located in the northern end of Hua Bei Plain and its area is 1,680,000 ha. The population in Beijing is about 10,000,000 and about 6,000,000 persons live in the municipal district (mainly 8 districts). Beijing belongs to temperate climate regions and is subject to continental climate. The mean annual temperature is 11.6°C, and the mean minimum monthly temperature is 4.7°C in January. Rainy season is from July to September. The mean annual precipitation is about 600 mm and the mean annual evaporation is about 1,850 mm.

Seeded area for crops is 640,000 ha, and 83% of which are cultivated for food crops. Major crops are corn and wheat. On the other hand, the seeded area for industrial crops is a few. And the seeded area for vegetables is about 57,000 ha, which correspond to 9% of the total seeded area (Refer to Chapter 8).

The Government of Beijing proposes that the suburbs of Beijing should be a base for subsidiary foods, vegetables, milk, egg, meat, livestock, fruit and flowering plant. Especially the vegetable production is regarded as important. The average area held by a farmer is about 0.13 ha at present, but the Government aims at increasing the area to be held by a farmer gradually, to 0.53 ha, 1.0 ha and 1.33 ha step by step. In order to achieve the objectives, the Government is considering the introduction of joint control for seedling, rational water control and farm machines and implements.

Vegetables are mainly produced in the suburbs within 20 km, and in the outskirts between 40 km and 60 km from the centre of Beijing. And their outputs are 921,000 tons and 588,000 tons, respectively, totalling 1,509,000 tons (see Table 1.1).

Table 1.1 Vegetables in Beijing (1985)

	Cultivated area (ha)	Seeded area (ha)	Output (1,000 t)
Suburbs	12,965	25,009	921
Outskirts	8,268	15,262	588
Total	21,233	40,271	1,509

Source: Beijing Municipal Agriculture Bureau

The demand in Beijing is estimated to bel,650,000 tons and its shortage is made up by the supply from other provinces.

Vegetables are transported into Beijing from the northeast regions in the preharvest season, August and September, and from Hua Zhong (middle) and Hua Nan (south) regions in winter. About 70% of output from the suburbs and outskirts, and 30% from the other provinces are supplied to the consumers, in Beijing of 5,500,000. An average daily consumption per head is about 500 g.

The present problems about vegetable production are as follows:

(1) Output

The production area in the suburbs is decreasing as a town area increased. The total output has been increasing by the development of outskirts, but the harvest is unstable every year.

(2) Quality and wastage

The quality of products becomes poor because of an imperfection of postharvest techniques and transportation system. The amount of wastage becomes large, accordingly.

(3) Unstability of supply

The biggest object is to stabilize the supply of food throughout the year. At present, the seasonal adjustment of surplus and shortage of food (quality and variety) is not enough.

1.1.4 Beijing Vegetable Research Centre

The Beijing Vegetable Research Centre is located at an area extending east and west directions along the Beijing Miyun Irrigation Canal in Banjing Village, Haidian District, Beijing.

The total area is about 12 ha, including the area of main facilities such as science and research building, seed laboratory, management house, guest house and green house, of 3 ha, and the area of experimental farm of 9 ha. As of June, 1988, new experimental farm of 6 ha is being prepared for this project.

The Beijing Vegetable Research Centre was established in 1981 in accordance with the minutes signed in 1980 between UNDP and the Government of China, by improving the Beijing Vegetable Research Station.

The Beijing Vegetable Research Station was inaugurated as a vegetable research body managed by both China Academy of Agriculture and Sciences and Beijing Municipal Academy of Agriculture and Forestry Sciences. Since then, it was divided in 1962, merged in 197, and divided again in 1978. As a result, it playsan active part of research works under present condition. The objectives of the Station were as follows:

1. To develop the vegetable productivity in the suburbs;
2. To stabilize the high output of vegetables which is necessary for establishing a base of subsidiary foods;
3. To innovate a technique for improvement in quality; and
4. To study fields of breeding, seed, storage, cultivation, quality evaluation, tissue culture and application of new techniques.

In addition, the Station played the activities for training of experts, compiling and publishing the collected data for vegetable research, international technical cooperation, taking on trainees and so on. Training section dealt with training and practice of various specialists from the whole country a few times a year. Extension activities of new varieties and new techniques were carried out at the production unit.

The Station was placed as a lower branch of Beijing Municipal Academy of Agriculture and Forestry Sciences and covered a rural area of Beijing. However, a number of products have been carryied into Beijing from wide areas outside Beijing. Establishment of a base of food production around Beijing is strongly expected. Therefore, this Research Centre was established in order to join a policy of agricultural build-up by the Government of China and to promote joint research with other universities, accademies, etc.

1.2 Background of the Survey

The demand for vegetables in Beijing is twice as much as the supply being carried from its suburbs. Therefore, it is very important to obtain stable vegetable supply and to diversify its variety throughout the year along with an improvement of the living standard and population increase.

The Beijing Municipal Government established the Beijing Vegetable Research Centre in 1981 in order to accomplish the above purposes by developing the techniques for increasing the yield of vegetables and improving its quality. However, the research facilities and research field to carry out the research activities have not been prepared sufficiently. It is quite necessary to strengthen and expand the function of the Centre so as to accomplish the initial objectives. The activities of the Centre will greatly contribute to the extension of the research results, techniques and training of the specialists not only in Beijing but also in the whole country. Accordingly, the Government of China has requested both the grant aid cooperation in connection with the preparation of the equipment and facilities and project-type technical cooperation in connection with the improvement of research level, strengthening and expanding the function from the Japanese Government.

In response to the request from the Government of China, the Government of Japan through the Japan International Cooperation Agency (JICA) sent the study team not only for preliminary survey concerned with grant aid cooperation but also for a survey concerned with technical cooperation, and it was concluded that these cooperations would be effective to solve the problems mentioned before. Accordingly, it would be agreed that the Beijing Vegetable Research Centre Project was promoted by both grant aid cooperation and project-type technical cooperation.

The JICA sent the basic design study team based on the result of the preliminary survey for grant aid cooperation in November 1986, and submitted the final report to the Government of China in March 1987. The Exchange of Notes was concluded between two Governments in April 1987, and the procurement of research equipment and facilities has been carried out.

The JICA sent a preliminary survey team for technical cooperation in April 1987, and the survey team confirmed the objectives of the project, the objectives of the technical cooperation and the project implementation conditions. Based on the result of the preliminary survey and discussions with the officials concerned, the JICA sent a detailed survey team to China in September 1987. The team signed the Record of Discussions (R/D) and Temporary Scheme of Implementation (TSI). As a result, the technical cooperation has been started.

At presentm three Japanese experts have been dispatched. These specialists are a promology expert, a breeding expert and a project coordinator. However, the irrigation facilities in the experimental farm are insufficient in order to carry out the Project smoothly. Therefore, it is necessary to improve the irrigation facilities as model infrastructure improvement works urgently.

1.3 Outline of the Project

1.3.1 Grant Aid Cooperation

(1) Objectives

The Project aims at the improvement of research level, and strengthening and expanding the research function in the Beijing Vegetable Research Centre so as to develop the techniques concerning with the highly stabilized production and quality improvement of vegetables. The main objectives of the Project are to contribute to the stabilized supply of vegetables throughout the year which is one of the important policies promoted by the Beijing Municiplal Government.

(2) Description of the Project

The overall improvement of the facilities and equipment will be made by the Project. As a result, the efficient research work and improvement of research level are expected to be developed. Expected activities are as follows:

1) Breeding of vegetables;
2) Standard for selection of seed and manner of examination ;
3) Production control techniques of selected variety's seed;
4) Cultivation techniques of vegetables;
5) Physiological and biochemical study after harvesting and processing techniques;
6) Preservation of seed, evaluation system and information management; and
7) Training for research workers, experts, etc.

(3) Project site

The Project site is located in the Beijing Vegetable Research Centre.

(4) Official organization of the Project implementation

Official organization of the Project implementation under the Government of China are as follows:

1) The responsible agency for the Project management is the Beijing Municipal Government.
2) The execution agency for the project implementation is Beijing Municipal Academy of Agriculture and Forestry Sciences.

The materials and equipment requested by the Government of China, and the sites to be installed are as follows:

	Equipment	Site of establishment
1.	Equipment necessary for breeding of new variety	Existing research work building and experimental farm
2.	Equipment necessary for the standardization and its examination method of selected seed	Existing seed laboratory and seed warehouse
3.	Equipment necessary for the development of production control techniques of seed	Experimental farm and newly established seed processing plant
4.	Equipment necessary for the preservation and its evaluation	Existing seed warehouse
5.	Equipment necessary for physiological and biochemical study after harvesting	Laboratory building under construction and existing research work building
6.	Equipment necessary for the study of cultivating techniques	Existing research work building
7.	Equipment necessary for training	Existing research work building and enlarged training room
8.	Equipment necessary for other research management	Existing research work building

The necessary measures to be undertaken by the Government of China are as follows:

1. To prepare the site, building and facilities accompanying with the Project such as distribution of electricity, air conditioning, water supply and drainage, and improvement of the buildings necessary for the Project implementation before the day of delivery and installation of the equipment. It is very important to complete the building which is going to construct by the Government of China as scheduled so as not to obstruct the start of the Project.

2. To ensure unloading, customs clearance of the equipment and materials to be imported for the Project at port of disembarkation and their transportation to the Project Site.

3. To ensure tax exemption and customs clearance of the equipment and materials and services necessary for the Project planning.

4. To accord Japanese nationals whose services may be required in connection with the supply and services under the verified contract with such services as may be necessary for their entry and stay therein for the performance of their work.

5. To permit and approve the works and services necessary for the Project implementation under the law of China.

6. To clear all expenses other than those to be borne by the Grant Aid Cooperation from Japan.

1.3.2 Technical Cooperation

(1) Objectives

The objectives of technical cooperation are to improve the research level, and to strengthen and expand the research functions of the Beijing Vegetable Research Centre through the research cooperation for stabilized high productivity and quality improvement of vegetables.

(2) Organization

1) Execution agency

Beijing Municipal Academy of Agriculture and Forestry Sciences

2) Site

Beijing Vegetable Research Centre

(3) Cooperation period

Five (5) years

(4) Technical cooperation activity

1) Field of research

a. Research for breeding of vegetables, standardization of selected seed and its examination method
b. Research for preservation of seed, and its evaluation and improvement for information processing system
c. Research for improvement of cultivating techniques
d. Physiological and biochemical study after harvesting

2) Advice and guidance concerning with training of research workers and experts

3) Informational exchange necessary for the above researchers

(5) Necessary measures to be undertaken by the Government of Japan

1) Dispatch of experts

a. Long term experts
b. Short term experts

2) Acceptance of counterparts to Japan for technical cooperation

3) Provision of equipment necessary for technical cooperation

(6) Necessary measures to be undertaken by the Government of China

1) Provision of land, building and facilities for implementation

2) Arrangements for the necessary number of counterpart and office worker

3) Securing of necessary operational expenses

1.4 Policy of the Model Infrastructure Improvement Works

1.4.1 Project-type Technical Cooperation

The project type technical cooperation which is affiliated with the model infrastructure improvement works was established following the provision of facilities and equipment by grant aid cooperation from Japan in the Project of the Beijing Vegetable Research Centre. The objectives of the technical cooperation are to further grant aid cooperation, and to improve a research level in the Centre. A breeding of vegetables, vegetable cultivation, post-harvest which are main fields in the Project will be studied under the technical cooperation.

The research work for the improvement of vegetable cultivation will be carried out in the experimental farm. As rainfall in the suburbs of Beijing averages 600 mm per year, and there is limit to utilize groundwater, an effective utilization of irrigation water is an important task. A research work and extension for water saving irrigation will be incorporated into the implementation plan.

1.4.2 Scheme for Irrigation Facilities and Supplementary Facilities

A basic concept for making a plan of irrigation facilities and supplemental facilities is as follows:

1) To plan the facilities which will improve the efficiency of irrigation water supply

2) To plan the optimum irrigation facilities for the openfield and vinyl house, respectively; and

3) To plan the facilities in which various irrigation methods and irrigation tests such as furrow irrigation, drop irrigation and sprinkler irrigation will be examined.

The irrigation area planned in the experimental farm concerning with the model infrastructure improvement works are as follows:

1)	Open field	About 7.3 ha
2)	Vinyl house	About 11,000 m^2 (Vinyl house itself will be constructed separately.)
3)	Net house	About 1,400 m^2

CHAPTER 2 PRESENT CONDITIONS

CHAPTER 2 PRESENT CONDITIONS

2.1 Project Area

(1) Location

Beijing Village, West Suburbs, Beijing

(2) Project Site

Beijing Vegetable Research Centre under Beijing Municipal Academy of Agriculture and Forestry Sciences

2.2 Execution Agency

(1) Responsible Agency

The State Science and Technology Commission of the People's Republic of China/Beijing Municipal People's Government

(2) Execution Agency

Beijing Municipal Academy of Agriculture and Forestry Sciences/JICA

2.3 Present Conditions of Project Site

As for the detailed design survey of the model infrastructure improvement, the study team has collected the data offered by Chinese counterpart. The study team has confirmed site conditions and carried out the field survey etc.

The results of the survey are as follows:

2.3.1 Natural Condition

(1) Topography

The suburbs of Beijing Municipality which is a part of Hua Bei Plain has partly small high and low portions, but it is generally flat.

The project area is included in a part of Hua Bei Plain. According to the topographic map of Beijing Municipal Survey Design Division offered by the counterpart, the elevation of the project area is 52 m - 53 m.

As the border irrigation is carried out in both old and new fields, the ground elevation of the fields is considered to be flat in case of the construction of the pipeline.

On the basis of the plan of Vegetable Research Centre (scale 1:500) drawn by Beijing Academy of Survey Design in the Irrigation and Power Department and the topographic map (scale 1:2,000) of Beijing Municipal Survey Division, the survey team conducted the confirmation survey in the field. As a result, these maps are accepted on the base maps for detailed design.

(2) Geology and soil

(a) Geology

As for the shallow layer, the study team examined the condition of the pit excavated for the foundation of the new training building. As for the deep layer, the geological logs on No. 1 and No. 3 Wells are provided (refer to Chapter 8).

The surface soil in the shallow layer is of 0.2 - 0.3 m thick and followed by the loess layer of 2 - 3 m thick. The yellow sand layer with gravel of 40 - 60 m thick exists underneath.

As for the foundation works for the buildings, the pile foundation works has not been conducted in the area. The direct foundation is common.

Judging from the above fact, the bearing capacityof the soil is strong enough for the civil works.

(b) Soil

The soil data offered by Beijing Municipal Academy of Agriculture and Forestry Sciences are shown in Table 2.1.

According to the result of the soil analysis and Chinese soil classification (or USSR classification), the soil of the project site is included in the heavy loam.

It is possibly mentioned that it is the clay loam with the strong water retaining capacity.

Table 2.1 Characteristics of Soil

Item		Present Field		New Field	
		0 - 0.1 m	0.1 - 0.2 m	0 - 0.1 m	0.1 - 0.2 m
Real Specific Gravity		2.66	2.66	2.67	2.68
Apparent Specific Gravity		1.17	1.25	1.42	1.31
Field Capacity		32.18		26.76	
Permanent Wilting Point		11.0		11.0	
Soil Grading	<0.05	43.94		48.03	
	<0.01	20.55		23.61	
	<0.006	15.40		17.50	
	<0.001	9.35		7.32	
Soil Texture		Heavy Loam		Heavy Loam	
Basic Intake Rate		23 mm/hr			

Source: Beijing Vegetable Research Centre

(3) Groundwater

(a) Groundwater and water capacity

According to the pumping test of No. 3 Well (conducted on Feb. 17, 1987), the groundwater level is -23 m and the pumping capacity is 737 m^3/min. with drawdown of 3 m.

The storage capacity is big enough for the Project, judging from the above mentioned figures (refer to Chapter 8).

