The lot of the small farmer's house is 220 sq.m, and it has 34 sq.m of building area. The lot of the large farmer's house is 350 sq.m, and it has 46 sq.m of building area.

Minimum required building size is planned at the early stage of development, however the area has enough space for expansion in the future. All the houses are planned to be made brick walls with wooden roofs.

The typical house plan is shown in Fig.G3-2.

G-3.3. Infrastructure

(1) Village Facilities Plan

1) Settlement

The administrative organization in the Project Area will be comprised of the local unit, village and hamlet. At the center of the local unit, a development office, primary and preparatory school, medical clinic, post office, etc. will be established. Buildings which will be constructed in the Project Area are shown in Tables G3-3 to G3-5 and Fig. G3-3.

2) Education

Two primary schools and one preparatory school will be built in North Wahby area each school will have an enrollment of about 240 students or six classes. After preparatory school, they will attend the secondary school in Tamiah city.

3) Health

A medical clinic will be built in the town to care for settlers.

4) Mosque

Mosques are usually provided by the Government. Four mosques will be built in North Wahby area. One mosque has charge of about 160 households.

5) Agricultural and Irrigation Services

Agricultural extension service and O & M of irrigation are executed by the agricultural co-operative association which will be established in the town. A representative person of the co-operative association will be selected from among the farmers at the village and hamlet levels. In the town and villages a storage house will be constructed for agricultural inputs for production or agricultural products.

6) Commercial

Several stores such as general store, grocery, gasoline station, will be established in the town and one store at the center of the village.

7) Others

A police station, a fire station, a post office, a bank and a telephone office will be established as social service facilities in the town.

(2) Road Network

As shown in Fig.G3-4 there are two main roads in the vicinity of the Project Area; one is the highway which connects Cairo and Fayoum and the other is the trunk road which connects Sennoris and Tamiah. The roads planned for the Project Area are connected to the Highway in order to transport materials and agricultural products.

Also, it is necessary to have a road for contact with Fayoum City which is the center of social activities in the Governorate.

Three types of roads; trunk road, branch road and farm road will be constructed in the Project Area. A trunk road with a width of 12 m will pass through the middle of the Project Area and be connected to the roads to Tamiah and Aslan. This road will be an important connecting road to Tamiah city which is the center of the district.

Branch roads with a width of eight meter will connect the trunk road with the hamlets.

Farm roads with a width of 5.5 m will be used for access to the farm land. the lengths of the trunk and branch roads are 16 km and 1.7 km, respectively.

(3) Potable Water

1) Water Quantity

At present approximately 60 liters per person per day is allocated in Fayoum Governorate. However, expansion of the existing treatment plant is planned because of the limited capacity. In the Project Area, water quantity per person will be 100 lit/day based on the future plan in Fayoum. Estimated water requirement is decided taking into consideration 20 percent increase in population, 50 lit/day per head of cattle and irrigation water for the trees in the housing lot. Total estimated water requirement of North Wahby and Com Osheem areas is estimated at 950 cu.m/day as shown in Table G3-6.

2) Water Supply

Existing water supply facilities extend to near Bahr Wahby. However, these pipe facilities are not enough to supply sufficient water to both Areas of North Wahby and Com Osheem. There are potable water treatment plants in Fayoum and Tamiah. However, there is not enough capacity to supply water to both areas. Therefore, a new water treatment plant will be established at the upper stream side of Bahr Wahby in the Project Area, for supplying water to the Area.

The potable water treatment plant which will be established should have a capacity of 1,100 cu.m/16 hr/day including ten percent water loss.

The total length of the pipeline will be about 16 km.

3) Facilities

Main facilities of water supply are as follows;

Potable station	1,100 cu.m/16hr/day (including 10% water loss)	
Pipeline	ϕ150	L = 7.9 km
	ϕ100	L = 4.5
	ϕ 75	L = 1.1 (6.7)*
	ϕ 50	L = 2.2 (4.6)*

Note: *, Com Osheem Area

(4) Sewage System

Treatment methods of sewage from houses are as follows;

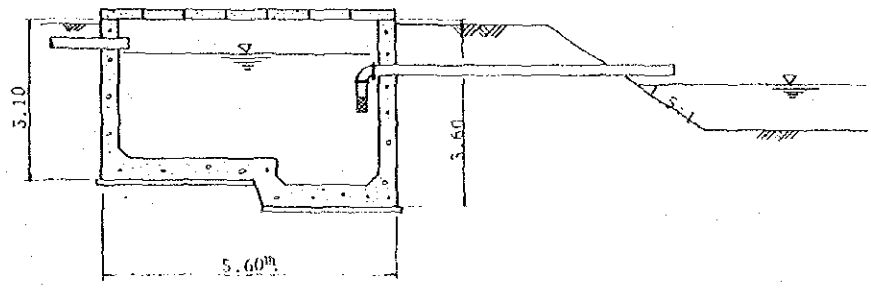
(a) conveyed by nearby ditch to outside of the Area

(b) conveyed by pipeline to simple treatment facilities

(c) conveyed by pipeline or trucks to a public sewage treatment station

Method (a) would require a constant flow of water in the ditches in order to convey sewage efficiently. Method (c) is considered to be too expensive since it would require construction of a sewage treatment station. Therefore, method (b) sewage from each house is conveyed by pipeline to simple treatment facilities located around the hamlet for its settling and evaporation is most suitable for the Project.

Sewage Treatment Station



(5) Electric Plan

Consumptive electric power in the Project Area will be about 1,100 KW for houses and offices, and about 4,200 KW for irrigation pumps and potable water station. This electric power is supplied from Tamiah sub-station former which will be completed in 1986 to the Project Area with 66 KVA and it is transformed from 11 KVA to 380 V or 220 V at the entrance of the hamlet.

(6) Telephone

At least, 30 telephone lines will be necessary in the town and one village. The line is from Tamiah Station to the telephone office in the town, and then to each house and office.

G-3.4. Construction Schedule

The construction will be implemented from 1987 to 1992 as shown in Fig. G3-7.

Table G3-1 Building Area of Houses

Item	Farmer		Director	Technician	Laborers
	Small	Large			
Lot (sq.m)	220	350	300	210	150
Building Area (sq.m)	34	46	90	64	64
Number of Rooms	2	2	4	3	3

Table G3-2 Type of Household

	Building	Farmer		Non Farmers			Total
		Small	Large	Directors	Technicians	Labor & Other	
Hamlet	Farmers	442	129				571
	Sub-total	442	129				571
Town	Development Offices			1	7	2	10
	Primary School			1	8	1	10
	Preparatory School			1	8	1	10
	Medical Clinic			2	4	1	7
	Police Station			1	1	1	3
	Post Office			1	2	1	3
	Telephone Office			1	2	1	3
	Fire Station			1	2	1	3
	Co-operative			1	5	1	7
	Bank			1	2	1	3
	Mosque				1		1
	Stores					6	6
	Sub-total			11	42	17	70
Village	Primary School			1	6	1	8
	Mosque				1		1
	Store					1	1
	Sub-total			1	7	2	10
	Total	442	129	12	49	19	651

Table G3-3 Building of Town
(Center of Local Unit)

Building	Building Area (m^2)	Number of Buildings	Number of Staff
Farmers Houses	34- 46	34	-
Non-Farmers Houses	64- 90	70	-
Development Office	300	1	10
Primary School	450	1	10
Preparatory School	450	1	10
Medical Clinic	150	1	7
Police Station	35	1	3
Post Office	150	1	4
Telephone Office	150	1	4
Fire Station	225	1	4
Co-operative	225	1	7
Storage House	300	1	-
Bank	150	1	4
Mosque	180	1	1
Store	120	6	6
Total			70

Table G3-4 Building of Village

Building	Building Area(m^2)	Number of Building	Number of Staff
Farmers Houses	34- 46	31	-
Non-Farmers Houses	64- 90	10	-
Primary School	450	1	8
Storage	90	1	-
Mosque	150	1	1
Store	120	1	1
Total			10

Table G3-5 Building of Hamlet

Buildings	Building Area (m^2)	Number of Buildings	Number of Staff
Farmers Houses	34 - 46	31 1/	-
Mosque 2/	150	1	

Note: 1/... Average of Project Area
2/... One in 4 or 5 Hamlets

Table G3-6 Potable Water Requirement(W.R)

Item	North Wahby Area Number	North Wahby Area W.R.	Com Osheem Area Number	Com Osheem Area W.R.	Total W.R.
Human (future) 1/	3,906	391	2,088	209	600
Animal 2/	2,917	146	1,373	69	215
Others		90		40	130
Total		630		320	950

Note: 1/... Number of one family will be 6 persons.
2/... 3.3 cows per one small farm house.