(b) Water quality

a) Hardness

Calcium and magnesium which are the hardness factors are included in the natural water.

In case of water with high hardness, a scale is producted in the pipe and it is not good for the industrial facilities especially boiler.

In case of the sprinkler and drip irrigation system, the clogging is occurred and it is necessary to take measures against the scale.

The result of the water quality analysis of No. 3 Well by Beijing Municipal Hydrology and Geology Engineering Corporation is shown in Table 2.2.

Table 2.2 Results of Water Quality Analysis (No. 3 Well)

Unit: German hardness

Item	Total Hardness	Temporary Hardness	Permanent Hardness	Measure-ment
Measured Value	27.5	16.8	10.7	87.3.4

Table 2.3 Classification of Water Hardness

Germany (°dH)	U.S.A. ($CaCO_3$ mg/1)	
Soft Water: 10° or less	Very Soft Water	: 50 ppm or less
	Soft Water	: 50 - 100 ppm
Moderate: 10 - 20°	A Little Hard Water	: 100 - 200 ppm
	Hard Water	: 200 - 300 ppm
Hard Water: 20° or more	Very Hard Water	: 300 ppm or more

Note: German Hardness 1° = 17.9 $CaCO_3$ mg/1

The hardness of the water is 16.8 and classified as Moderate. Therefore, the measures against hard water is necessary for the irrigation facilities.

b) pH

The pH of the water is 7.9 and classified as Slight Alkaline. However, this water is sufficient enough as irrigation water.

c) Other contents

CN and other harmful substance of the chemical components are not included. However, the fine sand was lifted up during pumping. It is necessary to provide some settling measures in the reservoir.

(4) Weather

The weather of Beijing Municipality is shown in Table 2.4.

Table 2.4 Weather Conditions in Beijing Municipality

Section	Item	Measured Value	Remarks
Temperature	Mean annual temperature	11.6°C	
	Mean minimum monthly temperature	-4.4	
	Mean maximum monthly temperature	25.5	
	Maximum temperature	40.4	
	Minimum temperature	-27.4	
Precipitation	Mean annual precipitation	608 mm	About 80% of annual precipitation is June-Sept.
	Maximum annual precipitation	1,169	
	Maximum daily precipitation	244.2	
	Maximum snowfall	23 cm	
Humidity	Mean annual humidity	59.1%	
	Mean maximum monthly humidity (Aug.)	80%	Mean monthly relative humidity.
	Mean minimum monthly humidity (Jan.)	41%	- ditto -
Evaporation	Mean annual evaporation	1,839.6 mm	Irrigation period (Apr.-Oct.)
	Mean maximum monthly evaporation (May)	291.1	1,155.7 mm
Daylight	Mean annual daylight	2,540 hr	
Depth of Frozen Earth	Maximum depth of frozen earth	85-100 cm	(Haidian 56 cm)
Wind Direction and Velocity	Annual most frequent wind direction	N	Mean maximum monthly wind velocity is 3.5 m/sec during the irrigation period.
	Frequency	14%	
	Mean maximum velocity	23 m/sec	
	Direction	W N	
	Mean annual wind velocity	2.6 m/sec	

Climate of Beijing Municipality is hot in summer and dry and cold in winter and there is yellow-sand storm in April and May.

It rally belongs to the continental monsoon climate zone of the temperature zone, but mean annual precipitation is 608 mm and mean annual evaporation is more than 1,800 mm.

This means that the project site is included in the dry agricultural area and it is certainly necessary to provide irrigation for proper cultivation in this area.

2.3.2 Condition of Social Infrastructure

(1) Electric power

The voltages of the power supply in Beijing Municipality are: voltage is 380V of three-phase and 220V of single phase, and the frequency is 50 Hz. The power supply of Beijing Vegetable Research Centre is 320 kVA at present.

Distribution line to the Centre is made with two-way system against power failure in order to keep the equipment installed with this project work safely.

In the case of increase of the power demand in this project, Beijing Municipal Government has agreed to accept the application for increasing the power supply from the Centre preferentially.

(2) Heat source

Coal (lump coal and powder coal etc.) is generally used as heat source in China.

Use of petroleum is only permitted for industrial raw materials and transportation. The Centre is using Da Tong coal (4,200 - 4,600 Kcal/kg) as heat source and its annual consumption is about 400 ton.

(3) Water supply and sewerage

Water supply and sewerage failure in Beijing Municipality are in good condition. Minimum water pressure is 1.8 kg/cm^2. Hardness of water is 150 ppm and is included in the hard water (100 - 200 ppm) range.

The scale of water supply faciilities in the apartment houses for diplomats are removed once a year. In case of the equipment which does not accept the scale, it is necessary to treat tge gard water to soft. Water resources for water supply in Beijing Municipality are Guan Ting and Mi Yun dam.

However, the lack of supplying water always occurrs due to rapid increase of population in Beijing Municipality. Beijing Municipal Government always calls for saving water and give the major consumers (school, hospital and factory etc.) the upper limit of water supply.

If water consumption of these major consumers exceeds the regulated volume, they must pay the progressive excess charge (10 to 50 times). Water supply was used for the domestic water, but it was stopped because of its low water pressure. The well water is used for both the domestic water and irrigation water in the Centre now.

The annual well water consumption in the Centre is regulated at 300,000 m^3 or less. Design annual domestic water volume is 40,000 m^3.

Sewerage is connected to Beijing public sewerage network by with/o500 mm concrete pipe.

(4) Road

The Centre is located in the field of Banjing Village, Haidian District of Beijing surburbs. The connection road from the national road is narrow and it is difficult to pass through by large vehicles such as a trailer.

However, there is no problem for the transportation of the materials to the Centre because there is a road of 5 - 6 m along Beijing Miyun Irrigation Canal up to the main gate of the Centre.

(5) Communication facilities

One direct-telephone line and one operation telephone line are available in the Centre at present.

It is expected that the use of telephone will increase due to this project. Therefore, it is recommended that the installation of two new lines including facsimile or more.

2.3.3 Present Conditions of Beijing Vegetable Research Centre

(1) Organization and operation

Beijing Vegetable Research Centre (BVRC) is maintained by China Academy of Agriculture and Science and Beijing Municipal Academy of Agriculture and Forestry Sciences (BAFS) and the director of BVRC is concurrently vice-president of BAFS.

BVRC and BAFS are independent organizations, but the researchers of BAFS concurrently hold the position of BVRC. At present, the system of the research divisions and sections is not clear. The Centre adopts group system for each study item.

The research fields are divided into six department as follows:

(a) Department of Breeding Study:
- Variety establishment
- Authorization of disease-proof

(b) Department of Seeds Study:
- Seeds physiology
- Seeds blight
- Test of seeds authorization
- Seeds processing
- Seeds preservation (variety source)

(c) Department of Post Harvest Study:
- Physiology and biochemistry after harvest
- Storage
- Preservation

(d) Department of Cultivation Study:
- Cultivation
- Facility cultivation
- Crop physiology

(e) Department of Quality Evaluation Study:
- Nutrition analysis
- Nutrition quality

(f) Department of Tissue Culture Study:
- Tissue culture,
- Multiplication of virus

Number of staff of the Research Centre is 167 persons. Scientist is 66 persons consisting of high-ranking staff (8 persons), intermediate staff (34 persons) and elementary staff (24 persons).

Ten paid postgraduates are also working in the research section.

The budget of the Centre consists of the maintenance cost and the study expenditure.

The annual maintenance cost is 600,000 yuan (actual amount in 1986) which is provided from Beijing Municipal People's Government.

The Centre gets the study expenditure from the State Science and Technology Commission, Ministry of Agriculture, Livestock and Fishery, China Academy of AGriculture and Sciences and Beijing Municipal Commission for Science and Technology etc. The average budget for study is 20,000 yuan per year for each study item.

(2) Present conditions of the facilities

(a) Building facilities

The existing buildings of the Centre are shown in Table 2.5.

Table 2.5 Existing Buildings of the Centre

Description	Number	Area (m^2)	Remarks
Research work building	1	2,226	Two stories, PC
Seed laboratory building	1	447	One story
Greenhouse	3	430	
Glass house and study house	3	830	
Laboratory of physiology and biochemistry after harvest	1	940	Two stories
Guest house	1	400	
Boiler, Bathroom, restaurant	3	2,020	
Administrative office	1	1,500	Three stories
Others (garage and warehouse, etc.)	4	1,160	Rebuilding is required.
Total	18	9,953	

China will construct the new buildings shown in Table 2.6 with the by local cost portion of the Grant Aid Cooperation:

Table 2.6 Planned New Buildings for the Centre

Description	No.	Remarks
Central laboratory building	1	
Seeds processing plant	1	
Model laboratory	1	Budget: 4,150,000 yuan
Workshop	1	
Warehouse of farm implements	1	
Extended garage	1	
Total	6	

(b) The site of the Centre and farm

The total area was 12 ha, consisting of 6 ha for buildings and 6 ha for the experimental farm. The Centre has procured the new farm land of 6 ha for the Project. Therefore, the total area is 18 ha at present.

(c) Water resources and irrigation facilities

Existing water resources are No. 1 and No. 2 Wells. Existing irrigation facility is the pipeline (l = 350 m, o100 mm, cast-iron pipe) connecting the farm with the elevated water tank (H = 24 m, V = 30 m^3).

These two wells irrigate the existing farm of 6 ha. One deep well was constructed in the new experimental farm. Each wellhas limitation of extraction. The approved extraction capacities of No. 1 and No. 3 Wells are 85 m^3 per hour and that of No. 2 Well is 30 m^3 per hour.

2.3.4 Investigation of Local Construction Materials

This project is the construction works of the irrigation facilities for the experimental farm in the Centre.

Deep well pumps of No. 1 and No. 3 Wells shall be installed by Grant Aid Cooperation. The reservoir and delivery pump shall be constructed and installed by Chinese side. Main works of this project is the installation of the irrigation facilities such as pipeline, sprinkler and drips etc.

The survey team conducted the investigation of the major construction materials. They visited Beijing Plastics Factory No. 7 and Beijing Plastic Product Factory for the pipe procurement.

The former is the biggest plastic pipe product factory in Beijing, but only moved to the new site in Jan. 1988 and the machines are under installation.

It will start the production of pipes (ø16 - 63 mm) with I.S.O.* Standard around July or August. It takes I.S.O. standard for pipes. The pipe of ø more than 100 mm can be produced with special order. But the supply will be too late for this projec, even if orderedt.

Beijing Plastic Product Factory is located in Daxing. It produces polyethylene (PE) and polyplopylene pipes, but not produces polyvinyl chloride (PVC) pipes. Pipes with I.S.O. standard are produced upto ø 200 mm.

Fittings such as elbow, cheese and reducer are produced upto o 90 mm outside (ø 75 mm inside).

---

* the International Organization for Standardization

In case of production of the fittings of large size, investment of 10,000 yuan for each form and production periods of about three months are required. Therefore, it is too late for this project and the procurement of Chinese pipes is not possible.

The conditions of the procurement of construction materials are shown in Table 2.7.

Table 2.7 Conditions of the Procurement of Construction Materials

Item	Conditions	Local Procurement
Cement	Available for various cement, Necessity of government approval for getting in quantities (difficulty of getting in quantities)	Yes
Coarse and fine aggregate	Available for various kind	Yes
Brick	Easy for getting Size: 240 x 115 x 53	Yes
Concrete block	Difficult for getting (few supply) Size: 400 x 195 x 180	Yes
Concrete	Mainly making infield	Yes
PVC pipe	Available for small size, Pressure pipe upto 50 mm, Not available for large size I.S.O. standard	No
PE pipe	I.S.O. standard, Pressure pipe available upto 90 mm	No
Cast iron pipe	Available	Yes
Reinforced concrete pipe	Available	Yes
Steel pipe	Available	Yes
Manhole cover	Available	Yes
Steel plate	Available Necessity of government approval for procuring in quantities	Yes
Form	Available for steel form in small size	Yes
Pump	Small pump, Available for special order	Yes

2.3.5 Investigation of Contractor

In case of using Chinese contractor, JICA will contract with a construction corporation. The construction corporation is one of the agencies of a local government. In case of Beijing, a construction corporation is an organization under the construction bureau of Beijing Municipal Government. Therefore, it is difficult to order and choose a construction corporation by the client side. Any competitive tendering has not been conducted.

The study team visited and investigated the field office of a Japanese construction company that was conducting construction works under the Japanese Grant Aid. The following are the results of the interview:

(1) In the selection of a Chinese construction corporation, Japanese side must accept the contractor recommended by Chinese side.

(2) Competitive tendering has not been conducted in China.

(3) It is difficult to procure a large amount of main construction materials such as iron and cement even with the government permission. Government can decide the priority of supplying materials. The works is sometimes suspended by a lack of construction materials.

(4) The prices of materials are different in case of procurement by Chinese contractor and foreign company. Double price system is applied. This system is applied also for maintenance expenditure.

The Centre has the same opinion as the above and wants to make a contract with JICA directly for Model Infrastructure Improvement Works, if possible.

The study team has discussed with JICA Beijing branch office and headquarters about the above matters.

The following are the results:

(1) It is difficult to make a contract with the Centre, but it is possible to make a contract with the construction corporation recommended by the Centre.

(2) If the reason why the competitive tendering is impossible is clear, a free contract is acceptable.

Therefore, it is recommended that a free contract system is applied for this project implementation with the following reasons:

The reason of an optional contract:

(1) China doesn't have a system of competitive tendering. Chinese government is recommending the introduction of a competitive tendering system, but this system is not established yet.

Therefore, in case that a foreign company (JICA is also registered as Japanese enterprise) executes a construction works in China, the foreign company uses the Chinese company recommended by Chinese side. Most Chinese construction corporations are the state agencies and their staff are public sector workers. There is no experience that a foreign company freely has chosen one Chinese company among some companies. Especially, there is no experience of the competitive tendering.

(2) Beijing No. 2 Construction Corporation recommended by the Centre has a contract for building construction and civil works in the Centre at present.

This corporation is constructing the laboratory buildings, the base of the greenhouse and garage with the contract of local portion of Grant Aid Cooperation. And it knows well about the situation of the site and the pipe fitting works which is indirectly related with Model Infrastructure Improvement Work.

CHAPTER 3 PROJECT PLANNING

CHAPTER 3 PROJECT PLANNING

3.1 Outline of the Project

3.1.1 Outline of the Improvement Works

An introduction of water saving cultivation to the technical cooperation program is one of the important objectives of the project. In this model infrastructure improvement works, the construction of irrigation facilities which can manage water saving irrigation practice will be carried out. The amount of annual precipitation in the Project site is estimated to be 600 mm, and the amount of more than 80% of the total concentrats in wet season, June to September. Due to the above, they commonly suffer from shortage of water in Beijing municipality and it is obvious that the establishment of water saving cultivation is important. In order to carry out complete research on water saving irrigation by Japanese experts, the construction of irrigation facilities is very important. It is recommended that these facilities be constructed as the model infrastructure improvement works by Japanese technical cooperation.

Because of the features of an experimental farm, various kinds of crops are grown with different growing period in the Centre. This is big difference between normal cultivation and experimental cultivation. Therefore, irrigation facilities in the Centre must have the function to meet the various kinds of water requirements. Furtherore, due to the instruction from Beijing Municipality, the extraction amount of for irrigation is limited. Also, countermeasures against scale problem are required due to hard water.

The intake facilities of irrigation system which consist of a storage tank, discharge pipes from No. 1 and 3 Wells to the storage tank and a booster pump with pressure tank from the storage tank to farm fields will be constructed by Chinese side. Submergible pumps for No. 1 and 3

Wells will be installed by Japanese Grant Aid, and water level gauges for an automatic regulating system between submergible pumps and the storage tank will be supplied by this Model Infrastructure Improvement Works. In the irrigation system, four automatic metering valves are planned to install in order to obtain accurate water amount measuring and automatic relay irrigation system for A, B, C and D farm plots.

Before the final agreement on this proposed improvement works, the Chinese authorities concerned requested to install ultramodern equipment (e.g., an automatic irrigation system with computer and field moisture censors) by emphasizing a demonstration purpose of the Centre. However, they have agreed this proposed improvement plan, because they have understood that the present technical research level of the Centre is water saving irrigation one.

A plan for construction of elevated tank was cancelled because of the Project site being included in the designated green area. The designation prohibits the construction of buildings 20 m or high or more. Finally, it has been agreed upon that the Chinese side will construct a storage tank and a booster pump with pressure tank as an alternative plan. The design calculation of these facilities was carried out in this design work for the sake of the Chinese side (refer to the Chapter 8).

3.1.2 Irrigation Area

The breakdown of net irrigation areas in the experimental farm of 12 ha is shown in Table 3.1.

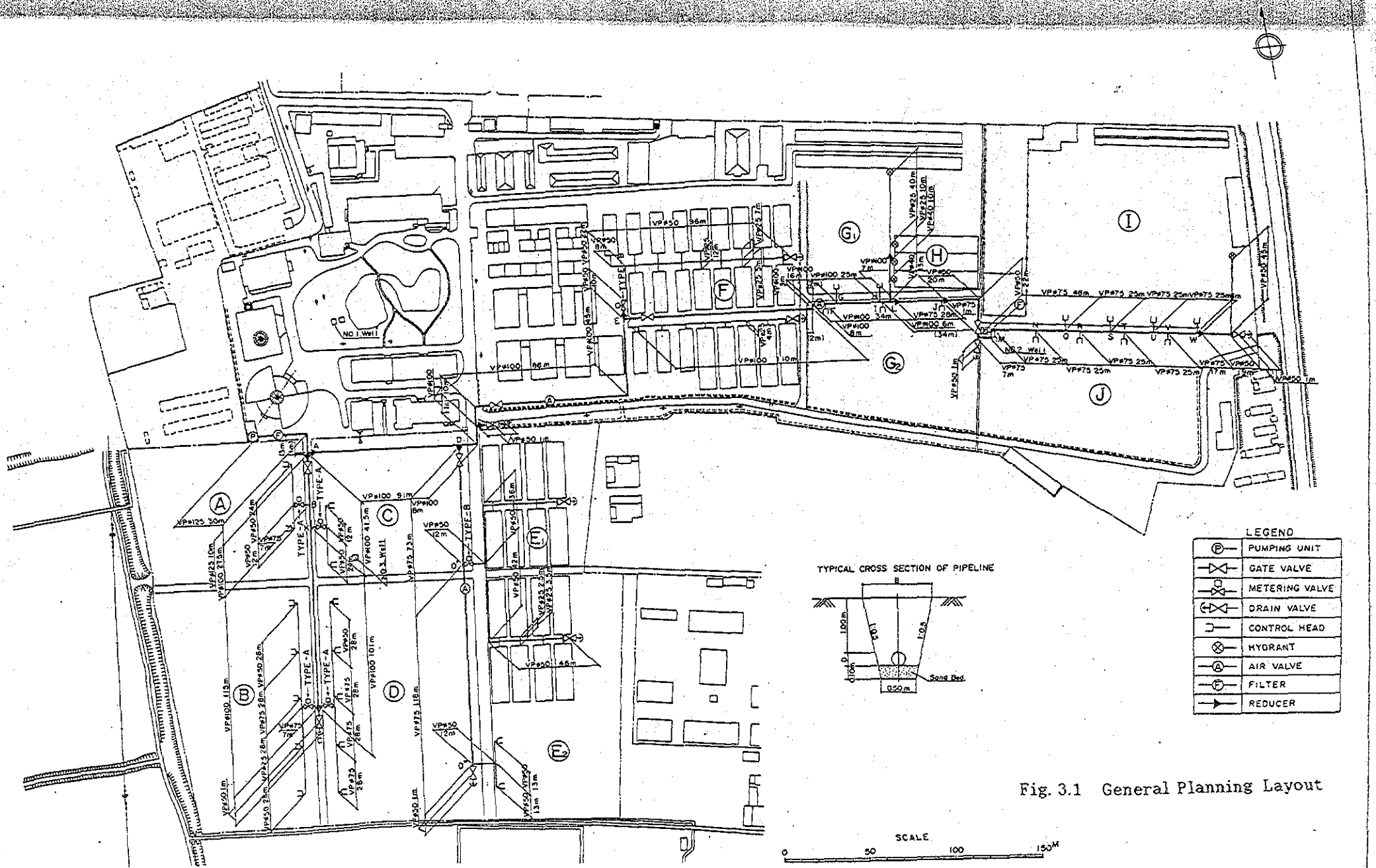


Fig. 3.1 General Planning Layout

Table 3.1 Irrigation Areas

Farm Plots	Area (m^2)	Irrigation Water	Farm Condition	
A	7,600	No. 1, No. 3 Well	Open Field	
B	11,200	"	"	
C	6,600	"	"	
D	12,600	"	"	
E_1	5,280	"	Vinylhouse	10 m x 33 m x 16 houses
E_2	4,851	"	Open Field	
F	6,070	"	Vinylhouse	10 m x 35 m x 5 houses
				10 m x 24 m x 10 houses
				8 m x 24 m x 10 houses
G_1	3,300	"	Open Field	
G_2	7,150	"	"	
H	1,440	"	Net House	10 m x 48 m x 3 houses
I	10,000	No. 2 Well	Open Field	
J	9,562	"	"	
Total	85,713			

3.2 Planning of Water supply

3.2.1 Amount of Intake Water

The irrigation water in the Centre will be supplied by two existing deep wells and one new deep well which has been dug for the new experimental farm of 6 ha.

The irrigation plan is prepared on the basis of the limitation of extraction of groundwater ordered by Beijing Municipality which is summarized in Table 3.2. The limitation for No. 1 and No. 3 Wells is 85 m^3/hr and for No 2 Well is 30 m3/hr. The estimated water requirement is 872 m^3/day. It will be occurred shortage of 58 m^3/day and a shortage of 1,798 m^3 (= 58 x 31) per month in August. However, precipitation in August is the most one through a year and the precipitation day of 5 mm or more in August are 6.7 times within 23.8 times per year. Therefore, it is expected that there are rainfall of 30 mm (= 6 x 5 mm) or more in August.

If the water requirement of 30 mm will be saved for 7.4 ha of the open field, it amounts to 2,220 m3 (= 7.4 ha x 30 mm). It is considered that the water requirement is sufficient together with rainfall in August of the most serious restriction during irrigation period.

Table 3.2 Restriction on Groundwater Consumption

Period	Jan.-Mar.	Apr.-May	June	July	Aug.	Sept.	Oct.-Dec.	Annual
Total	71,848	56,008	29,866	27,053	25,253	30,259	65,656	305,943
Daily*	798.3	918.1	995.5	872.6	814.6	1,008.6	713.6	-

* Daily water consumption includes domestic water of 110 m^3/day.

3.2.2 Water Quality and Countermeasures

According to the results of water quality analysis for No. 3 well made by Beijing hydrogeological engineering geology company, the water hardness has been measured at 16.8° which included in a range of medium hardness (10° to 20°). Therefore, scale in sprinkler and drip-line should be washed out by chemical solution of chlorine acid. Cleaning work should be carried out twice a year by injecting chemical solution through equipment attached to the control heads .

3.3 Basic Factors for Irrigation Planning

3.3.1 Topography, Climate and Soil

The conditions of topography, climate and soil are described in the Section 2.3.1 Natural Conditions of the Chapter 2.

3.3.2 Crop Water Requirements

Crop water requirements can be estimated by various methods. In the Centre, various kinds of crops with different growing periods will be cultivated at the same time. Therefore, the estimation of the optimum crop water requirements is very difficult in consideration of the future combination of cultivation. Crop water requirements for the

irrigation plann are empirically estimated to be 8 mm/day due to lack of recorded data around/in Beijing Municipality. According to the existing data (refer to Table 3.3), the amount of 8 mm/day is enough for the cultivation of almost all kinds of vegetables.

Table 3.3 Growing Period and Crop Water Requirement for Vegetables

Crops	Growing Period (day)	Total Water Requirement (mm)	Crop Water Requirements (mm/day)
Cabbage	30a+ 60 - 110	300	5 - 2.7
Lettuce	40 - 100	450	11.3 - 4.5 7.9
Onion	90 - 250	400 - 600	4.4 - 1.6 6.7 - 2.4
Spinach	35 - 40	250	7.3 - 6.3
Sweet Corn	65 - 100	450	6.9 - 4.5
Beet	60 - 70	450	7.5 - 6.4
Carrots	68 - 85	400	6.7 - 4.7
Cucumber	50 - 75	450	9 - 6.4 7.7
Pumpkin	85 - 120	450	5.3 - 3.8
Red pepper	60 - 85	50a+450	7.5 - 5.3
Melon	80 - 120	600	7.5 - 5.3
Tomato	50a+ 60 - 100	600	10.0 - 6.0 8.0
Watermelon	70 - 95	450 - 600	6.4 - 4.7 8.5 - 6.3 7.4
Sweet Potato	40a+ 150	450	3.0

Source: Reserach by Desean & Gillirra "Vegetables of the World", Yookendo

3.3.3 Estimation of Water Use Efficiency

(1) Effective Depth of Root Zone

An effective depth of root zone differs according to individual crops and soil conditions and is influenced by irrigation method. As mentioned before, as the crops planted in the Centre are various, it is difficult to determine a certain effective depth of root zone for the irrigation planning. Generally speaking, an effective depth is 50 cm or less in Japan in case of good soil conditions, (e.g. for Aichi Irrigation Project, a depth of 20 to 40 cm has been adopted.). In the United States, however, effective depth is generally estimated to be 30 to 90 cm and largely affected by soil conditions.

In Hua Bei plain, China, depth of plow layer is 20 to 30 cm. Based on this fact, an effective depth of root zone can be estimated to be around 40 cm.

(2) Moisture Extraction Pattern

Water consumption of crops is influenced by soil texture, cultivation practice, irrigation method, etc. The experimental farm is simply covered by loess layer. Therefore, the standard moisture extraction pattern prepared by Shockloy is adopted for the planning. The standard moisture extraction pattern consists of four layers with thickness of 10 cm each. Distribution of moisture extraction pattern varies with every layer; 40, 30, 20 and 10% from the first layer.

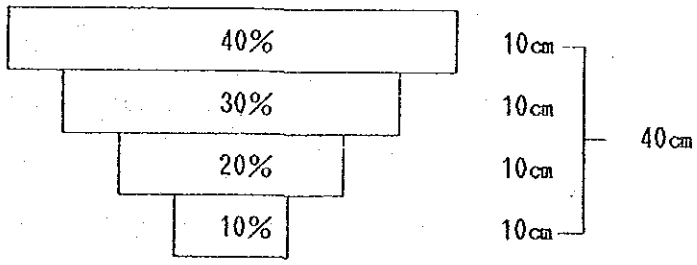


Fig. 3.2 Soil Moisture Extraction Pattern

3.3.4 Considerationof Irrigation Method

(1) Soil Conditions

Basic intake rate of soil is one of very important factors for selection of irrigation method. Basic intake rate is mainly used to estimate deep percolation loss. For example, in case of sand with high basic intake rate an amount of deep percolation loss will be considerably big, and an irrigation method which takes a long time is not recommended. In Table 3.4, the relationship between basic intake rate, and irrigation method is summarized. According to the classification, either irrigation methods, spray irrigation or surface irrigation, can be adopted in the experimental farm which has a basic intake rate of 23 mm/hr.

Table 3.4 Basic Intake Rate and Irrigation Method

Basic Intake Rate (mm/hr)	Irrigation Methods
High : 75 or more	Spray
Medium: 40 to 75	Spray, Surface
Low : 40 or less	Spray, Surface

(2) Climate Conditions

Spray irrigation is not sufficient in the case of wind velocity of over 5 m/sec. In the Project site, maximum mean wind velocity during irrigation period, April to October, has been observed to be 3.5 m/sec in April. Spray irrigation method can be applied for the plan.

(3) Land Slope Conditions

The experimental farm is generally flat and there is no topographical constraint.

(4) Water Supply Condition

Total water consumption of the Centre is limited up to 300,000 m^3 per year (including 40,000 m^3 of domestic water). Therefore, in the case of surface irrigation, shortage of irrigation water will happen due to its high percolation loss of the system. Introduction of spray irrigation and/or drip irrigation which have high irrigation efficiency is recommended. Irrigation efficiencies of various irrigation methods are summarized in Table 3.5.

Table 3.5 Irrigation Method and Efficiency

Irrigation Method	Water Application Efficiency (%)	Conveyance Loss (%)	Irrigation Efficiency (%)
Drip	95 or more	5 to 10	85 to 95
Sprinkler	80 to 90	5 to 10	70 to 85
Surface	70	5 to 10	60 to 65

3.3.5 Irrigation Planning

(1) General

In addition to basic factors which are mentioned in Section 3.3.4, some other factors such as irrigation hour, irrigation interval, land use (open field and/or greenhouse) and irrigation purpose are required for irrigation planning. The experimental farm consists of both open field and greenhouse, and in order to cope with various experimental requirements, the proposed irrigation system should be able to fit to drip, spray and/or surface irrigations in all farm plots. For this purpose, control-head control system is adopted. Surface irrigation, however, can be carried out in some plots only at the same time due to the restriction on water consumption by Beijing Municipality.

To meet the operation schedule of the Centre, the irrigation system has irrigate all the plots in one day with an irrigation hour of eight hours or less. Furthermore, irrigation intensity should be 7.7 mm/hr or less. Because irrigation intensity in the flat land should be one third or less of basic intake rate (23 mm/hr in the Centre).

According to the operation schedule of the Centre, one day irrigation interval is requested. However, six day interval is possible based on the calculation of TRAM. Two day irrigation interval for drip irrigation is derived from DTRAM and the imaginary TRAM in total area (refer to Chapter 8).

The following conditions are applied for the irrigation plan:

1. Irrigation interval : 1 day
2. Irrigation hour : 8 hours or less
3. Irrigation intensity: 7.7 mm/hr or less

(2) Irrigation System

Two irrigation systems are planned based on water supply from three wells. One irrigation system will depend on No. 1 and 3 Wells, and the other on No. 2 Well. Table 3.1 shows the irrigation systems and their irrigation areas.

(3) Conditions of Irrigation Planning

The conditions of the irrigation planning are summarized in Table 3.6.

Table 3.6 Conditions of Irrigation Planning

Item	Value	Remarks
Crop water requirements	8 mm/day	
TRAM	55.96 mm	DTRAM 47.56 mm
Irrigation interval	1 day	
Application efficiency	95%	
Conveyance loss	5%	
Irrigation efficiency	90%	
Net water requirements	8.0 mm/day	
Gross water requirements	8.9 mm/day	
Field water requirements	8.4 mm/day	
Irrigation system A-H	6.62 ha	No. 1 and 3 wells
" I-J	1.96 ha	No. 2 well
Irrigation hour	8 hours	

CHAPTER 4 DESIGN OF IRRIGATION FACILITIES

CHAPTER 4 DESIGN OF IRRIGATION FACILITIES

4.1 Contents of Irrigation Facilities

The irrigation facilities which will be constructed in this Model Infrastructure Improvement Works consist of pipeline system and its related structures except some intake facilities as mentioned in Chapter 2. The design calculation for these intake facilities, however, has been carried out in response to the request of Chinese side. Because the results of the calculation of pressure and discharge of the intake facilities are the basis of the design of pipeline system. The summary of the calculation is shown below (refer to Chapter 8).

Pump capacity : 1,500 lit./min.