Table G3-7 Electric Power

Houses	Unit Power (w)	North Site	Wahby Power (kw)	Com Site	Osheem Power (kw)	Total Power (kw)
Farmer' House	1,000	571	571	270	270	841
Non Farmers' Houses	2,000	80	160	78	156	316
Development Office	5,000	1	5	-	-	5
Primary School	10,000	2	20	1	20	40
Preparatory School	10,000	1	10	-	-	10
Medical Clinic	20,000	1	20	-	-	20
Police Station	2,000	1	2	-	-	2
Post Office	2,000	1	2	-	-	2
Telephone Office	5,000	1	5	-	-	5
Fire Station	5,000	1	5	-	-	5
Co-operative	5,000	1	5	-	-	5
Storage House	1,000	2	2	1	1	2
Bank	2,000	1	2	-	-	2
Mosque	1,000	4	4	3	3	7
Stores	2,000	7	14	1	2	16
Road	10,000	1	10	-	-	10
Cattle Breeding and Fattening Farm	10,000	-	-	4	40	40
Others			213		128	341
Sub-total			1,050		620	1,670
Potable Water Supply Station		1	250	-	-	
Pump Station for Irrigation			3,860		2,800	6,660
Sub-total			4,110		2,800	6,910
Total			5,160		3,420	8,580

Table G3-8 Number of Telephones

(1) North Wahby

Town	Development Office	2
	Primary School	1
	Preparatory School	1
	Hospital	1
	Police Station	1
	Post Office	1
	Fire Station	1
	Telephone Office	1
	Co-opearative	1
	Bank	1
	Store	6
	Director	11
	Sub-total	28
Village	Primary School	1
	Store	1
	Director	1
	Sub-total	3
	Total	31

(2) Com Osheem

Village	Primary School	1
	Store	1
	Director	1
	Sub-total	3
Hamlet	Director	4
	Freezing Center	4
	Sub-total	8
	Total	11

Fig.G3-1 Location of Village

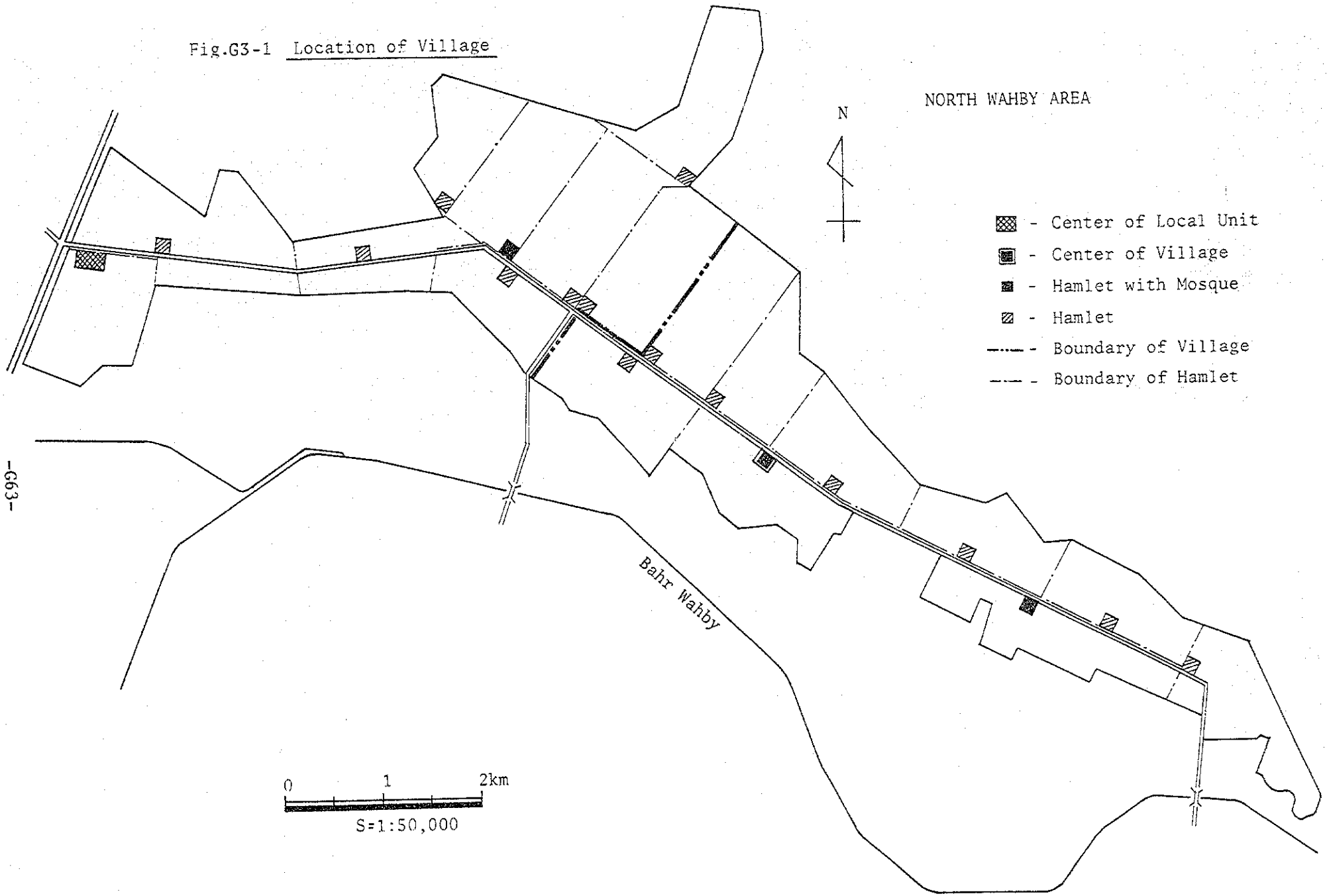


Fig.G3-2 (1) Typical Design of Farmers House

(Small Farmers)