Required head : 40 m

Sprinkler nozzle pressure	:	25.0 m
Friction head loss	:	8.0 m
Pump head loss	:	3.0 m
Actual pump head	:	4.0 m
Total		40.0 m

Required volume of the pressure tank which should be attached to the booster pump is estimated to be 1.6 to 2.1 m^3. The layout of the pipeline system is shown in Fig. 4.1.

The planned irrigation facilities are respectively explained as follows:

4.1.1 Control Head

In comsideratin of the purpose of the experimental farm, the irrigation system that will allow the change of various kinds of irrigation methods such as drip, sprinkler and surface irrigation is required. Therefore, control heads are required in order to adjust water pressure for different terminal systems in every plot (see Fig. 4.3).

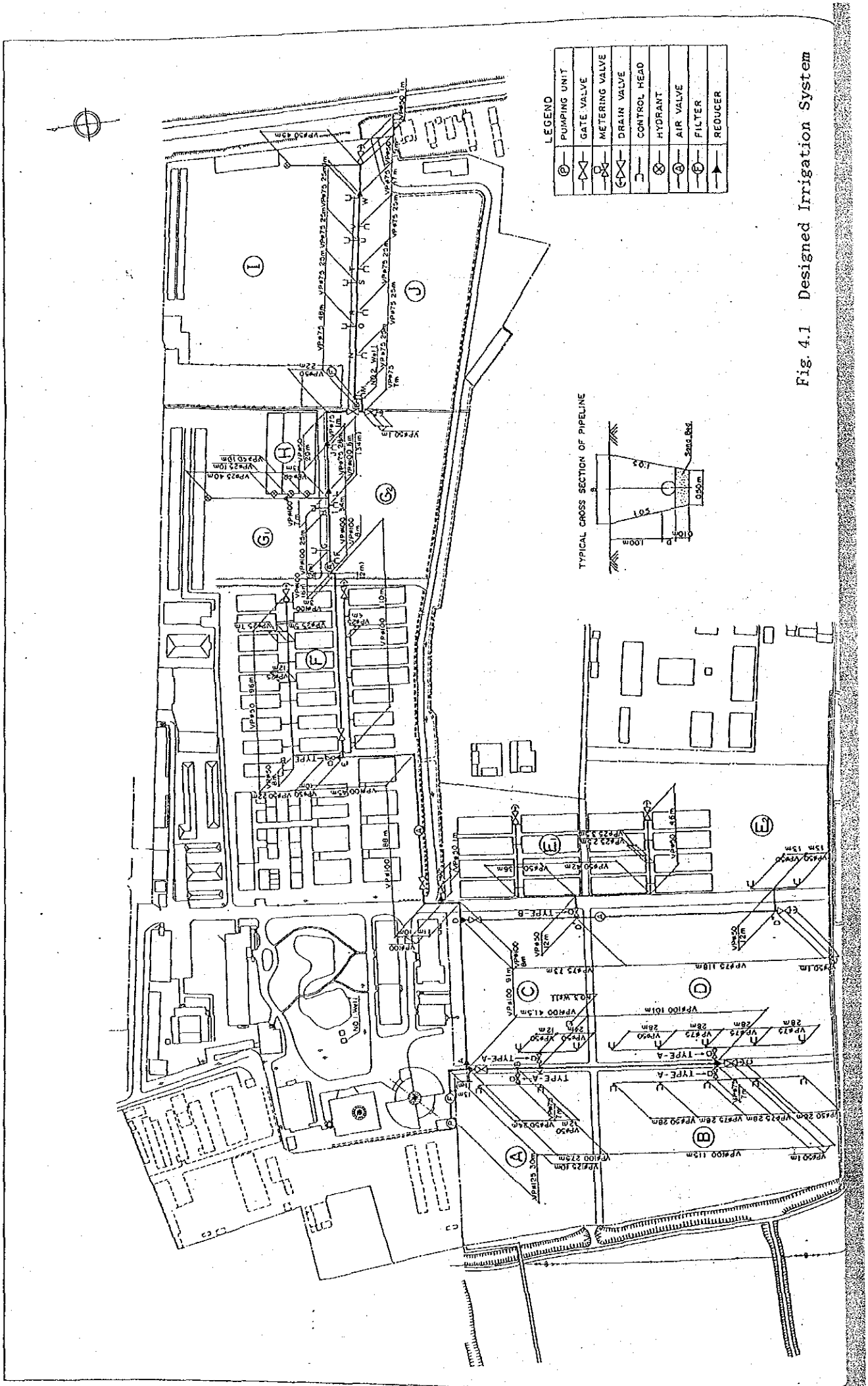
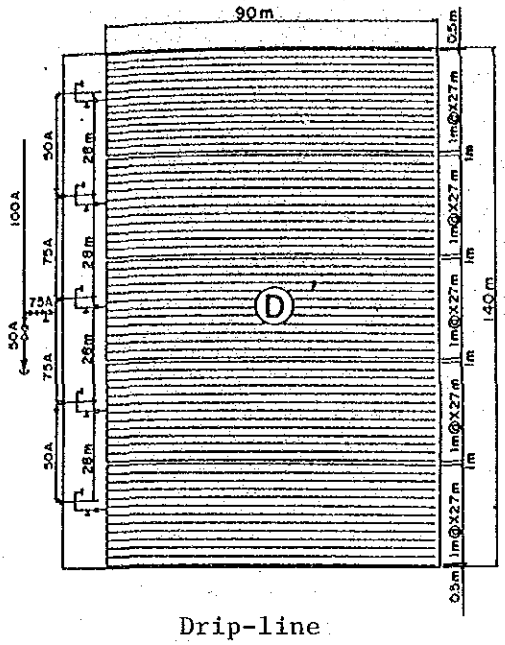
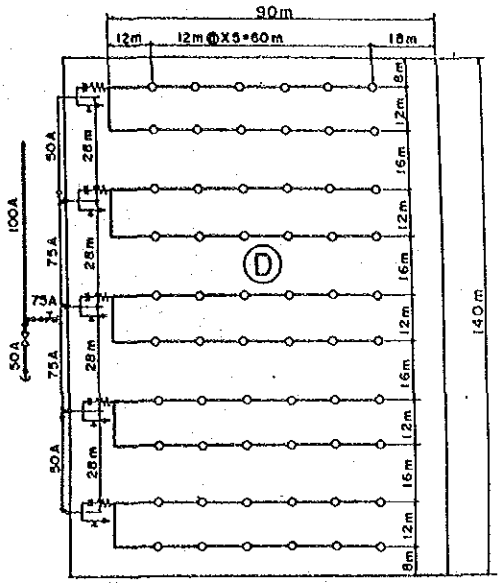


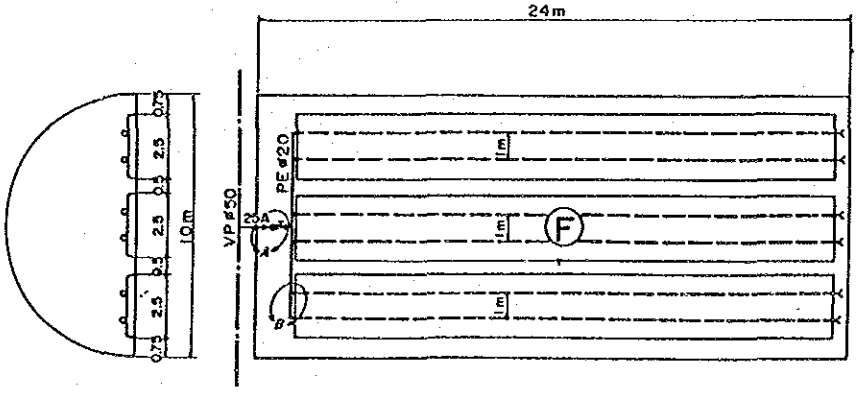
Fig. 4.1 Designed Irrigation System



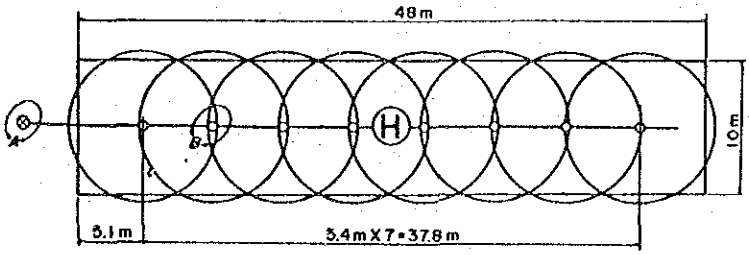
Drip-line



Portable Sprinkler

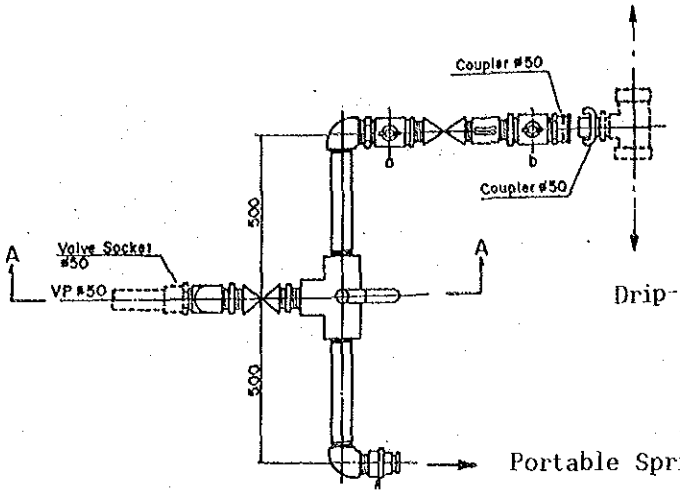


Drip-line in Vinylhouse

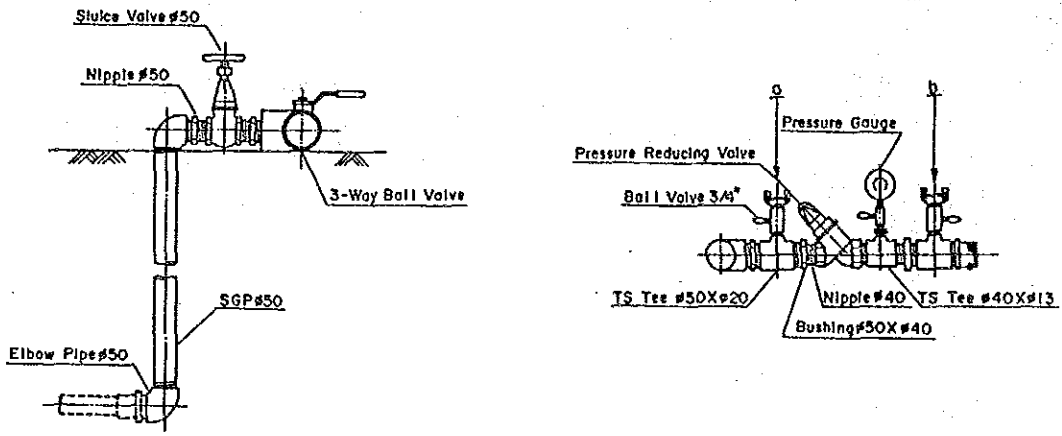


Mini Sprinkler

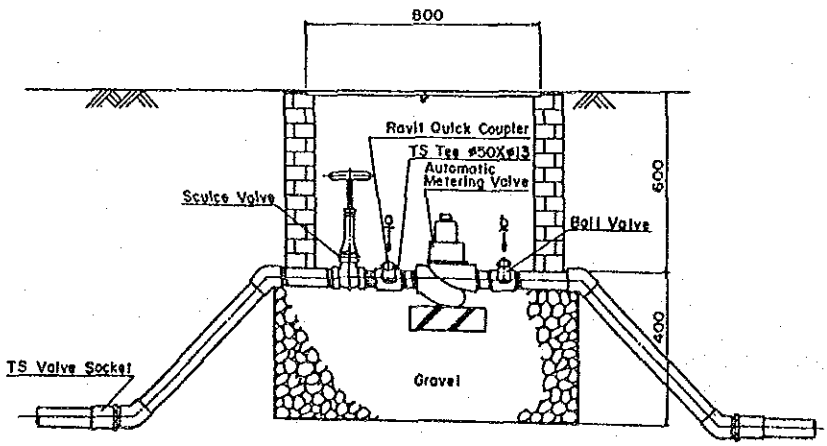
Fig. 4.2 Standard Irrigation Models



A — A



Control Head



Automatic Metering Valve

Fig. 4.3 Details of Valves

4.1.2 Automatic Metering Valve

In order to measure the amount of irrigation water, automatic metering valves are installed for A, B, C and D plots, and E and F greenhouses. The automatic metering valves are automatically closed after spplying pre-set amount of water. A hydraulic relay system is applied for A, B, C and D plots so that these plots is automatically irrigated one by one in order.

4.1.3 No. 2 Well and its Irrigation System

I and J plots (approx. 2 ha) are irrigated by No. 2 Well using the existing pump. Sprinkler irrigation will be mainly carried out, even though control heads are installed, Specifications of the booster pump for this block are also shown in Chapter 8.

4.1.4 Mini Sprinkler for Net House

Narrow Net Houses located in H plot will be irrigated by mini sprinkler system through hydrants which are installed at each net house. Eight sets of mini sprinkler system will be required.

4.2 Hydraulic Analysis

Selection of sprinkler, drip-line and others have been firstly carried out according to the soil conditions and intake facilities, and specifications of irrigation apparatuses have been decided. Based on the specifications, the hydraulic calculations are performed.

In the case of the establishment of irrigation system, the system is divided into two blocks by the wells. The block under No. 1 and 3 Wells is further divided into two sub-blocks which have approximately the same area for the hydraulic calculation. The blocks for the hydraulic calculation are shown in Table 4.1.

Table 4.1 Irrigation Blocks in Experimental Farm

Blocks	Plots	Area (m^2)	Conditions	
No. 1	A	7,600	Open field	
	B	11,200	Open field	
	E1	5,280	Vinylhouse	10 m x 33 m x 16 houses
		(3,168)		
	E2	4,851	Open field	
	F	6,070	Vinylhouse	10 m x 35 m x 5 houses
		(3,930)		10 m x 24 m x 10 houses
				8 m x 24 m x 10 houses
Sub total		35,001	Open field	Approx. 2.36 ha
		(30,749)	Greenhouse	Approx. 1.14 ha
No. 2	C	6,660	Open field	
	D	12,600	Open field	
	G1	3,300	Open field	
	D2	7,150	Open field	
	H*	1,440	Net house	10 m x 47 m x 3 houses
Sub total		31,150	Open field	Approx 2.97 ha
			Net house	Approx 0.14 ha
No. 3	I	10,000	Open field	
	J	9,562	Open field	
Sub total		19,562		
Total		85,713		

Notes:
1. Figures in parenthesis indicate net irrigation area in vinylhouse.
2. * H plot will be irrigated by mini sprinkler system.
3. Location of plots is shown in Fig. 4.1.

4.2.1 Selection of Sprinkler

$$q = \frac{1}{60} D \cdot S1 \cdot Sm \cdot \frac{1}{T}$$

where, q : sprinkler capacity
D : allowable spray intensity
S1 : distance of sprinkler head
Sm : Distance of sprinkler line
T : Irrigation hour

As basic intake rate is estimated to be 23 mm, allowable spray intensity should be 23/3 = 7.7 mm or less. When irrigation hour and sprinkler head interval are assumed to be one hour and 12 x 12 m, respectively, sprinkler capacity is calculated as follows:

$$q = \frac{1}{60} \times 7.67 \times 12 \times 12 = 1{,}104.48 / 60 = 18.41 \text{ lit./min.}$$

Allowable sprinkler capacity is less than 18.41 lit./min. In the case of working pressure of 2.5 kg/cm2, features of the required sprinker are as follows:

Working pressure	:	2.5 kg/cm2
Irrigation intensity	:	18.2 lit./min.
Diameter of irrigation area	:	24.9 m
Nozzle size	:	3.6 x 2.4 mm

In this project, an irrigated area of 5,000 m^2 is covered by four lines of irrigation system with seven sprinkler heads. Discharge of irrigation water will be:

28 x 18.2 = 509.6 lit./min. = 30,576 lit./hr

And an irrigation intensity will be

$$I = \frac{18.2 \times 60}{12 \times 12} = 7.58 \text{ mm/hr}$$

The field water requirements are estimated to be 8.9 mm/day, required irrigation hour will be:

8.9 / 7.58 = 1.17 hours

A required irrigation hour for an area of 1.0 ha will be estimated to be 3.34 hours which consist of 2 times of unit irrigation hour of 1.17 hours and 1 hour resetting.

4.2.2 Selection of Drip-line

(1) Length of drip-line

Length of drip-line is calculated as irrigated area divided by line interval which is 1.0 m in this case. Therefore, length of drip line for a unit area of 1.0 ha is estimated to be 10,000 m.

(2) Estimation of infiltration width

Infiltration width should be determined through actual field test. However, the following standard values are used in case of no data.

Sand and sandy loan	:	0.30 m
Loam	:	0.40 m
Clay loan and clay	:	0.50 m

(3) Discharge of drip-line

Discharge of drip-line is calculated with following formula.

$q = Lp \times qE / LE$

where, q : Discharge (lit./min.)
Lp : Drip-line length (m)
qE : Discharge per emitter (lit./min.)
LE : Interval of emitter (m)

As the soil in the experimental farm is classified as loam and/or clay loam, interval of emitter is 0.40 m. Total discharge of drip-line for a unit area of 1.0 ha (10,000 m^2) will be calculated below:

$q = 10,000 \times qE / 0.4 = 25,000\ qE$

As the field water requirements, and 89,000 lit./day, discharge from an emitter will be

$qE = 89,000 / 25,000 = 3.56$ lit./day

Furthermore, irrigation hour should be 1.17 hr or more which is estimated based on the basic intake rate (refer to 4.2.1).

When irrigation hour is 3 and 2 hours, the discharge per emitter will be as follows:

3 hours: $3.56 / 3 = 1.18$ lit./hr
2 hours: $3.56 / 2 = 1.78$ lit./hr

As some farm plots have a drip-line of its length of more than 100 m, drip-line should fulfill following conditions:

Drip-line length	:	110 - 120 m
Pressure loss	:	10% or less
Emitter interval	:	0.4 m
working pressure	:	1.0 - 1.5 kg/cm^2

A drip-line with working pressure of 1.25 kg/cm^2, discharge of 1.17 lit./hr and emitter interval of 0.4 m, is adopted for the project.

(4) Irrigation hour of drip-line

The total irrigation area of No. 1 and 3 Wells irrigation system except net houses is 60,459 m^2. In this case, total number of emitter is 60,459 / 0.4 = 151,158. When all emitters release a discharge of 1.17 lit./hr each at the same time, the total discharge is estimated as follows.

151,148 x 1.17 = 176,843 lit./hr

As the pump capacity is 1,500 lit./min. (90,000 lit./h), the total irrigation area should be divided into two parts, (176.843 / 2 = 88,422 90,000 lit./hr). The total amount of irrigation water for an area of 30,230 m2 with the field water requirement of 8.9 mm is calculated below:

30,230 x 8.9 = 269,047 lit.

When this amount of water is irrigated with a rate of 88,422 lit./h, 3.04 hours will be required (269,047/88,422 = 3.04).

4.2.3 Irrigation Practice and Equipment

Irrigation practice and equipment which are mentioned in Sections 4.2.1 and 4.2.2, are summarized in Tables 4.2 and 4.3.

Table 4.2 Irrigation Practice

	Equipment		
	Drip-line	Mini Sprinkler	Sprinkler
1. Unit irrigation hour	3 hr	2.03 hr	1.17 hr
2. Times of resetting per day	-	2 times	3 times
3. Net irrigation hour per day	6 hr	6.09 hr	4.68 hr
4. Resetting hour per day		1.0 hr	3 hr
5. Working hour per day	6.0 hr	7.09 hr	7.76 hr
6. Number of lines in standard plot	-	-	4
7. Unit irrigation area	3 ha	-	0.5 ha
8. Irrigation area per day	6.0 ha	0.14 ha	2.0 ha

Table 4.3 Specifications of Irrigation Equipment

		Equipment		
		Drip-line	Mini Sprinkler	Sprinkler
1. Nozzle pressure	(kg/cm^2)	1.25	2.0	2.0
2. Discharge	(lit./min.)	0.018	4.38	18.2
3. Diameter of irrigation area	(m)	1.0	13.0	24.9
4. Interval	(m)	0.4	5.4	12 x 12
5. Irrigation intensity	(mm/hr)	2.7	4.38	7.6

4.2.4 Hydraulic Calculation of Pipeline

(1) For the hydraulic calculation of pipeline, Hazen William's formula is employed.

(2) Unplasticized polyvinyl chloride pipe (JIS K6741) is used, and diameter of pipe is 150 mm or less. Coefficient of roughness C is 140.

$$V = 0.35464 \times C \times D^{0.63} \times I^{0.54}$$

$$Q = 0.27853 \times C \times D^{2.63} \times I^{0.54}$$

$$D = 1.6258 \times C^{-0.38} \times Q^{0.38} \times I^{-0.205}$$

$$I = \frac{hf}{L} = 10.666 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85}$$

where,
- V : Velocity, m/sec
- Q : Discharge, m^3/sec
- D : Diameter of pipe, m
- I : Hydraulic gradient
- hf : Friction loss of head, m
- L : Length of pipeline, m
- C : Coefficient of roughness (140)

(3) Allowable maximum velocity of pipe is 5.0 m/sec. Design velocity, however, should be in a range of standard design velocity of, 0.7 to 1.0 m/sec as much as possible.

Table 4.4 Standard Design Velocity and Allowable Maximum velocity

Diameter of pipe (mm)	Standard design velocity (m/sec)	Allowable max. velocity (m/sec)
75 - 150	0.7 - 1.0	5.0
200 - 400	0.9 - 1.6	
450 - 700	1.2 - 1.8	

(4) Results of the hydraulic calculation are shown in Table 4.5. Maximum velocity and maximum friction loss of heads in the pipeline system are estimated to be 2.18 m/sec and 7.94 m, respectively.

4.2.5 Hydraulic Calculation of Unsteady Flow

(1) Estimation of water-hammer pressure

Water-hammer pressure in a closed-type pipeline system can be roughly estimated based on the hydrostatic pressure as follows:

	Hydrostatic pressure		Water-hammer pressure
a.	Less than 3.5 kg/cm^2	:	100% of the hydrostatic pressure
b.	3.5 kg/cm^2 or more	:	40% of the hydrostatic pressure or 3.5 kg/cm^2 which is bigger

In this case, the hydrostatic pressure is calculated to be 4.0 kg/cm^2. Therefore, the water-hammer pressure is set at 3.5 kg/cm^2.

4.3 Design of Pipeline

4.3.1 Selection of Pipe Material

Unplasticized polyvinyl chloride pipe (PVC) is adopted because of its easy handling and good economy.

4.3.2 Thickness of Pipe

In the case of pipe with a diameter of 150 mm or less, following formula is applied.

$$t \geqq \frac{H_1 + H_2}{2\ a}\ d$$

where t : Design thickness of pipe (cm)

H_1: Hydrostatic pressure 4.0 (kg/cm^2)

H_2: Water-hammer pressure 3.5 (kg/cm^2)

a: Allowable stress (100 kg/cm^2, polyvinyl)

d : Inside diameter of pipe (cm)

Therefore,

$$t = \frac{4.0 + 3.5}{2 \times 100} d = 0.0375d$$

When d is 10 cm, 0.038 x 10 = 0.38 cm and when d is 7.5 cm, 0.038 x 7.5 = 0.28 cm

Thicknesses of VP pipe with a diameter of 10 and 7.5 cm are 0.71 and 0.59 cm, respectively. Therefore, VP pipes which are on the market can be used for the project.

4.3.3 Laying Depth of Pipe

Standard laying depth of pipe (from ground surface to pipe crown) is 1.20 m under public road, 1.20 m for pipe with diameter of 500 mm or more and 1.0 m for that of 450 mm or less under farm road, and 0.6 m under farm land. In Beijing, depth of frost penetration is estimated to be 80 to 100 cm. Therefore, in this project a laying depth of 100 cm is adopted for either under farm road or farm land.

4.3.4 Foundation of Pipe

Considering safety of pipeline, sand bed is placed under the pipe. Thickness of the sand bed is 10 cm in the normal ground condition.