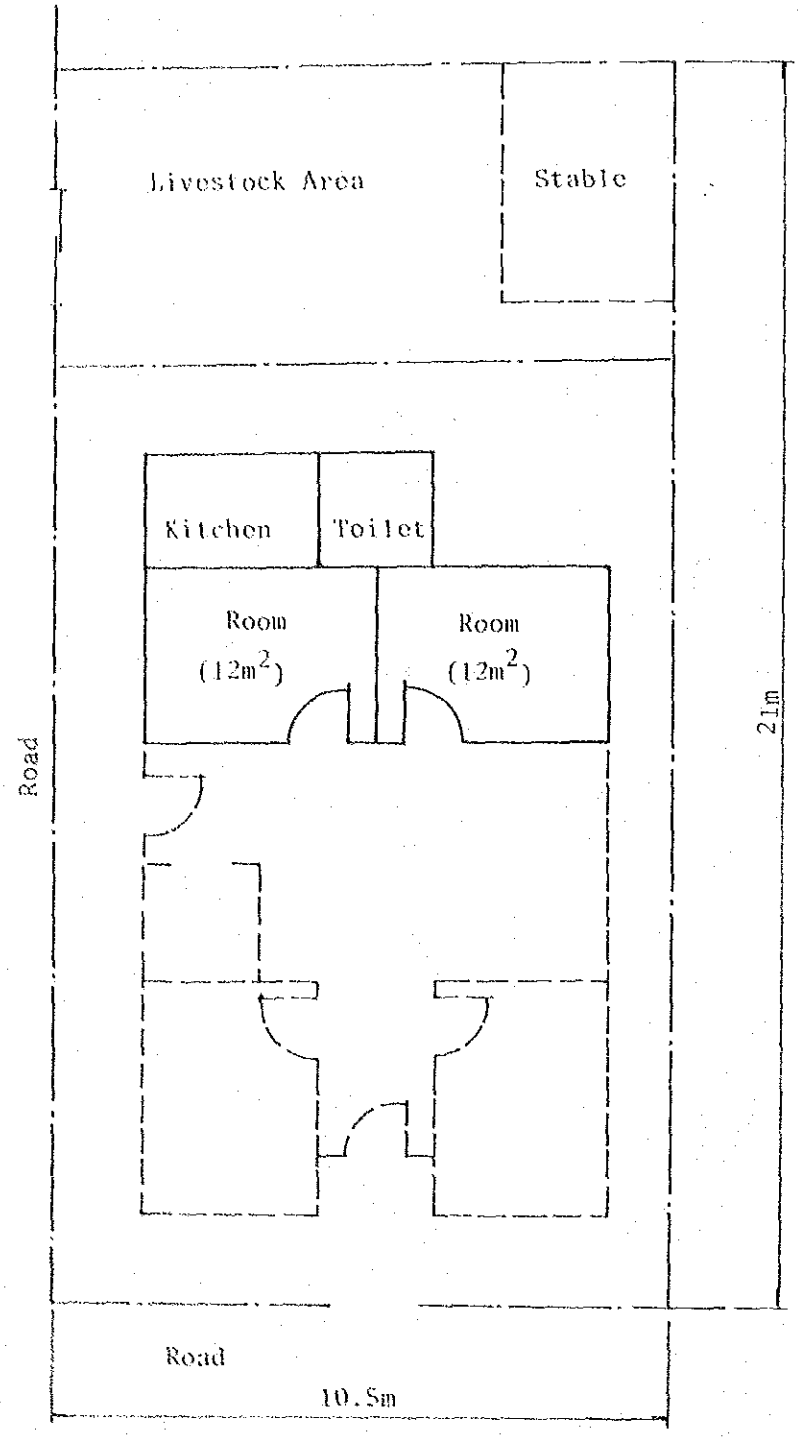


Fig.G3-2 (2) Typical Design of Farmer's House

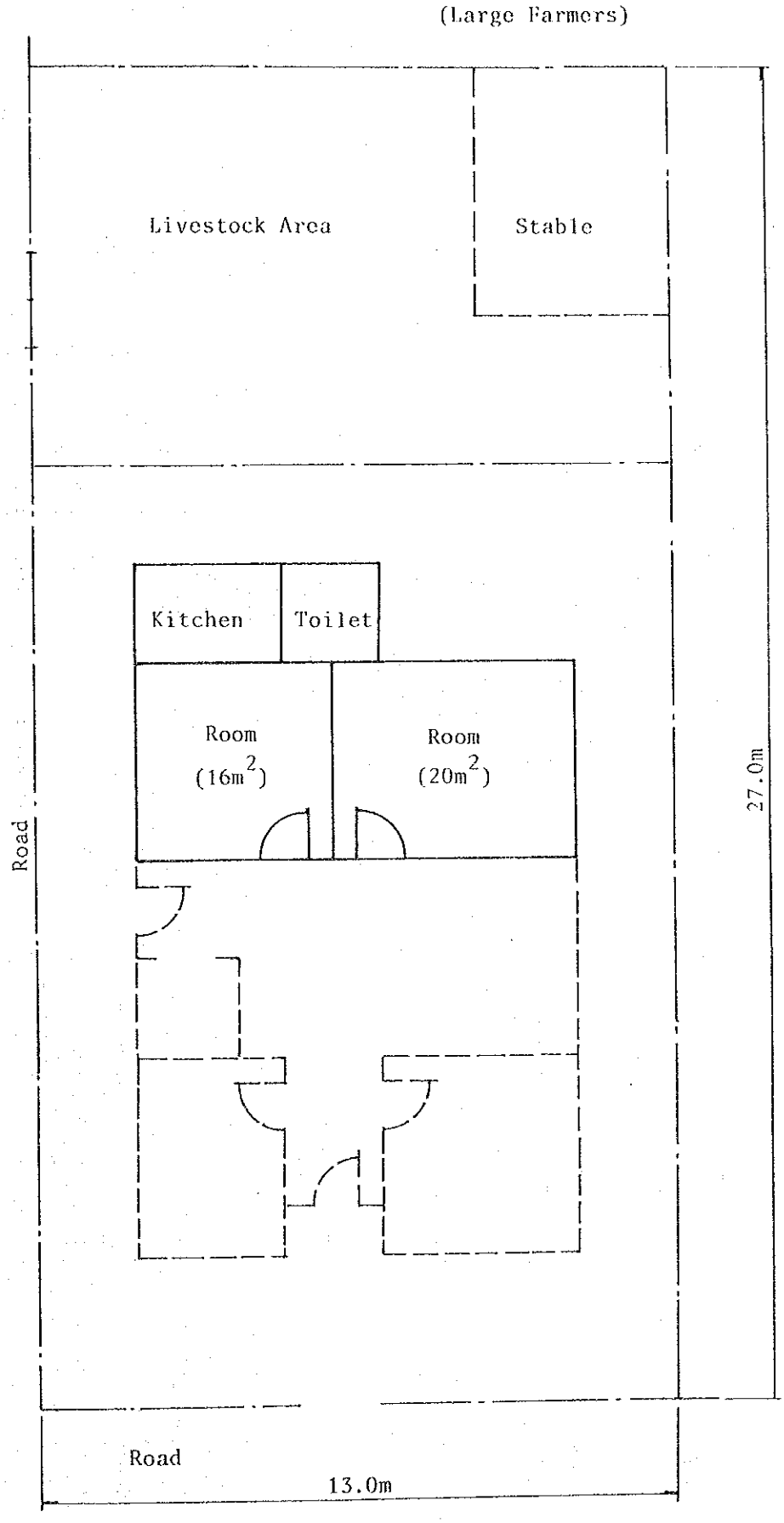
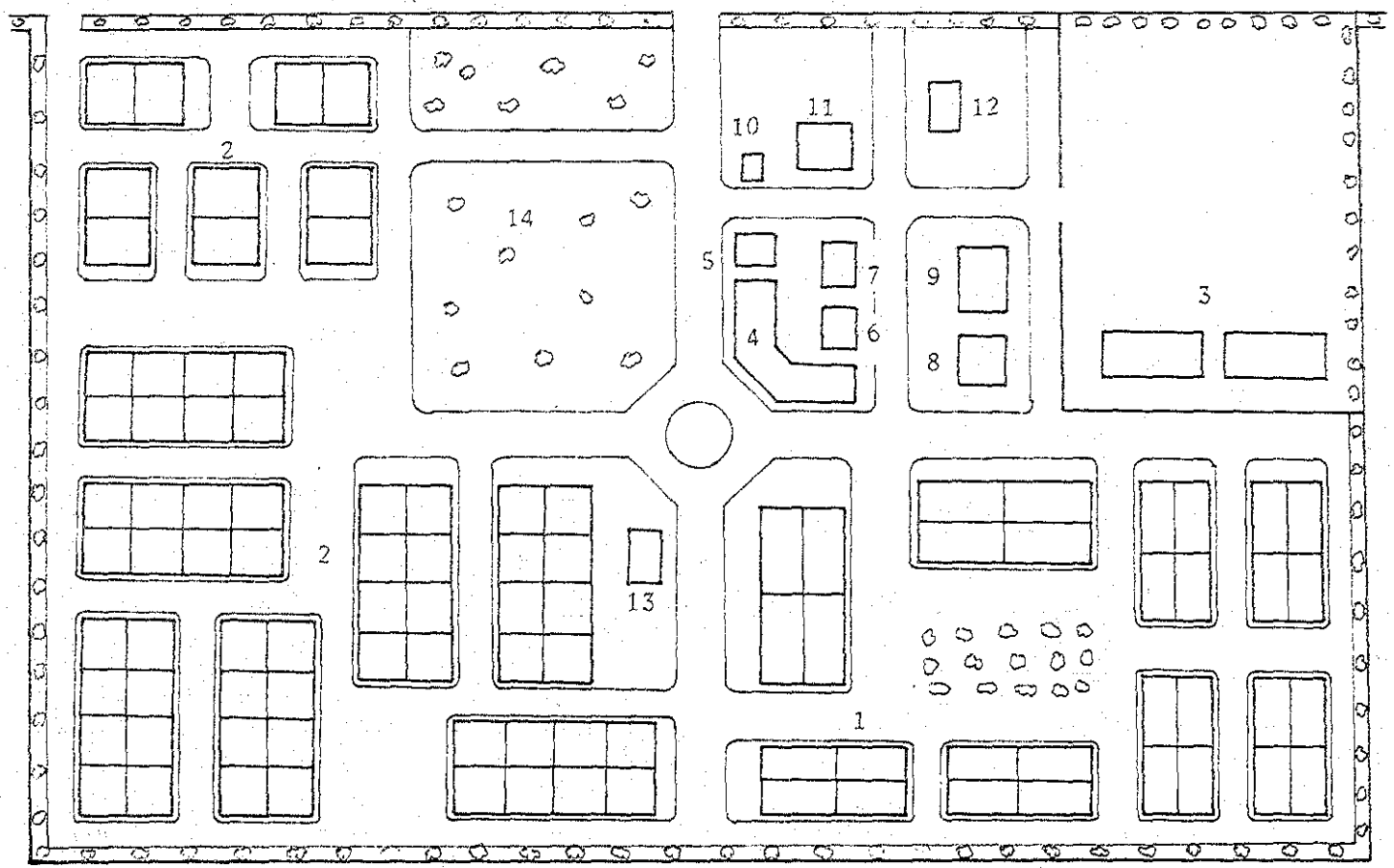