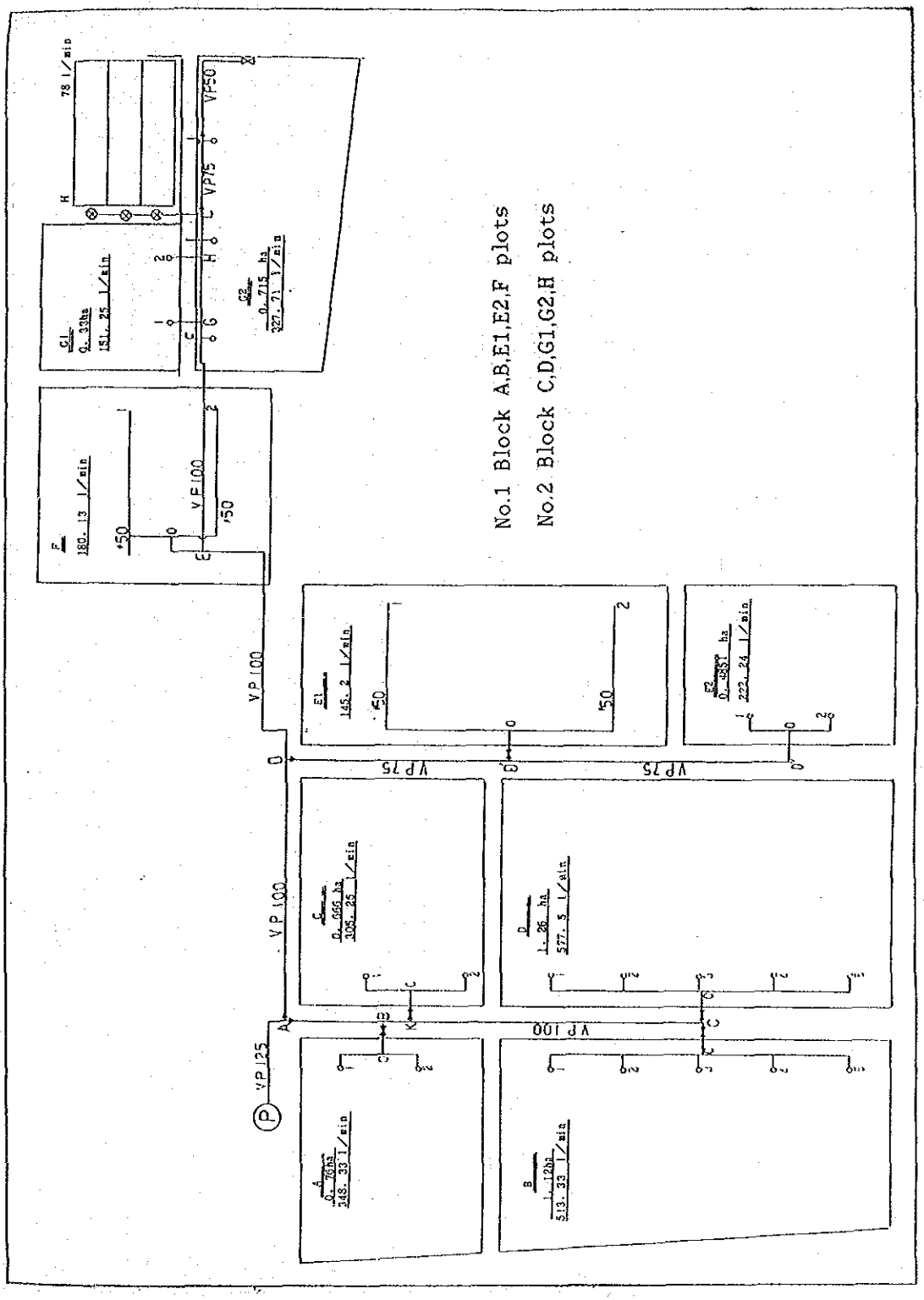


Fig. 4.4 Irrigation Pipeline System - 1

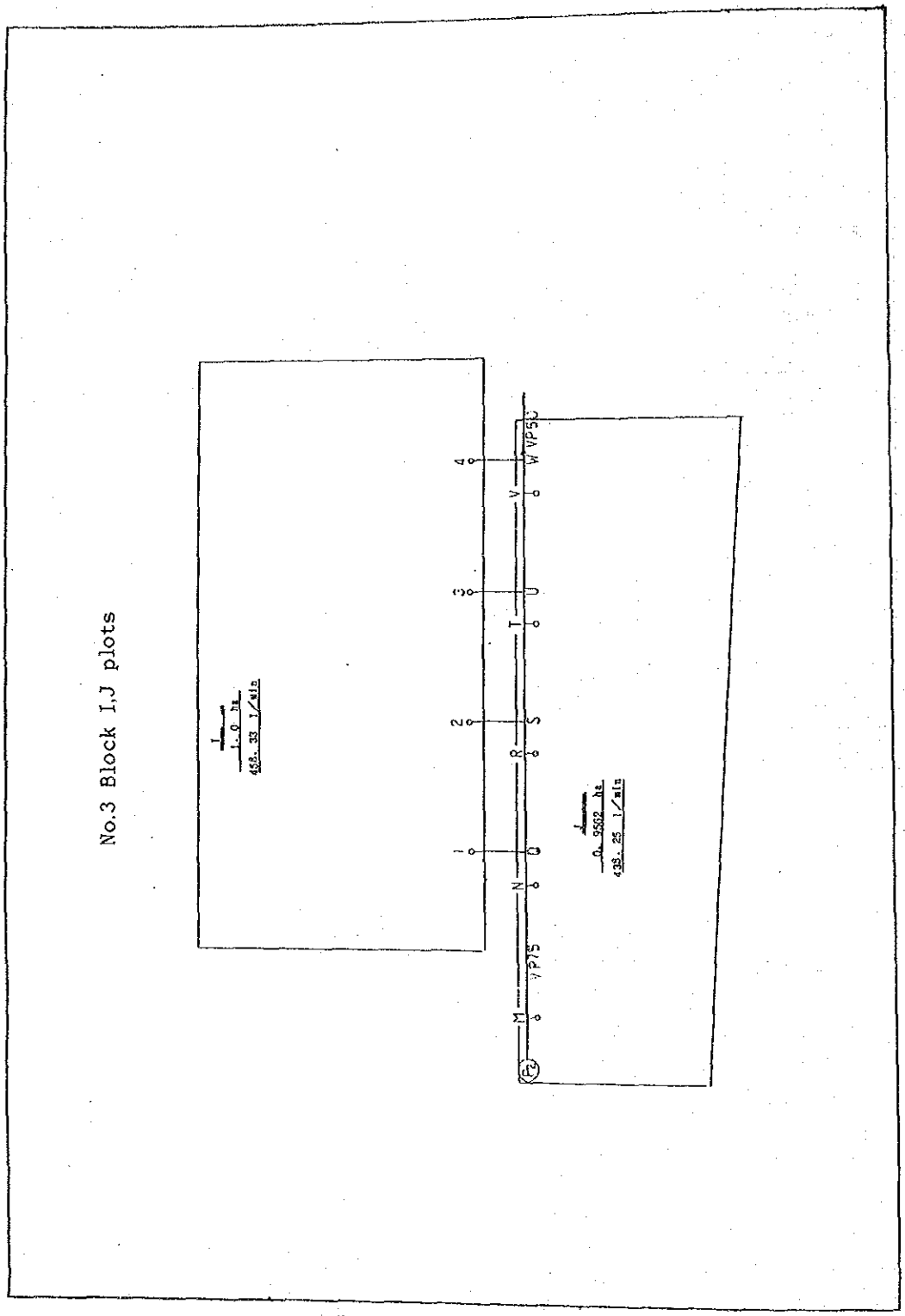


Fig. 4.5 Irrigation Pipeline System - 2

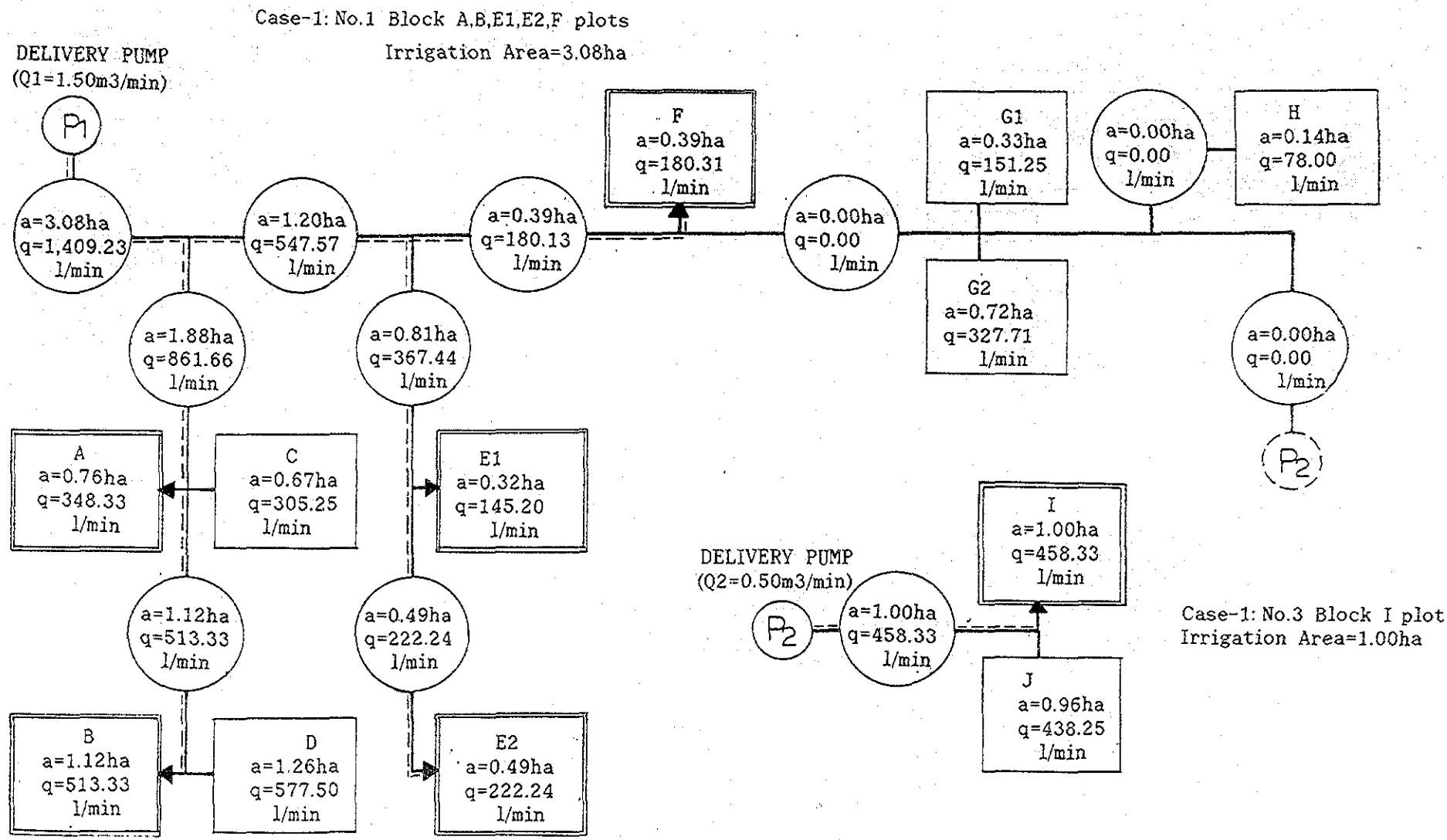


Fig.4.6 Irrigation Diagram-1

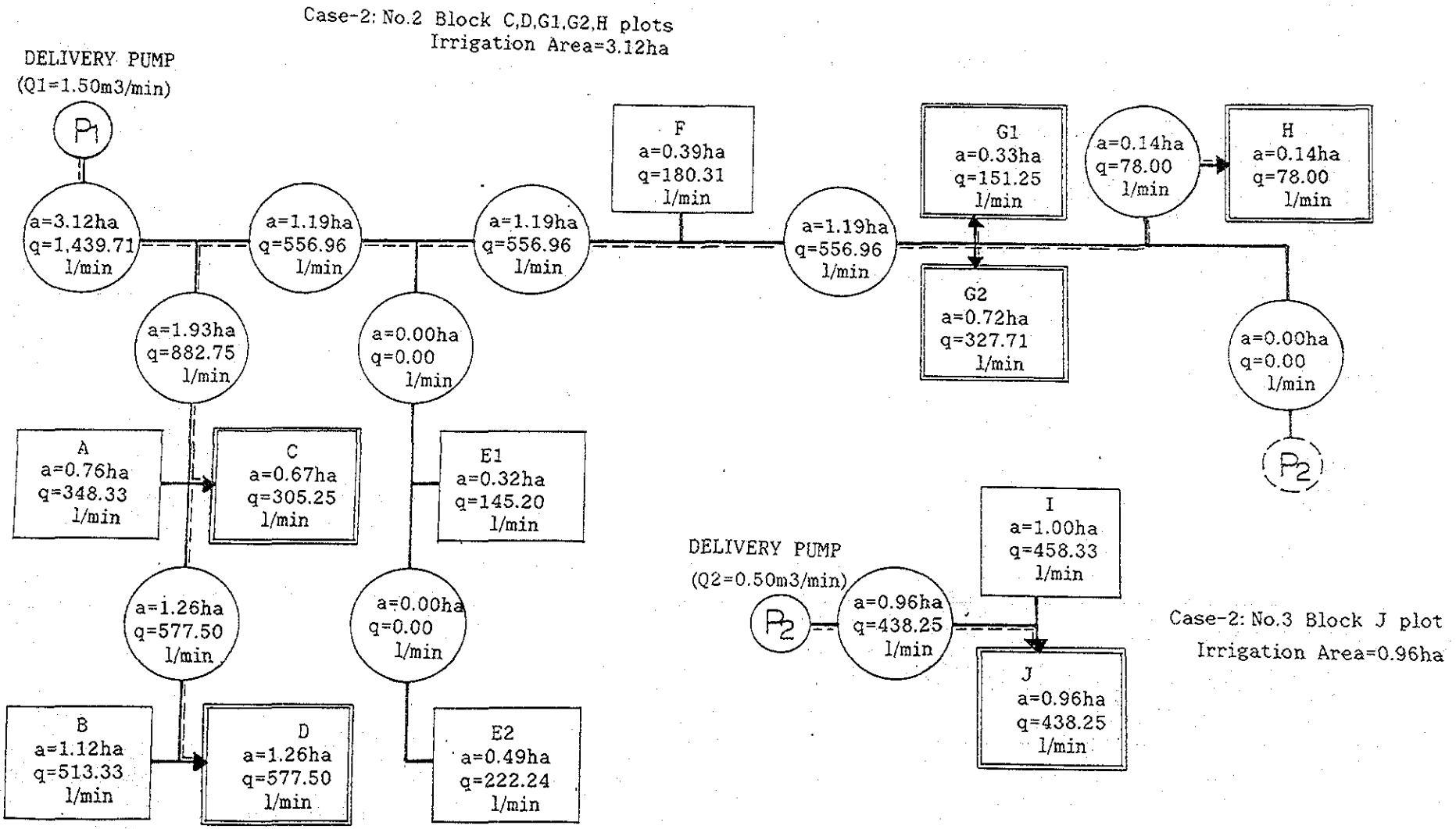


Fig.4.7 Irrigation Diagram-2

Table 4.5 Hydraulic Calculation of Irrigation Pipeline - 1

No. 1 Block Case 1 Drip irrigation

Plot & Section	Length (m)	Discharge (l/min)		Diameter (mm)	Velocity (m/sec)		Head Loss Section (m)	Head Loss Total (m)
P ~ A	40	1409.23		125	1.91		1.11	
A ~ B	27.5	861.66		100	1.83		0.91	2.02
B ~ C	115	513.33		100	1.09		1.46	3.48
A ~ D	91	547.57		100	1.16		1.3	2.41
D ~ D'	73	367.44		75	1.39		2.02	4.43
D ~ E	162	180.13		100	0.38		0.3	2.71
A								
B ~ 0	3	348.33		75	1.31		0.08	2.1
0 ~ 1	24	174.165		50	1.48		1.2	3.3
0 ~ 2	12	174.165		50	1.48		0.6	2.7
B								
C ~ 0	3	513.33		75	1.94		0.15	3.63
0 ~ 3	1	307.998		75	1.16		0.02	3.65
3 ~ 2	28	205.332		75	0.78		0.26	3.91
2 ~ 1	28	102.666		50	0.87		0.53	4.44
0 ~ 4	28	205.332		75	0.78		0.26	3.89
4 ~ 5	28	102.666		50	0.87		0.53	4.42
E1								
D' ~ 0	12	145.2		50	1.23		0.43	4.86
0 ~ 1	82	72.6		50	0.62		0.81	5.67
0 ~ 2	88	72.6		50	0.62		0.87	5.73
E2								
D' ~ D"	118	222.24		75	0.84		1.29	5.72
D" ~ 0	12	222.24		50	1.89		0.94	6.66
0 ~ 1	13	111.12		50	0.94		0.28	6.94
0 ~ 2	13	111.12		50	0.94		0.28	6.94
F								
E ~ 0	10	180.13		50	1.53		0.53	3.24
0 ~ 1	126	112.2						
0 ~ 2	111	67.93						

Table 4.5 Hydraulic Calculation of Irrigation Pipeline - 2

No. 1 Block Case 2 Drip irrigation and Sprinkler irrigation at E2

Plot & Section	Length	Discharge		Diameter	Velocity		Head Loss Section	Total
	(m)	(l/min)		(mm)	(m/sec)		(m)	(m)
P ~ A	40	1368.99		125	1.86		1.05	
A ~ D	91	507.33		100	1.08		1.13	
D ~ D'	73	327.2		75	1.24		1.63	3.81
E2								
D' ~ D"	118	182		75	0.69		0.89	4.7
D" ~ O	12	182		50	1.55		0.65	5.35
O ~ 1	13	182		50	1.55		0.71	6.06

Table 4.5 Hydraulic Calculation of Irrigation Pipeline - 3

No. 2 Block Case 1 Drip irrigation

Plot & Section	Length (m)	Discharge (l/min)	Diameter (mm)	Velocity (m/sec)	Head Loss Section (m)	Head Loss Total (m)
P ~ A	40	1439.71	125	1.96	1.15	
A ~ K	41.5	882.75	100	1.87	1.43	2.58
K ~ C	101	577.5	100	1.23	1.59	4.17
A ~ D	91	556.96	100	1.18	1.34	
D ~ E	162	556.96	100	1.18	2.38	4.87
E ~ F	121	556.96	100	1.18	1.78	6.65
C						
K ~ 0	3	305.25	75	1.15	0.06	2.64
0 ~ 1	12	152.625	50	1.3	0.47	3.11
0 ~ 2	24	152.625	50	1.3	0.94	3.58
D						
C ~ 0	3	577.5	75	2.18	0.19	4.36
0 ~ 3	1	346.5	75	1.31	0.02	4.38
3 ~ 2	28	231	75	0.87	0.33	4.71
2 ~ 1	28	115.5	50	0.98	0.66	5.37
0 ~ 4	27	231	75	0.87	0.32	4.68
0 ~ 5	28	115.5	50	0.98	0.66	5.34
G1						
F ~ G	8	447.76	100	0.95	0.08	6.73
G ~ 1	6	75.625	50	0.64	0.06	6.79
G ~ H	25	372.135	100	0.79	0.17	6.9
H ~ 2	6	75.625	50	0.64	0.06	6.96
G2						
H ~ I	1	296.51	100	0.63	0.0	6.9
I ~ J	34	109.31	75	0.41	0.1	7.0
H						
I ~ L	4	187.31	100	0.4	0.01	6.91
L ~ 1	13	78	40	1.04	0.44	7.35
1 ~ 2	10	52	40	0.69	0.16	7.51
2 ~ 3	10	26	25	0.88	0.43	7.94

Table 4.5 Hydraulic Calculation of Irrigation Pipeline - 4

No. 2 Block Case 2-1 Drip Irrg. and Sprinkler Irrg. at G

Plot & Section	Length (m)	Discharge (l/min)		Diameter (mm)	Velocity (m/sec)		Head Loss Section (m)	Total (m)
P ~ A	40	1385		125	1.88		1.07	
A ~ D	91	502.25		100	1.07		1.11	2.18
D ~ E	162	502.25		100	1.07		1.97	4.15
E ~ F	121	502.25		100	1.07		1.47	5.62
G								
F ~ G	8	502.25		100	1.07		0.1	5.72
G ~ H	25	426.625		100	0.91		0.22	5.94
H ~ I	1	351		100	0.75		0.01	5.95

No. 2 Block Case 2-2 Drip Irrg. and Sprinkler Irrg. at D

Plot & Section	Length (m)	Discharge (l/min)		Diameter (mm)	Velocity (m/sec)		Head Loss Section (m)	Total (m)
P ~ A	40	1299.01		125	1.77		0.95	
A ~ K	41.5	742.05		100	1.58		1.04	1.99
K ~ C	101	436.8		100	0.93		0.95	2.94
D								
C ~ 0	3	436.8		75	1.65		0.11	3.05
0 ~ 3	1	218.4		75	0.82		0.01	3.06
3 ~ 2	28	218.4		75	0.82		0.3	3.36
2 ~ 1	28	218.4		50	1.85		2.13	5.49

Table 4.5 Hydraulic Calculation of Irrigation Pipeline - 5

No. 3 Block Case 1 Drip Irrigation

Plot & Section	Length	Discharge		Diameter	Velocity		Head Loss Section	Total
	(m)	(l/min)		(mm)	(m/sec)		(m)	(m)
I								
P2 ~ Q	48	458.33		75	1.73		2.0	
Q ~ 1	6	114.6		50	0.97		0.14	2.14
Q ~ S	25	343.73		75	1.3		0.61	2.61
S ~ 2	6	114.6		50	0.97		0.14	2.75
S ~ U	25	229.13		75	0.86		0.29	2.9
U ~ 3	6	114.6		50	0.97		0.14	3.04
U ~ W	25	114.53		75	0.43		0.08	2.98
W ~ 4	6	114.53		50	0.97		0.14	3.12
J								
P2 ~ M	7	438.25		75	1.65		0.27	
M ~ N	25	350.6		75	1.32		0.63	0.9
N ~ R	25	262.95		75	0.99		0.37	1.27
R ~ T	25	175.3		75	0.66		0.18	1.45
T ~ V	25	87.65		75	0.33		0.05	1.5

No. 3 Block Case 2 Sprinkler irrigation

Plot & Section	Length	Discharge		Diameter	Velocity		Head Loss Section	Total
	(m)	(l/min)		(mm)	(m/sec)		(m)	(m)
I								
P2 ~ U	98	382.2		75	1.44		2.92	
U ~ 3	6	127.4		50	1.08		0.17	3.09
U ~ W	25	254.8		75	0.96		0.35	3.27
W ~ 4	6	254.8		50	2.16		0.61	3.88
J								
P2 ~ T	82	436.8		75	1.65		3.13	
T ~ V	25	218.4		75	0.82		0.26	3.39

CHAPTER 5 PROJECT COST ESTIMATION

CHAPTER 5 PROJECT COST ESTIMATION

5.1 Outline of Construction Works

Civil works and installation of irrigation facilities will be carried out by a Chinese construction corporation. Some construction materials and equipment such as pipes, irrigation equipment and others which cannot be found on the market in China will be procured in Japan and supplied to the construction corporation through JICA office in China. Outline of construction works is summarized in Table 5.1.

5.2 Procedure for Cost Estimation

Estimation of construction cost has been carried out based on the table of standard construction cost of Beijing Municipal Construction Committee, 1986, the cost estimation data of the Model Infrastructure Improvement Works for integrated agricultural experimental field in San Jiang Plain of China and the cost estimation standard of the Japanese Ministry of Agriculture, Forestry and Fisheries. Price of supplied materials is estimated as Japanese market price plus transportation cost to the Centre. Indirect cost is estimated to be 30% of the direct construction cost, and a contingency is estimated 10% of the construction cost. The total project cost includes miscellaneous cost of 5% of the total construction cost.

Table 5.1 Summary of Construction Works

Item	Volume	Remarks
1. Pipeline	2,134 m	
ϕ125	40 m	PVC Socket Pipe
ϕ100	557 m	"
ϕ 75	471 m	"
ϕ 50	807 m	PVC Pipe
ϕ 40	23 m	"
ϕ 25	236 m	"
2. Irrigation facilities		
Drip	4.52 ha	A, B, C, D plots and E1, F vinylhouse
Sprinkler	1 Unit	7 sets x 4 line
Mini sprinkler	1 Unit	8 sets x 1 line
Control head	30 sets	
Chemical injector	1 set	
3. Valves		
Sluice valve	5 Unit	
Air valve	3 Unit	
Scouring valve	9 Unit	
Metering valve	6 Unit	
4. Miscellaneous	L.S.	Arrangement of roads and drain canals

5.3 Project Cost Estimation

The project cost of Model Infrastructure Works for Beijing Vegetable Research Centre Project is shown in Table 5.2. Exchange rate is taken 1 yuan = ¥35.0 = US$3.6 at the end of April, 1988.

Table 5.2 Project Cost

Item	Amount (Japanese Yen)
A. Direct Construction Cost	
1. Construction Cost	1,301,000
2. Procured Materials Cost	20,070,000
Sub total	21,371,000
B. Indirect Cost (A.1 x 30%)	390,000
Total (A + B)	21,761,000
C. Contingency (10%)	2,176,000
Total	23,937,000
D. Miscellaneous Cost (within 5%)	1,063,000
Grand Total (A - D)	25,000,000

5.4 Breakdown of Construction Cost

Breakdown of the construction cost is shown in Table 5.3 (Refer to chapter 8 Appendices about the statement of items).

Table 5.3 Construction Cost

	Quantity	Amount (¥)	Remarks
1. Pipline Works			
a) Pipline earth works	2,134 m	871,000	Section (A)
b) Pipe laying works	2,134 m	36,000	Section (B)
c) Installation of valves	L.S.	23,000	Section (C)
Total		930,000	
2. Irrigation facilities			
a) Installation of dripline	4.52 ha	40,000	Section (D)
b) Installation of control head	30 sets	19,000	Section (E)
Total		59,000	
3. Construction of valve hole			
a) Sluice valve hole	5 unit	36,000	Section (F)
b) Air valve hole	3 unit	22,000	Section (G)
c) Scour valve hole	9 unit	167,000	Section (H)
d) Metering valve hole	6 unit	21,000	Section (I)
Total		246,000	
4. Appurtenant works	L.S.	66,000	Section (J)
Grand Total		1,301,000	

5.5 Procured Materials

It is necessary to procure from Japan some construction materials and equipment such as pipes, dripline, sprinkler and valves which cannot be procured on the market in China.

These items are shown in Table 5.4.

Table 5.4 Cost of Equipment and Materials -1

Item	Specification	Unit	Q'ty	Unit Price	Amount (¥)
1. Pipeline					
PVC pipe (TS)	ø125 x 4m	no.	11	7,450	81,950
(TS)	ø100 x 4m	"	147	5,650	830,550
(TS)	ø 75 x 4m	"	122	3,880	473,360
	ø 50 x 4m	"	208	1,820	378,560
	ø 40 x 4m	"	7	1,280	8,960
	ø 25 x 4m	"	76	725	55,100
				Sub-total	(1,282,480)
Fitting materials for PVC	TS	L.S.			334,365
MF joint	ø125, 75	"			20,500
Galvanized Steel Pipe (SGP)	ø125 - ø20	"			547,600
Fitting materials for SGP	socket, elbow, tee	"			650,215
Pipe with flanges	ø125, 75	"			115,900
Elbow with flanges	ø125, 75	"			195,000
Accessaries	solvent cement	"			7,500
Sub-Total					3,699,560

Table 5.4 Cost of Equipment and Materials -2

Item	Specification	Unit	Q'ty	Unit Price	Amount (¥)
2. Valves					
Sluice valve	with handwheel ø125 -ø20	L.S			350,500
Air valve	ø 50	no.	5	55,000	275,000
Sluice valve	without handwheel ø100	"	3	38,400	115,200
"	" ø75	"	1	28,700	28,700
"	" ø50	"	1	23,000	23,000
Scour valve	ø50	"	9	23,000	207,000
Angle valve	ø50, 25 x 90°	L.S	1		61,800
Metering valve	3"	no.	4	178,000	712,000
"	2"	"	2	115,000	230,000
Accessaries	riser saddle etc	L.S			37,700
Sub-Total					2,040,900
3. Drip					
Polyethylene pipe	ø50	m	420	620	260,400
"	7/8"	"	277	250	69,250
Dripline	ø16	"	45,158	130	5,870,540
Accessaries		L.S			625,850
Sub-Total					6,8260,040
4. Control Head					
Cock	ball, 3-way valve	L.S			511,000
Pressure gauge		no.			170,400
Pressure-reducing valve	ø40	no.			780,000
"	ø20	"			143,500
Accessaries		L.S			690,000
Sub-Total					2,294,900

Table 5.4 Cost of Equipment and Materials -3

Item	Specification	Unit	Q'ty	Unit Price	Amount (¥)
5. Mini-sprinkler					
Mini-sprinkler	ø2.5mm	no.	8	1,500	12,000
Accessaries		L.S			53,110
Sub-Total					65,110
6. Sprinkler					
Sprinkler head	3.6 x 2.4mm				154,000
Aluminium pipe	ø50 x 6m	no.	32	5,500	400,000
"	(riser) ø50 x6m	no.	28	12,500	406,000
Riser with supports	3/4" x 1m	"	28	14,500	162,400
Accessaries		L.S		5,800	58,800
sub-Total					1,181,200
7. Filter					
Filter	6"	no.	1	500,000	500,000
"	3"	no.	1	160,00	160,000
Sub-Total					660,000
8. Chemical injector	with hydraulic motor	no.	1	197,000	197,000
9. Water level gauge	with 3 points	L.S			306,000
Total					17,270,710
Transportation cost	Japan - Beijing	L.S			2,800,000
Grand Total					20,070,710
				Say	20,070,000

Table 5.5 Transportation Cost

Item	Specification	Unit	Q'ty	Unit Price	Amount (¥)
1. Packing charge		m^3	100	9,000	900,000
2. Loading charge Container 20t					
a) Out-in container yard		m^3	100	3,000	300,000
b) Transportation fee		unit	6	15,000	90,000
c) Fixing fee		"	6	17,000	102,000
Sub-Total					492,000
3. Customs clearance fee		L.S			5,600
4. Transportation fee					
a) Ocean freight	Japan - Chinese port	unit	6	120,000	720,000
b) Road transporation	Chinese port - Beijing	"	6	98,000	588,000
Sub-Total					
5. Insurance	(Materials cost and transportation fee) x 0.5%	L.S			100,000
Grand Total					2,805,600
				Say	2,800,000

CHAPTER 6 PROJECT IMPLEMENTATION

CHAPTER 6 PROJECT IMPLEMENTATION

6.1 Construction Planning

6.1.1 Construction System

The Beijing municipal No. 2 construction corporation is carrying out some construction works in the Centre and will construct the storage tank, the new experimental farm and others. Therefore, it is desirable to make a contract with this corporation to construction the irrigation system with a view to facilitating the implementation.

6.1.2 Construction Materials

PVC pipes, drip-line, sprinkler and others which cannot be found on the Chinese market will be procured in Japan. However, cement, timber, stone, pre-fabricated concrete materials can be supplied at the project site.

6.1.3 Construction Method

Construction works should be mainly carried out by manual operation in accordance with the Japanese and Chinese standards and conditions considering site.

6.1.4 Schedule

The exchange of a verbal note will be expected on late July 1988. After the contract which will take one month, the construction should be started from middle of September and completed by late November before winter season. It will take around 70 days. It takes about 1.5 months to send the materials from Japan. Therefore, the contract concerned should be concluded before end of August.

A construction supervise expert is required from the contract of construction works to the completion of construction works, from middle of August to early December.

6.2 Implementation Schedule

The construction period will be around two and harf months. The estimated implementation schedule of construction is shown in Fig. 6.1.

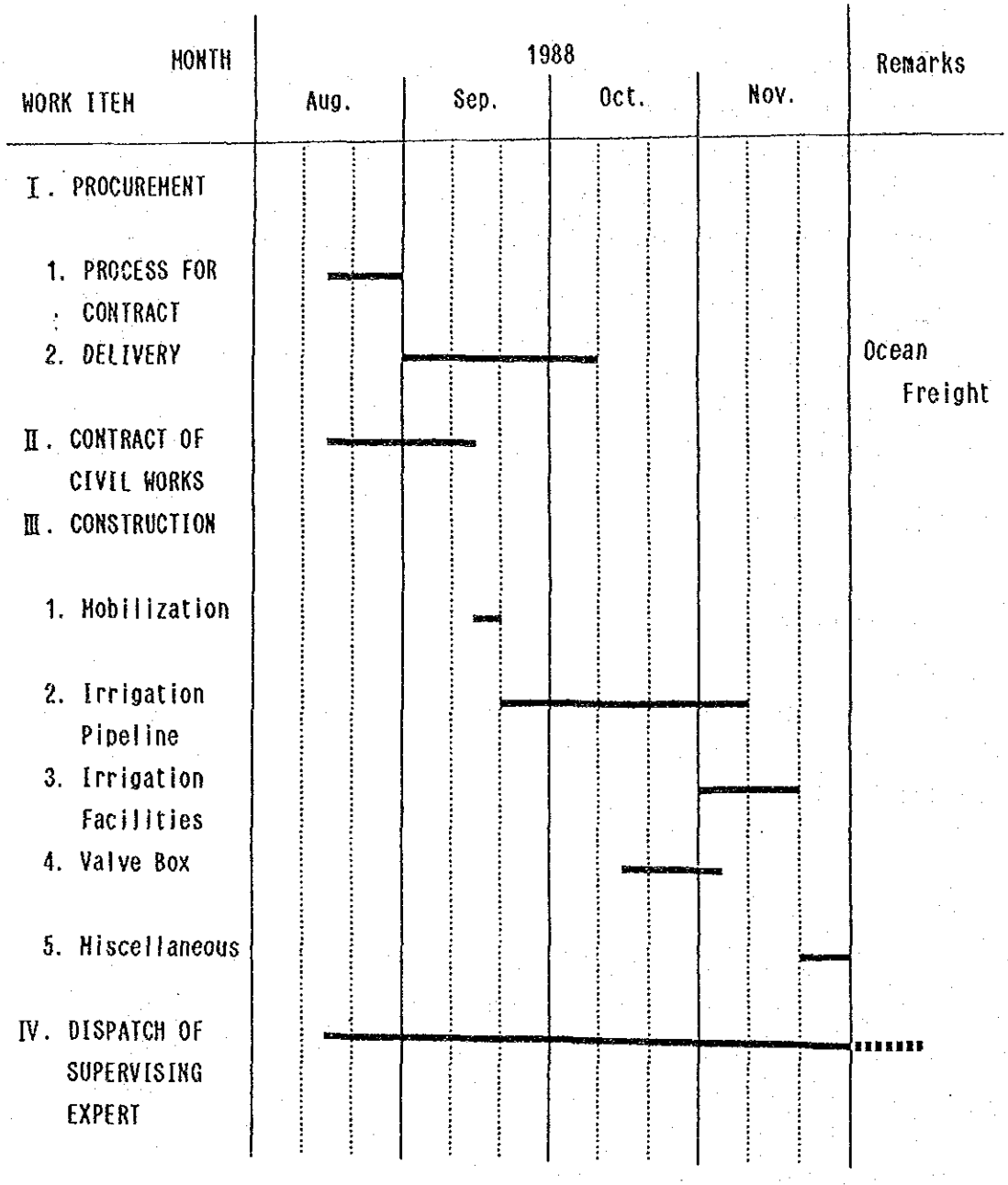


Fig. 6.1 Implementation Schedule

CHAPTER 7 TENDER DOCUMENTS

CHAPTER 7 TENDER DOCUMENTS

7.1 Contract Agreement, Conditions of Contract (Draft)

(See Chapter 8 Appendices)

Referring to the similar projects, the draft contract agreement shown in APPENDIX is prepared. Main items mentioned are as follows:

- Preface, name of Project, employer and contractor
- Purpose of the Works and contract amount
- Scope of Works
- Payment, advance payment (40%), final payment (60%)
- Time for completion and delays
- Compensation to JICA for damages caused by the Contractor's failure
- Alteration in drawings of the Works
- Inspection and delivery of the Works
- Defect liability, one (1) year period
- Subcontractors
- Settlement of disputes
- Signing

7.2 General Conditions (Draft)

(See Chapter 8 Appendices)

This general conditions referes to the specifications of other similar projects, and it stipulates an outline of the operation and a description of the methods for the execution of the Works.

7.3 Technical Specifications (Draft)

(See Chapter 8 Appendices)

Detailed descriptions which shall be restrictively followed for the construction of the Works by the Contractor are stipulated item by item.