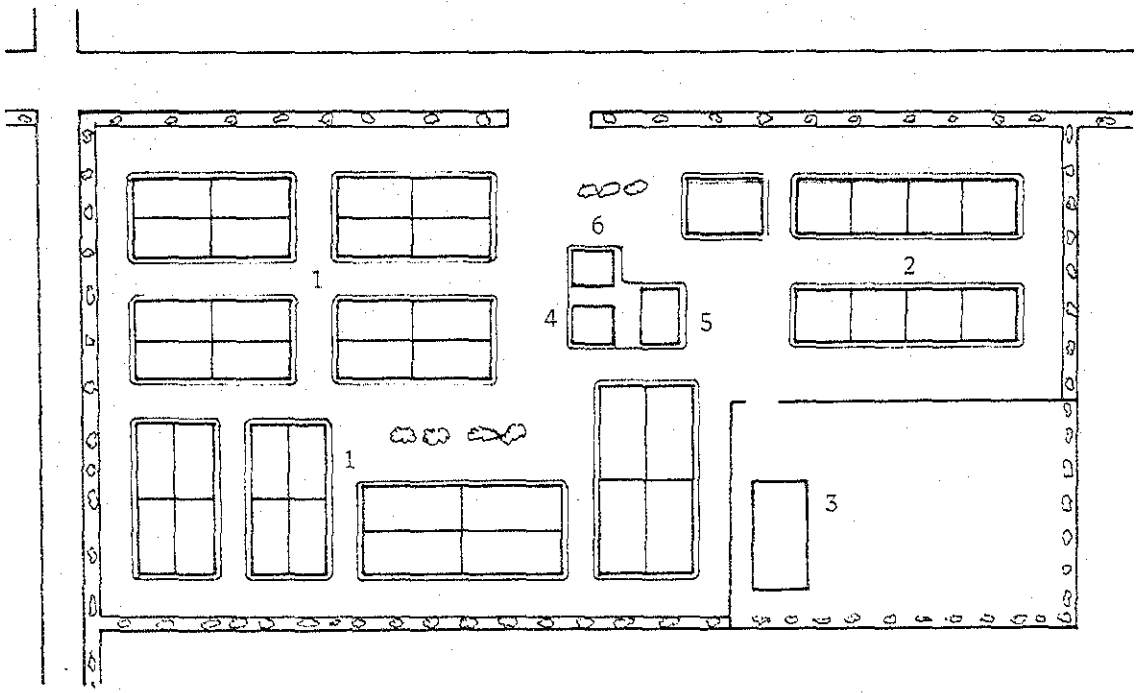
Fig. G3-3(1) Location of Buildings (Town)



NOTE

1. Farmers' Houses
2. Non Farmers' Houses
3. Primary & Preparatory School
4. Stores
5. Fire Station
6. Post Office
7. Telephone Office
8. Co-operative
9. Storehouse
10. Police Station
11. Development Office
12. Medical Clinic
13. Mosque
14. Park

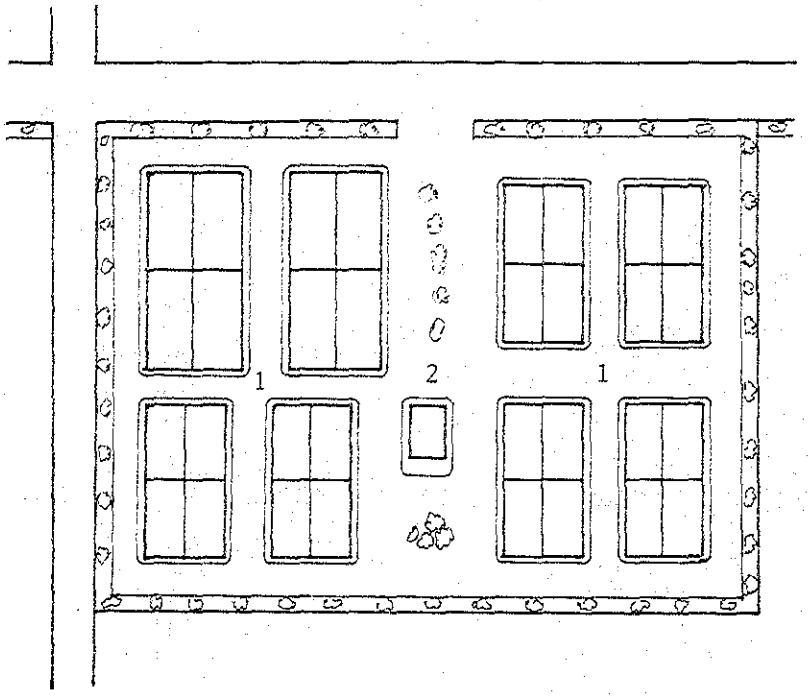
Fig.G3-3 (2) Location of Building (Village)



NOTE

1. Farmers' Houses
2. Non Famers' Houses
3. Primary School
4. Storage
5. Mosque
6. Store

Fig.G3-3 (5) Location of Building (Hamlet)



NOTE

1. Farmers' Houses
2. Mosque

Fig.G3-4 Existing Road Network

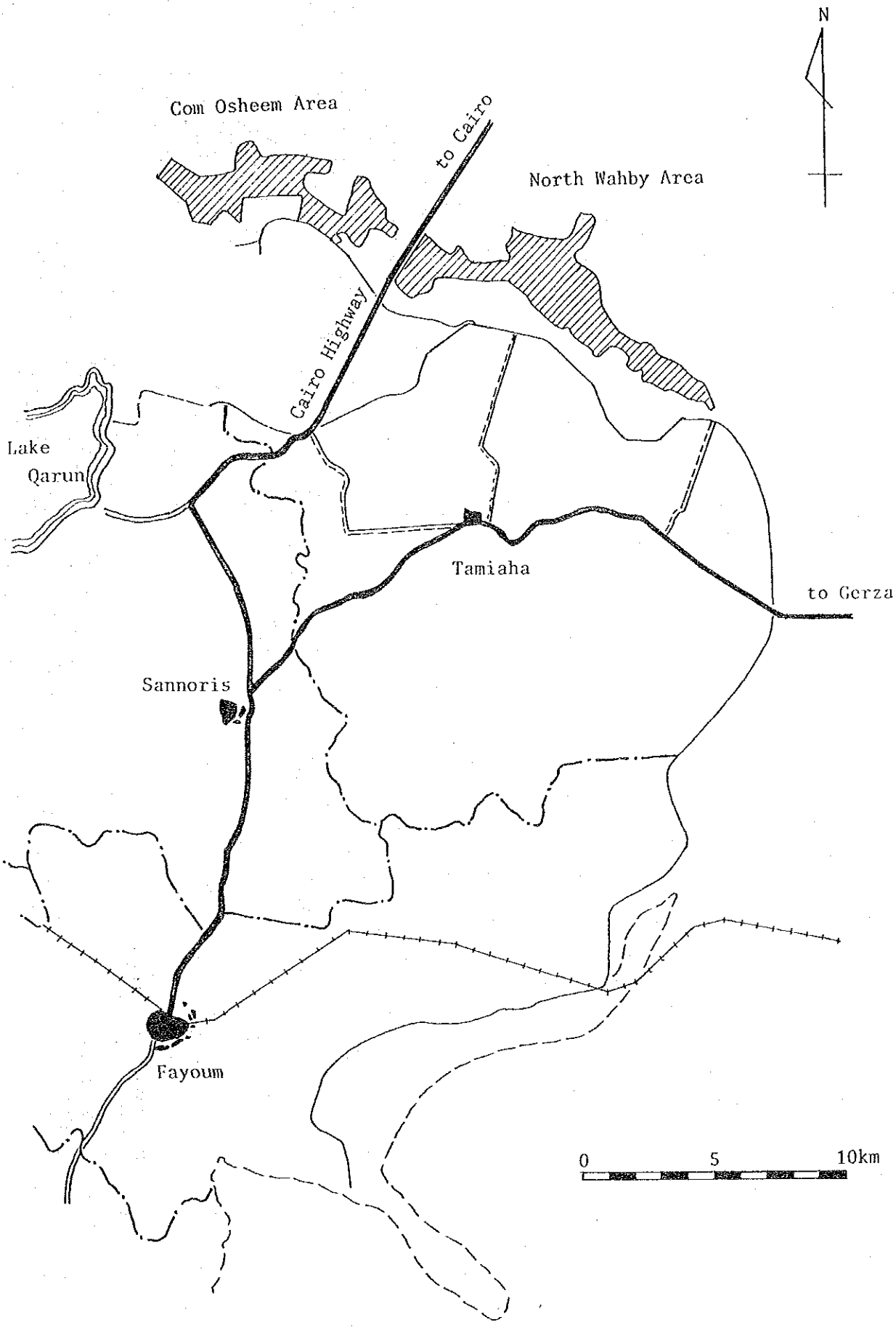


Fig.G3-5 Pipe Line of Potable Water

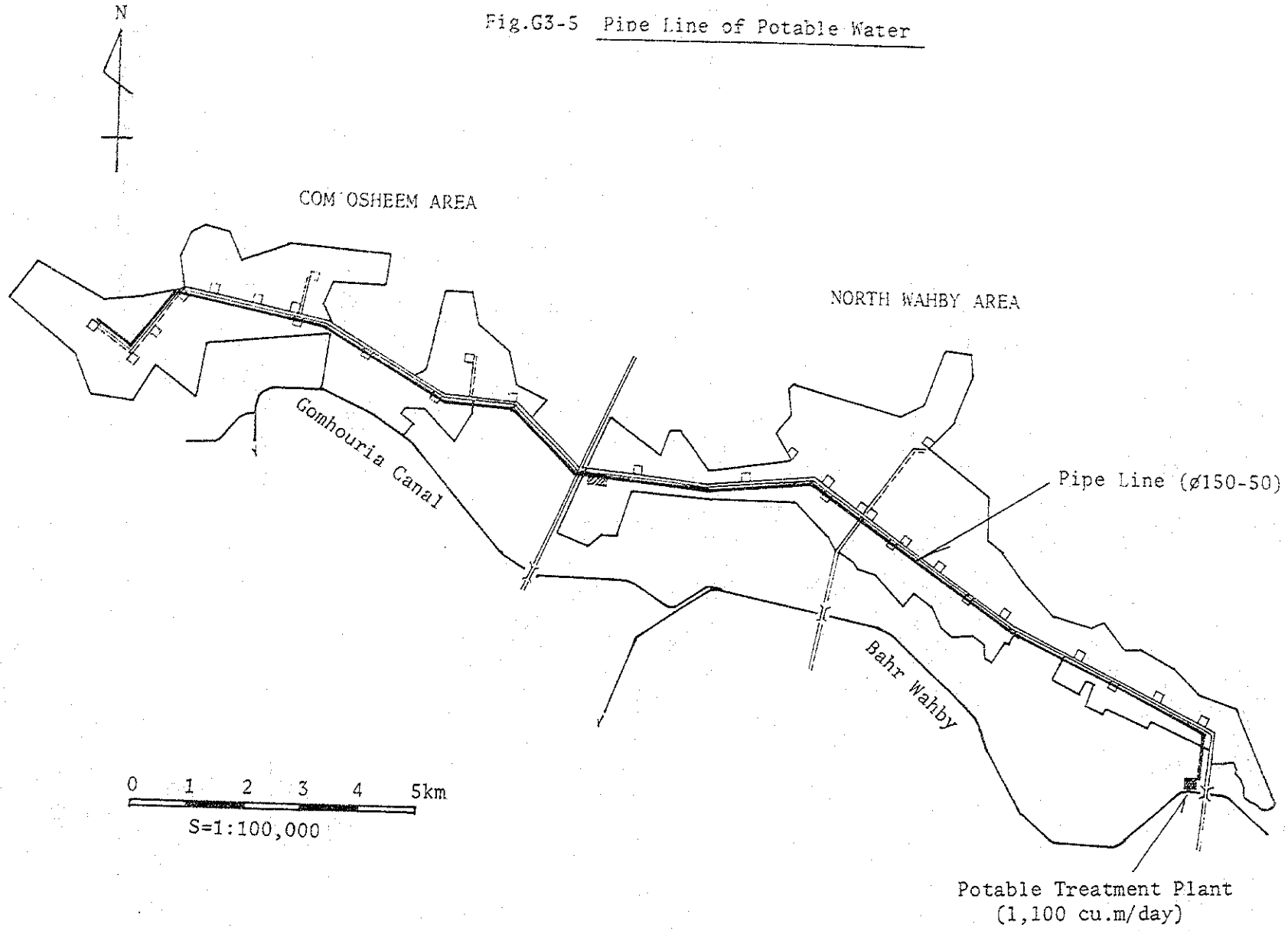


Fig.G3-6 Electric Plan

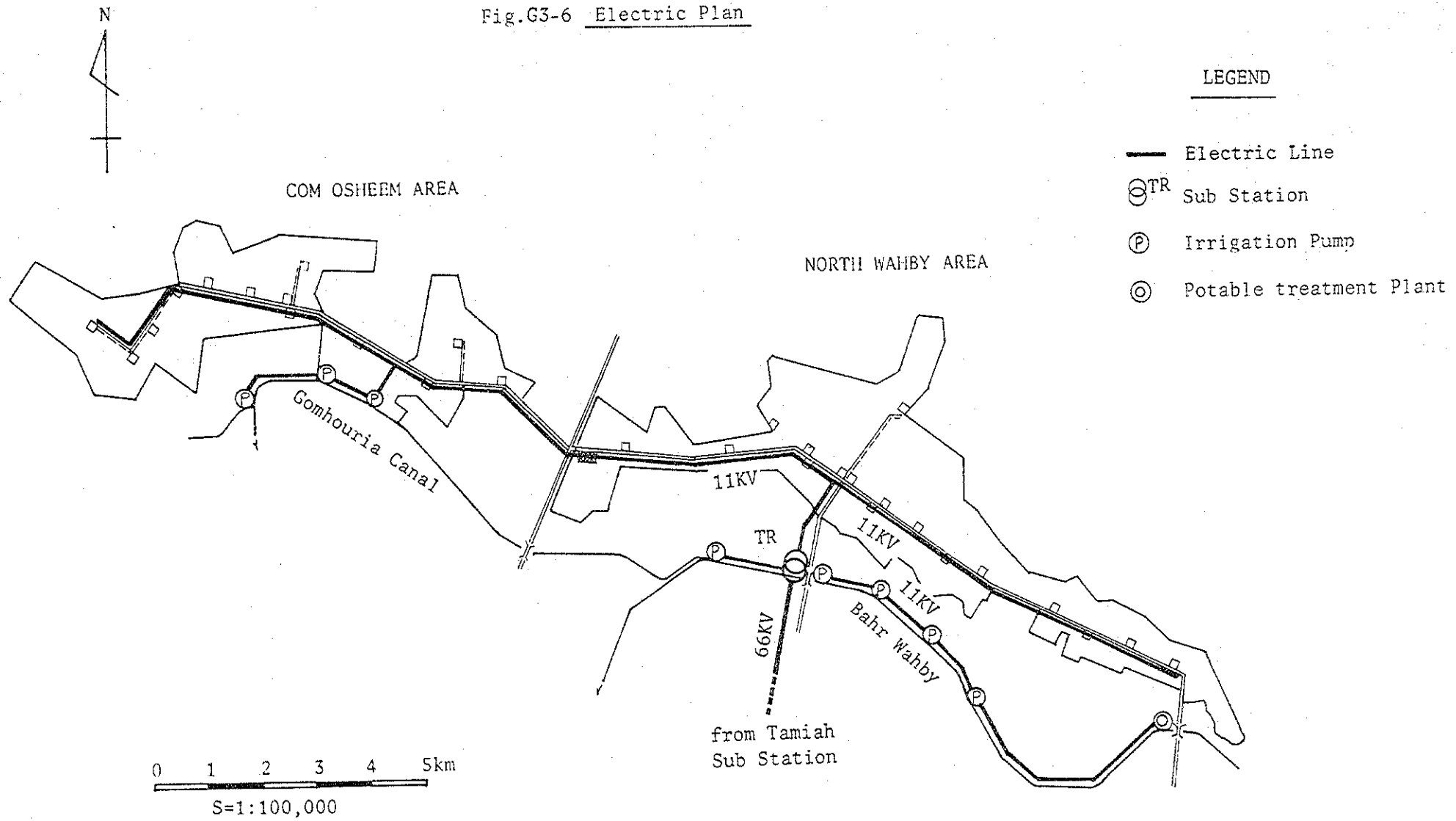
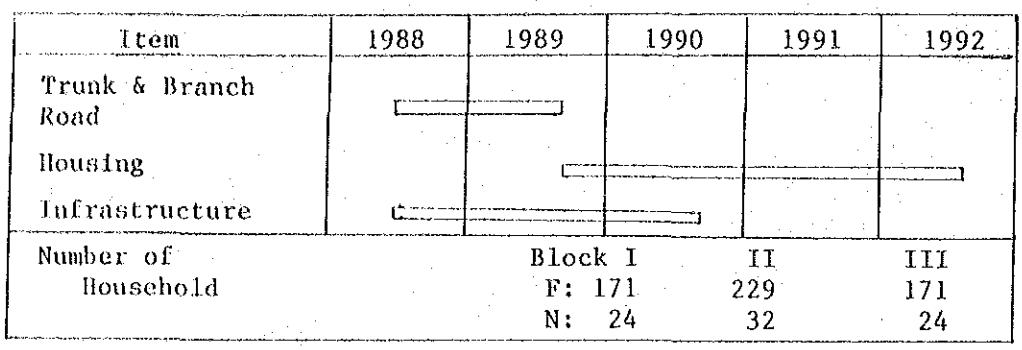


Fig. G3- 7 Construction Schedule



Note: F ; Farmers' House

N ; Non Farmers' House

G-4. Rural Development of Com Osheem Area

G-4.1. Settlement Plan

(1) Settlement Form

Settlement form for Com Osheem area is the same as in North Wahby area. In Com Osheem area, there will be one village and several hamlets each comprised of about 30 households. A cattle breeding and fattening farm with an area of 1,250 feddan is planned in the Project Area and it is divided into four blocks. 17 households from the Governorate will be settled in each block and will organize the hamlets.