7.4 Tender Drawings

(See Chapter 8 Appendices)

Table 7.1 List of Drawings

Work Item	Drawing Title	Number
General	Location Map	1
"	General Layout	1
Pipe Line	Pipe Arrangement of Pipeline Irrigation System	1
Drip Irrigation	Drip Irrigation System	1
Sprinkler Irrigation	Sprinkler Irrigation System	1
Others	House Drip Irrigation System, Net	1
	House Sprinkler Irrigation System	
	Valve Box and Hydrant	1

CHAPTER 8 APPENDICES

CHAPTER 8 APPENDICES

8.1 Data of the Survey Team

8.1.1 Members of the Survey Team

The team consists of four experts including team leader as listed below;

Osamu SEINO	Team Leader	Technical Cooperation Officer, International Cooperation Division, Economic Bureau, Ministry of Agriculture, Forestry and Fisheries
Kazumi KOBAYASHI	Coordinator	Agricultural Development Division, Agricultural Development Cooperation Dept., Japan International Cooperation Agency (JICA)
Yasuro HAGIHARA	Planning of Upland Irrigation	Agricultural and Rural Development Dept., Pacific Consultants International
Osamu YAMAMOTO	Design of Irrigation Facilities	Agricultural and Rural Development Dept., Pacific Consultants International

8.1.2 Itinerary of the Team

	Date		Description
1.	March 30	(Wed.)	Trip (TYO-BJN) by CA-926
2.	March 31	(Thu.)	Greeting to Embassy of Japan and JICA China office
3.	April 1	(Fri.)	Discussion in the Beijing Vegetable Research Centre
4.	April 2	(Sat.)	Greeting to the State Science and Technology Academy
5.	April 3	(Sun.)	Data arrangement
6.	April 4	(Mon.)	Discussion in BVRC
7.	April 5	(Tue.)	Discussion in BVRC
8.	April 6	(Sed.)	Discussion in BVRC
9.	April 7	(Thu.)	Preparation of Team Leader's Letter
10.	April 8	(Fri.)	Visiting Embassy of Japan and JICA China office/Trip (BJN-TYO) by JL-782
11.	April 9	(Sat.)	Data arrangement
12.	April 10	(Sun.)	Data arrangement
13.	April 11	(Mon.)	Discussion in BVRC
14.	April 12	(Tue.)	Investigation of Beijing Plastics Factory No. 7
15.	April 13	(Wed.)	Visiting 2nd Light Industrial Corporation
16.	April 14	(Thu.)	Field survey in the experimental farm
17.	April 15	(Fri.)	Field survey in the experimental farm
18.	April 16	(Sat.)	Discussion in JICA China office
19.	April 17	(Sun.)	Data arrangement
20.	April 18	(Mon.)	Investigation of Beijing Plastic Product Factory
21.	April 19	(Tue.)	Construction material survey
22.	April 20	(Wed.)	Discussion in BVRC and JICA China office
23.	April 21	(Thu.)	Additional field survey
24.	April 22	(Fri.)	Visiting National Technical Import & Export Corp.
25.	April 23	(Sat.)	Estimate of construction cost
26.	April 24	(Sun.)	Data arrangement and preparation of field report
27.	April 25	(Mon.)	Discussion in BVRC and preparation of field report
28.	April 26	(Tue.)	Additional market research
29.	April 27	(Wed.)	Discussion in BVRC and preparation of field report
30.	April 28	(Thu.)	Discussion in BVRC and preparation of field report
31.	April 29	(Fri.)	Reporting Embassy of Japan and BVRC
32.	April 30	(Sat.)	Reporting JICA China office
33.	May 1	(Sun.)	Data arrangement
34.	May 2	(Mon.)	Data arrangement
35.	May 3	(Tue.)	Trip (BJN-TYO) by UA-890

8.1.3 Team Leader's Letter

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)
DETAILED DESIGN SURVEY TEAM
FOR
THE BEIJING VEGETABLE RESEARCH CENTER PROJECT

April 7, 1988

Mrs. Chen Hang
Director of the Beijing Vegetable Research Center

RE: Model Infrastructure Improvement Works for the Beijig Vegetable Research Center Project

We, the Detailed Design Survey Team, have been organized by JICA for the purpose of promoting the Model Infrastructure Improvement Works for the Beijing Vegetable Research Center Project.

The Team has, so far made a series of field survey and discussions with the staffs concerned of the Project in order to determine the outline of the Works. We would like to hereby confirm the items which have been agreed to mutually.

In accordance with the above confirmed items, we will proceed to do further field survey and to make the detailed design of the Works. After the completion of the detailed design and assessment of the cost of the Works estimated by JICA, you will receive the Final Report of the Team through the JICA China Office.

Further, for the timely start of the construction we request you to take the necessary action of going through formalities, while consulting with the JICA China Office.

Lastly, we would like to appreciate the hospitality and cooperation of the Chinese staffs concerned of the Project during our stay.

Sincerely yours,

清野 修

Osamu Seino
Team Leader

cc: 1)State Science and Technology Commission of China
2)Embassy of Japan in China
3)JICA China Office

1.OBJECTIVE OF THE MODEL INFRASTRUCTURE IMPROVEMENT WORKS AND THE DETAILED DESIGN SURVEY TEAM

(1)In the Beijing Vegetable Research Center Project, it is urgently necessary to prepare the irrigation facilities of the Experimental Farm that serve for the activities of the Project.

(2)The Team was dispatched in order to make a detailed design of the above mentioned irrigation facilities based on the investigation at the site of the Project.

2.BASIC PLAN OF THE MODEL INFRASTRUCTURE IMPROVEMENT WORKS

The Team has decided the basic plan of the Works as follows through a series of field survey and discussions with the Chinese counterparts and the Japanese experts. The irrigation facilities' plan is as shown in the ANNEX 1. However, some items may be changed by the detailed survey.

(1)Irrigation Area

The aproximate area to be irrigated will be as follows.

*Green house : 0.3ha
*Vinyl house : 1.5ha
*Upland field: 8.2ha
*TOTAL : 10.0ha

(2)Irrigation Systems

In order to execute the various research items, the control heads that serve for the adjustment of the water pressure will be installed at the ends of the pipelines. The following irrigation systems will be utilized in the Works to economize water.

*Drip system

*Low pressure sprinkler system

(3)Water Source

No.1,2 and 3 wells can be the water source of the Works. Irrigation water will be pumped up to the reservoir which will be constructed separately from the Works within the permitted amount by the authorities concerned.

(4)Methods of Water Control

The lifting pumps (by Grant Aid Program) will be controlled automatically by sensoring the water level in the reservoir.

In some parts of the green houses, the valves at the ends of the pipelines will be automatically controlled by the discharge of water.

3.OUTLINE OF THE SCHEDULE OF THE MODEL INFRASTRUCTURE IMPROVEMENT WORKS

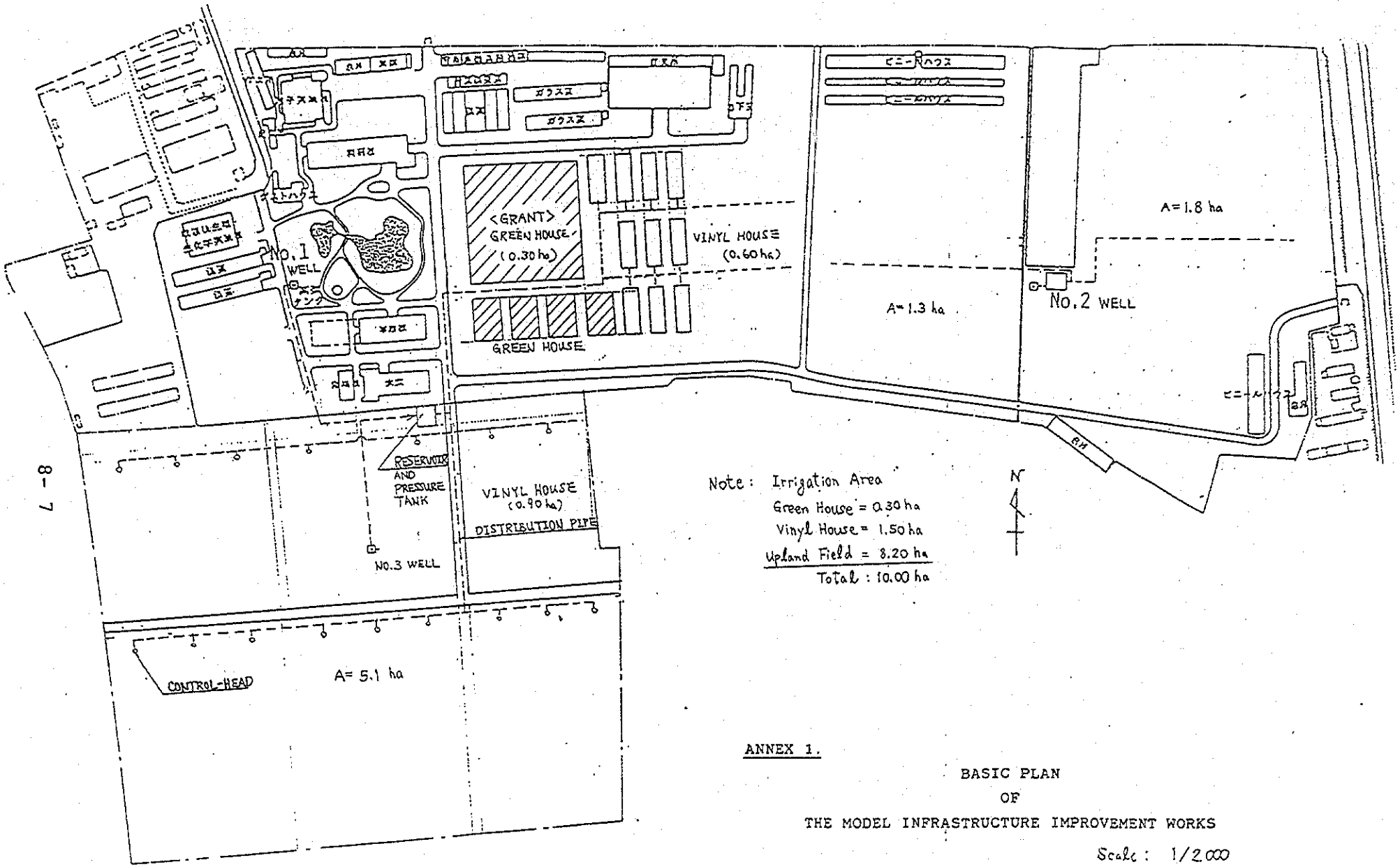
The outline of the schedule of the Works is as shown in the ANNEX 2.

4.MEASURES TO BE TAKEN BY THE CHINESE SIDE

(1)The water reservoir and the pressure tanks will be constructed considering the schedule of the Works.

(2)The water pumps, green houses and vinyl houses (by Grant Aid Program) will be installed considering the schedule of the Works.

(3)Some technicians will be assigned for the operation and maintenance of the irrigation facilities.



ANNEX 1.

BASIC PLAN

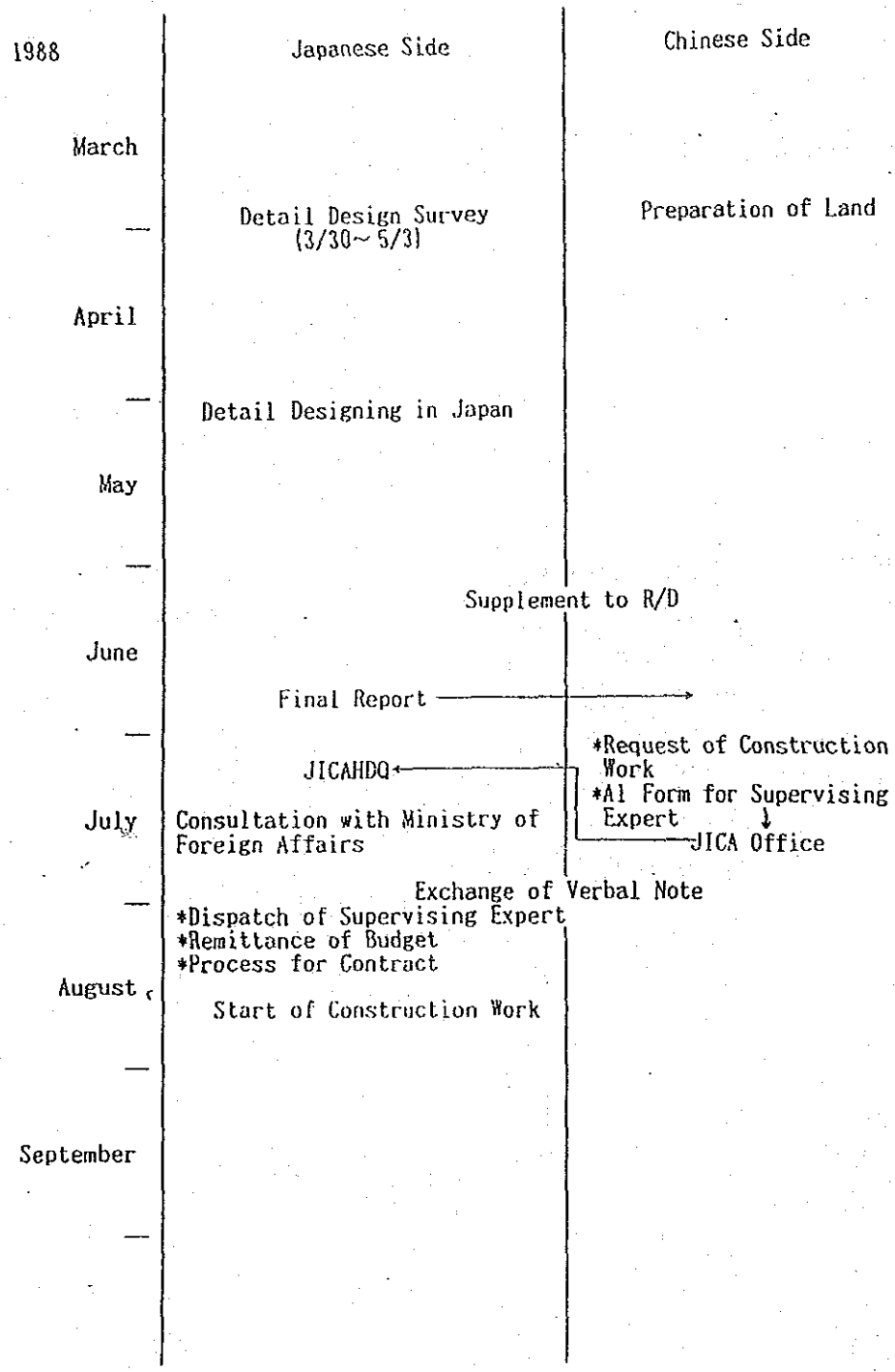
OF

THE MODEL INFRASTRUCTURE IMPROVEMENT WORKS

Scale : 1/2000

ANNEX 2.

OUTLINE OF THE SCHUDULE OF THE MODEL INFRASTRUCTURE IMPROVEMENT WORKS



ANNEX 3.

MEMBER'S LIST
OF
THE DETAILED DESIGN SURVEY TEAM
FOR
THE BEIJING VEGETABLE RESEARCH CENTER PROJECT

Osamu SEINO	Team Leader	Technical Cooperation Officer, International Cooperation Division, Economic Bureau, Ministry of Agriculture, Forestry and Fisheries
Kazumi KOBAYASHI	Coordinator	Agricultural Development Division, Agricultural Development Cooperation Dept., Japan International Cooperation Agency(JICA)
Yasuro HAGIHARA	Planning of Upland Irrigation	Agricultural and Rural Development Dept., Pacific Consultants International
Osamu YAMAMOTO	Design of Irrigation Facilities	Agricultural and Rural Development Dept., Pacific Consultants International

8.1.4 List of Main Officials Concerned

面会先	氏名	所属
北京市農林科学院	范毓揚	科学院　院長
	陳杭	科学院　副院長兼北京蔬菜研究中心主任
北京蔬菜研究中心	馬士新	科学院　副院長兼北京蔬菜研究中心副主任
	烏以徳	計画主任助理
	王永健	計画主任助理
	楊阿明	研究員
	徐剛毅	研究員
	段建雄	研究員
	付培清	秘書
国家科学技術委員会	張慧春	国際科学合作局官員
	金堅敏	国際科学合作局官員
北京市科学技術委員会	劉敬華	国際科学交流合作処　副処長　工程師
対外経済貿易部	楊鉄林	国際連絡局官員
北京市対外経済貿易委員会	孟憲振	官員
北京二軽総公司	王春明	対外経済処
北京市塑料七厂	劉振江	厂長
	白洪文	付厂長（工程師）
	石鉄錚	生産計画科長
北京塑料制品厂	陳家瑞	総工程師
	于東明	工程師
中国技術進出口総公司	劉士然	北京市公司　第四事務部副経理
北京農業工程大学	李藹鏗	水力机械教研室　副主任・副教授
河北省廊坊市	張殿英	商品経済指導中心副主任
中国農墾農工商聯合	劉宏	対外聯絡室
北京通用机械設備公司	張秋影	翻訳
在中華人民共和国	速見統一	参事官
日本国大使館	大久保寿夫	一等書記官
	稲田修一	二等書記官
	平木場弘人	二等書記官
国際協力事業団	田口定則	所長
中華人民共和国事務所	木村信雄	副所長
	小松征司	職員
北京蔬菜研究中心	渥美照男	専門家
	筆本能行	専門家
（株）竹中工務店	藤川浩成	中日青年交流中心施設建設工事作業所事務課長