(2) Alignment of Settlement

Center of the local unit is settled in North Wahby area. 13 hamlets are organized into one village. Settlement in the hamlets will be established along the trunk road which runs through the middle of the Project Area. The layout of these settlement is shown in Fig. G4-1.

(3) Household and Population

Households in the Project Area estimated as follows;

Type	Number of Household
Small Farmer (5 feddan)	208
Large Farmer (15 feddan)	36
Large Farmer (20 feddan)	26
Sub-Total	270
Non Farmer	78
Total	348

Number of the farmers' houses is 270 households and that of non-farmers' houses is 78 households. As for the destination of non-farmers' housing, explanation is given in Table G4-4. Among 78 of non-farmers houses, 68 households belong to the cattle breeding and fattening farm, and they are settled in four hamlets. The population is 1,740 persons.

Settlers will be comprised of the following number of farmer and non-farmer's household.

Unit	Number of Unit	Farmers' Households (Average)	Non-Farmers' Households (Average)
Village	1	30	10
Hamlet	8	30	-
Hamlet*	4	-	17

Note; Hamlet with a mark * is for Cattle Breeding and Fattening Farm

G-4.2. Housing

Five types of houses are planned such as small farmer's houses, large farmer's houses, director's houses, technician's houses and laborer's houses.

The lot of the small farmer's house is 220 sq.m, and it has 34 sq.m of building area. The lot of the large farmer's house is 350 sq.m, and it has 46 sq.m of building area.

All the houses are to be built of bricks with wooden roofs.

Number of household of each type is shown in Table G4-1.

G-4.3. Infrastructure

(1) Village Facilities Plan

1) Settlement

Buildings which will be built in the village and the hamlet are the same as North Wahby Area. 17 houses will be built in the hamlet of the cattle breeding and fattening farm.

2) Education

One primary school will be built at the center of the village.

3) Mosque

Three mosques will be built in Com Osheem area.

(2) Road

A trunk road will be constructed through the middle of the Area and connected to the Highway. The lengths of the trunk road and the branch roads are 8.3 km and 3.8 km, respectively.

(3) Potable Water

In Com Osheem area, 320 cu.m/day of potable water will be required. It will be supplied to the Area coming through North Wahby area. Irrigation water is used for cattle in the cattle breeding and fattening farm.

The length of pipes are 6.7 km of ϕ75 and 4.6 km of ϕ50.

(4) Sewage

Sewage system is the same as North Wahby area. Sewage from each house is to be piped to the simple treatment facilities located around the hamlet for its settling and evaporation.

(5) Electric Plan

Consumptive electric power in the Area will be about 700 KW for houses and office, and about 2,800 KW for irrigation pumps. It is supplied through North Wahby area.

(6) Telephone

At least 11 telephone lines will be necessary for the primary school, the cattle breeding and fattening farm and the director's house.

G-4.4. Construction Schedule

The construction will be implemented from 1987 to 1992. Settlement order is shown in Figure G4-2.

Table G4-1 Type of Household

	Building	Farmers		Non Farmers			Total
		Small	Large	Directors	Technicians	Labor & Other	
Hamlet	Farmers	208	62				270
	Sub-total	208	62				270
Village	Primary School			1	6	1	8
	Mosque				1		1
	Store					1	1
	Sub-total			1	7	2	10
Cattle Breeding and Fattening Farm							
	General Manager			4			4
	Manager for Agriculture				16		16
	Financial Manager				4		4
	Manager for Animals				4		4
	Labors					40	40
	Sub-total			4	24	40	68
	Total	208	62	5	31	42	348

Table G4-2 Type of Non-Farmers House
(North Wahby Area)

	Building	Directors	Technicians	Labor & Others	Total
Town	Development Offices	1	7	2	10
	Primary School	1	8	1	10
	Preparatory School	1	8	1	10
	Medical Clinic	2	4	1	7
	Police Station	1	1	1	3
	Post Office	1	2	1	4
	Telephone Office	1	2	1	4
	Fire Station	1	2	1	4
	Co-operative	1	5	1	7
	Bank	1	2	1	4
	Mosque	-	1	-	1
	Stores	-	-	6	6
	Sub-total	11	42	17	70
Village	Primary School	1	6	1	8
	Mosque	-	1	-	1
	Store	-	-	1	1
	Sub-total	1	7	2	10
	Total	12	49	19	80

Table G4-3 Type of Non-Farmers House
(Com Osheem Area)

	Building	Directors	Technicians	Labor & Others	Total
Village	Primary School	1	6	1	8
	Mosque	-	1	-	1
	Store	-	-	1	1
	Sub-total	1	7	2	10
Cattle Breeding and Fattening Farm					
	General Manager	4	-	-	4
	Manage for Agriculture	-	16	-	16
	Financial Manager	-	4	-	4
	Manager for Animals	-	4	-	4
	Labors	-	-	40	40
	Sub-total	4	24	40	68
	Total	5	31	42	78

Table G4-4 Definition of Non-Farmers' Housing

Non-farmers' housing is of three type, directors' house, technicians' house, and laborers and others. Persons coming under each type of housing are determined according to their position and income.

Type	Person
Directors' House;	One house for every office director (person in charge of a public office such as post office, school, etc.). Two houses for the medical clinic, one for each of the two doctors assigned. The General Manager of Cattle Breeding and Fattening Farm will also come under this category.
Technicians' House;	Subordinates of the directors, office workers and teachers will live in this type.
Laborers and others;	Assistants to technicians and laborers will live in this type. Also, store-keepers will be included in this rank.

Fig.C4-1 Location of Village

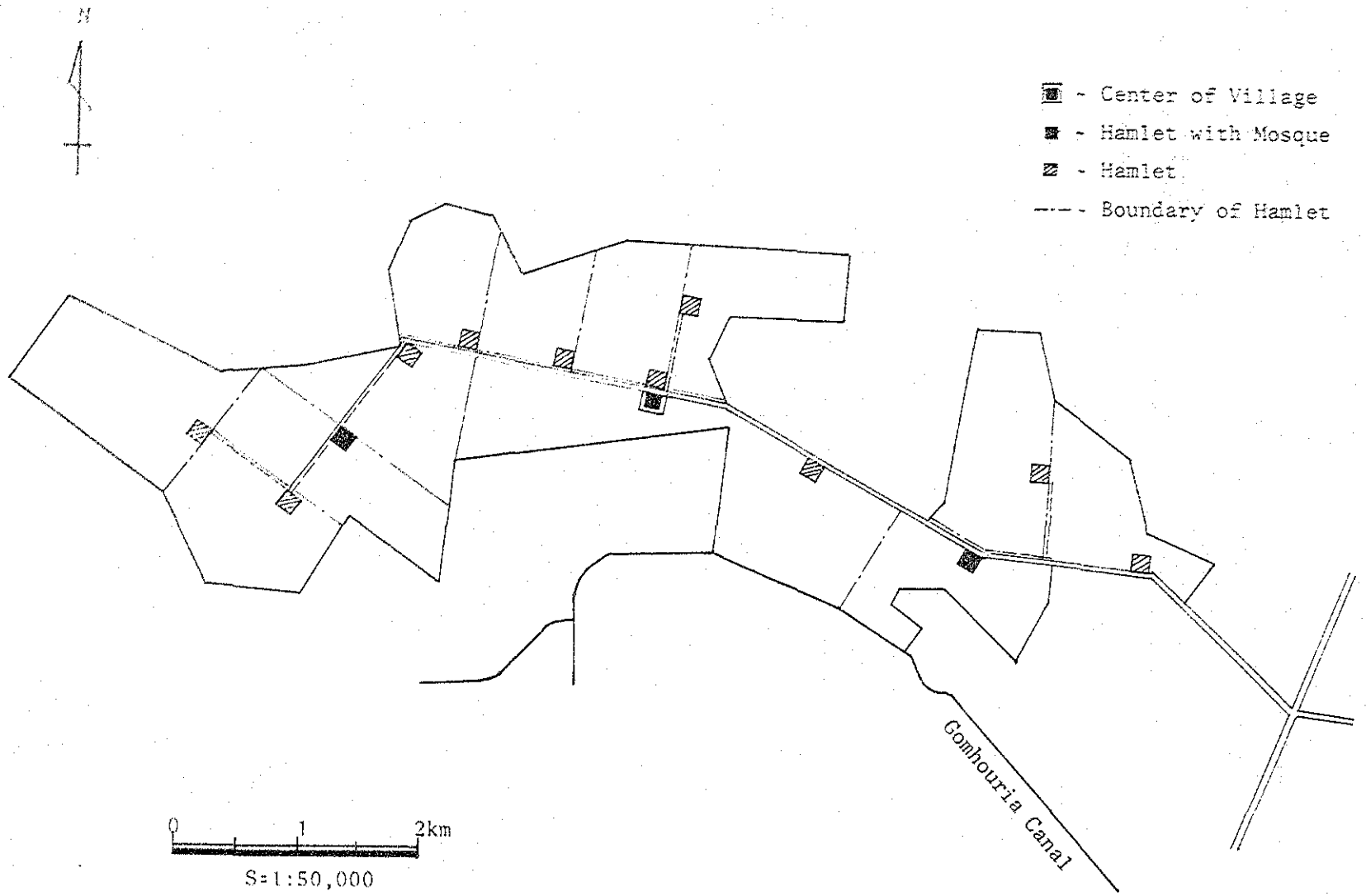


Fig. G4-2. Construction Schedule

Item	1988	1989	1990	1991	1992
Trunk & Branch Road					
Housing					
Infrastructures					
Household			Block I F; 54 N; 16	II F; 94 N; 27	III F;121 N: 35

Note: F; Farmers House

N; Non Farmer House

APPENDIX H.

IRRIGATION AND DRAINAGE FACILITIES

APPENDIX H. IRRIGATION AND DRAINAGE FACILITIES

LIST OF TABLES

LIST OF FIGURES

APPENDIX H. IRRIGATION AND DRAINAGE FACILITIES

H-1. Comparative Study of Irrigation System

H-1.1. Selection of Numbers of Pumping Stations (Comparative Study A)

(1) General

Referring to the 1/10,000 topographic map, the both area of North Wahby area and Com Osheem area have a long and narrow shape from east to west.

Considering the above condition, the following four cases are examined:

* Case-I Construction of 9 pumping stations
* Case-II - do - of 6 pumping stations
* Case-III - do - of 3 pumping stations
* Case-IV - do - of 1 pumping station

The comparison has been made by a model for the convenience of study in the North Wahby area, however, the factor affected to the comparison (especially shape and location of irrigation area) has been taken into considerations.

Moreover, the following assumptions have been made for the convenience of study;

1) Design Discharge (Q)

Design discharge of each case are calculated as follows;

$$Q = q \times A$$

where, q: Unit water requirement
30.0 cu.m/day/feddan

A: Irrigation Area (feddan)

2) Irrigation Area

Total irrigation area is assumed at 5,700 feddan and each irrigation blocks has been divided into equal area for each case.

3) Water Distribution System

In order to exclude the effect of on-farm facilities in the comparison, the farm pond method are applied in the study.

Each farm ponds will be constructed at EL 30.0m (Available high point for each irrigation blocks).

Thus, high water level (HWL) and low water level (LWL) at each farm pond are,

HWL = EL 30.0m + 1.0m = EL 31.0m
LWL = HWL - 2.5m = EL 28.5m

Distribution tank (capacity is 30 minutes of pump discharge) have been provided for Case II to Case IV and feeder pipeline have been provided between each distribution tank and each farm pond, in order to make the comparison at the same level.

The illustration and some basic data for each case are shown in Fig. H1-1.

(2) Major Dimensions of Proposed Facilities

Based upon the above assumptions, the design works have been performed. Major dimensions of proposed facilities for each case are presented in Table H1-1.

(3) Construction Cost and Economic Comparison

The summary of construction cost and economic comparison including annual costs are presented in Tables H1-2 and H1-3.

Annual costs are estimated on the conditions of an annual interest rate of ten percent and a project life span of 50 years. In the estimation, pumping equipment were replaced every ten (10) years.

Referring to Table H1-3, as for the construction cost, Case IV is the highest and Case I is the cheapest. On the other hand, as for annual costs including operation and maintenance cost, Case II is the cheapest.

Thus, Case-II is recommended because of the lowest annual costs and diversification of the risks in the system.

(4) Conclusion

Taking into considerations the above, comparative study B, on farm development plan, rural development plan, site conditions, construction and operation and maintenance, the construction of five pumping station in the North Wahby area and that of three pumping stations in the Com Osheem area are proposed.

H-1.2. Selection of Water Conveyance and Water Distribution System (Comparative Study B)

(1) General

In the study, the following conditions will be taken into considerations;

- The irrigation area is about 3 m to 18 m high and about 1.5 km in average apart from the water source.
- There is no available high land of more than 70 m above MSL within or near-by the Area, where can make possible the sprinkler irrigation method will be done by gravity through ponds after pumping up the water from the water source.
- The water from the water source shall be taken through 24 hours due to the re-use program of the Batts Drain water.
- Easy operation and maintenance

Considering the above-mentioned conditions, the following two cases have been examined;

Case-A: Direct conveyance and distribution system through main pumping station with pressure tank

Case-B: Individual system of water conveyance and distribution, providing both farm pond and booster pumping station with pressure tank.

The study has been performed at the P3 irrigation system set up by the result of comparative study A in the North Wahby area as a model.

The illustration of each case are shown in Table H1-4.

From 24 hours intake, Case-A shall be obliged the main pumping station has three irrigation blocks (three villages) as minimum size of irrigation division and also at least main pumps have to irrigate the three irrigation blocks per one day through 24 hour operation. Moreover, 24 hour operation at on-farm level is required for Case-A.

On the other hand, the main pumps for Case-B shall be operated through 24 hours, however, irrigation hour of on-farm level will be done by 16 hours, since the farm pond is provided as regulating reservoir of the time lag of eight hours between main pumps and on-farm irrigation time.

(2) Major Dimensions of Proposed Facilities

1) Design Conditions

a. Design Discharge

Case-A

Based upon the on-farm design and also intake conditions as mentioned above, the unit water requirement are estimated as follows;

q_1 = 0.0268 cu.m/min/feddan (refer to Appendix H-2.1)

Thus, the design discharge for pumps and pipelines can be calculated as follows;

$$Q_1 = q_1 \times A$$

where, q_1 : Unit water requirement
0.0268 cu.m/min/feddan

A : Net irrigation area (feddan)

As for the unit design discharge of each pump are estimated, based upon the number of pumps and the operation method of each pump is 16 hour-on and eight (8) hour-off due to the restriction of intake conditions (24 hour intake).

No. of Pump Units	Unit Design Discharge
6	1/4 Q_T = 4.68 cu.m/min

Note: $Q_T = q_1 \times A_T$

where;

Q_T : Total Discharge cu.m/min
q_1 : Water Duty 0.0268 cu.m/min/feddan
A_T : Total net irrigation area (699 feddan)

Case-B

- Main pumping station and distribution pipeline from a pond to a pond (24 hour irrigation)

$$q_2 = 1.02 \ (A + B)$$
$$= 0.019 \text{ cu.m/min/feddan}$$

where;

A: Daily water requirement for crops from on-farm design

5,695 cu.m/day / (228 feddan x 0.95)
= 0.0183 cu.m/min/feddan

B: Daily water requirement for wind brake

158 cu.m/day / (228 feddan x 0.95)
= 0.0005 cu.m/min/feddan

- Booster pumping station and distribution line after farm pond

$q3=1.02(A+B) / 228 \times 0.95$
$= 0.040$ cu.m/min/feddan

where;

A: 16 hour water requirement for crops
8.358 cu.m/min/16 hour

B: 16 hour water requirement for windbreak
0.164 cu.m/min/16 hour

0.95: Conveyance loss factor

228 : Net area of one irrigation blocks from the model(feddan)

1.02: 2% of (A + B) is considered for miscellaneous water

Thus, the design discharge for pumps and pipelines can be calculated as follows;

$Q_2 = q_2$ or $q_3 \times A$

where, q_2, q_3 : Water Duty (cu.m/min/feddan)
A : Net irrigation area (feddan)

b. Net Irrigation Area

The irrigation area consists of three irrigation blocks (three villages) and its total irrigation area is 699 feddan, referring to Table H1-4.

Irrigation block	1	180 feddan
- do -	2	264 feddan
- do -	3	255 feddan

c. Water Conveyance and Distribution System

The Hazen-Williams formula has been applied for the calculation of friction loss.

Case-A

Two third (2/3) of each irrigation block are always irrigated at the same time.

Case-B

Each irrigation block (each village) has her own irrigation system.

The capacity of farm pond is adopted at 8 hour volume of pump discharge.

2) Major Dimensions of Proposed Facilities

Based upon the above assumptions, the design works have been performed. As a result, the major dimensions of the proposed facilities for each case are presented in Table H1-5.

3) Construction Cost and Economic Comparison

The summary of construction cost and economic comparison including annual costs are presented in Table H1-6 and Table H1-7.

Annual costs are estimated on the conditions of an annual interest rate of ten percent and a project life span of 50 years. In the estimation, pumping equipment were replaced every 10 years.

Referring to Table H1-7, as for the construction cost, Case-A is cheaper than Case-B and, moreover, as for the annual cost including operation and maintenance cost, Case-A is cheaper than Case-B.

Thus, Case-A is recommended although operation at on-farm level is a little bit complicated and 24 hour operation will be required.

The summary of annual costs and some comments on the both cases are presented in Table H1-4.

Table III-1 Major Dimensions of Proposed Facilities

Item	Unit	Case-I	Case-II	Case-III	Case-IV
1. Pumping Station	places	9	6	3	1
Command Area	feddan	633	950	1,900	5,700
Design Capacity	cum/s	0.22	0.33	0.66	1.98
Suction Water Level	m	12.30	12.30	12.20	13.65
Discharge Water Level	m	31.00	33.50	35.00	38.10
Actual Head	m	18.70	21.20	22.80	24.45
Number of Pumps sets		4	4	4	4
Pump Capacity	cum/min	4.4	6.6	13.2	39.6
Total Head	m	42.0	39.0	37.0	34.0
Pump Diameter	mm	200	250	350	600
Motor Output	kw	55	75	150	370
2. Discharge Pipe					
DIP ϕ 400	m	27,000			
-do- ϕ 500	m		18,600		
-do- ϕ 700	m			9,900	
-do- ϕ1,200	m				3,500
3. Distribution Tank	m^3	-	3,600	3,630	3,610
4. Distribution Pipe					
DIP ϕ 400	m		7,320		
-do- ϕ 500	m		3,960	4,020	1,280
-do- ϕ 600	m			5,780	3,600
-do- ϕ 700	m			1,200	2,890
-do- ϕ 900	m				840
-do- ϕ1,000	m				1,280
-do- ϕ1,200	m				1,990
-do- ϕ1,500	m				1,030

Note : 1. Dimensions of pumping station shows those for a pump station.
2. Type of pumps for all stations is an horizontal axis double suction volute pump.
3. No. of pumps includes one stand-by unit.

Table III-2 Construction Cost of Comparative Study A

(Unit : '000 LE)

Item	Case-I	Case-II	Case-III	Case-IV
1. Pumping Station				
Equipment	3,366	2,632	2,598	1,579
Civil Works	3,325	2,946	2,549	2,308
Sub-total	6,691	5,568	5,147	3,887
2. Distribution System				
Discharge Tank	0	160	157	151
Pipes	0	1,113	1,677	4,084
Sub-total	0	1,273	1,834	4,235
Total	6,691	6,841	6,981	8,122

Table III-3 Economic Comparison of Comparative Study A

(Unit : '000 LE)

Description	Case-I	Case-II	Case-III	Case-IV
A. Const. Cost				
1. Pumping Sta.	6,691	5,568	5,147	3,887
2. Distribution Syst.	-	1,273	1,834	4,235
Total	6,691	6,841	6,981	8,122
B. Annual Costs				
1. Amortization 1/	675	690	704	820
2. Maintenance 2/	235	216	218	210
3. Replacement 3/	208	163	161	98
4. Operation of Pumps 4/	191	174	174	143
Total	1,309	1,243	1,257	1,271

Notes : 1/; construction cost × 0.1009 (n=50 yrs, i=10%)

2/; civil works × 0.02 + equipment × 0.05

3/; 0.1009 × 0.6135 × main pump (n=10 yrs, i=10%)

4/; Case I , 141,770 Hr × 55 kw × 0.0245 LE/kwh

Case II, 94,510 Hr × 75 kw × 0.0245 LE/kwh

Case III, 47,260 Hr × 150 kw × 0.0245 LE/kwh

Case IV, 15,750 Hr × 370 kw × 0.0245 LE/kwh

Table H1-4 Comparison Table of Comparative Study B

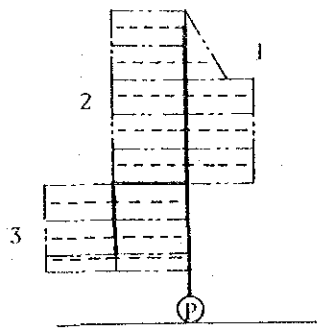
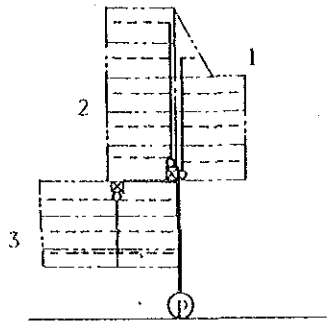
Description	Case-A	Case-B
1. Illustration	 Bahr Wahby	 Bahr Wahby
2. Annual Cost	1.00	1.75
3. Operation & Maintenance		
a) O&M executing body	· Total system - Cooperative	· Main Pumping Station - Cooperative · After Farm Pond - Each Village
b) Operation	· Rather Complicated than Case-B especially valve control at the On-farm level	· Simple
c) Irrigation hour	· Main Pumping Station - 24 hours · On-farm level - 24 hours	· Main Pumping Station - 24 hours · On-farm level - 16 hours
d) Safetiness of system	· In case the conveyance pipe is damaged, two(2) irrigation blocks will be obliged to stop the irrigation	· Good

Table III-5 Major Dimensions of Proposed Facilities(1/3)

Item	unit	Case-A	Case-B
1. Pump Station			
a. Main Pump Station	places	1	1
Command Area	feddan	699	699
Design Capacity	cum/s	0.312	0.221
Suction Water Level	m	13.30	13.30
Discharge Water Level	m	72.00	21.50
Actual Head	m	58.70	8.20
No. of Pumps	sets	7	4
Pump Capacity	cum/min.	4.68	4.43
Total Head	m	76.0	21.0
Pump Diameter	mm	200	200
Motor Output	kw	90	30
b. Booster Pump Station	places	0	3
· Irrigation Block No.1			
Command Area	feddan	-	180
Design Capacity	cum/s	-	0.12
Suction Water Level	m	-	19.00
Discharge Water Level	m	-	68.00
Actual Head	m	-	49.00
No. of Pumps	sets	-	6
Pump Capacity	cum/min.	-	1.44
Total Head	m	-	52
Pump Diameter	mm	-	125
Motor Output	kw	-	30

Table H1-5 Major Dimensions of Proposed Facilities(2/3)

Item	unit	Case-A	Case-B
· Irrigation Block No.2			
Command Area	feddan	-	264
Design Capacity	cum/s	-	0.176
Suction Water Level	m	-	19.00
Discharge Water Level	m	-	72.00
Actual Head	m	-	53.0
No. of Pumps	sets	-	6
Pump Capacity	cum/min.	-	2.11
Total Head	m	-	66.0
Pump Diameter	mm	-	150
Motor Output	kw	-	37
· Irrigation Block No.3			
Command Area	feddan	-	255
Design Capacity	cum/s	-	0.170
Suction Water Level	m	-	19.00
Discharge Water Level	m	-	62.00
Actual Head	m	-	43.00
No. of Pumps	sets	-	6
Pump Capacity	cum/min.	-	2.04
Total Head	m	-	52.0
Pump Diameter	mm	-	150
Motor Output	kw	-	30

Table III-5 Major Dimensions of Proposed Facilities (3/3)

Item	unit	Case-A	Case-B
2. Distribution System			
a. Farm Pond	places	0	2
4,200 m^3	places	0	1
2,400 m^3	places	0	1
b. Pipe Lines			
DIP ø 500	m	1,450	-
ø 400	m	180	1,810
ø 350	m	330	510
ø 300	m	815	850
PVC ø 300	m	510	990
ø 250	m	660	330
ø 200	m	495	1,155

Note: 1. Type of pump in the main pumping station is,

Case A: Horizontal Axis Single Suction Multi-Stage Volute Pump

Case B: Horizontal Axis Double Suction Volute Pump

2. Type of pump in the booster pumping station is,

Case B: Horizontal Axis Single Suction Multi-Stage Volute Pump

3. Volume of farm pond shows effective volume and effective height is adopted at 2.5m.

Table III-6 Construction Cost of Comparative Study B

(Unit: '000 LE)

Item	Case-A	Case-B
1. Pump Station		
a. Main Pump Station		
Equipment	460	193
Civil works	93	61
Sub-total	553	254
b. Booster Pump Station		
Equipment	-	622
Civil works	-	129
Sub-total	-	751
Total	553	1,005
2. Distribution System		
a. Farm Pond	-	297
b. Pipes	254	261
Total	254	558
Grand-total	807	1,563

Table III-7 Economic Comparison of Comparative Study B

(Unit: '000 LE)

Item	Case-A	Case-B
A. Construction Cost		
1. Pump Station	553	1,005
2. Distribution System	254	558
Total	807	1,563
B. Annual Cost		
1. Amortization[1/]	81	158
2. Maintenance[2/]	30	56
3. Replacement[3/]	28	50
4. Operation of Pumps[4/]	43	54
Total	182	318

Notes: 1/ ; construction cost x 0.1009 (n = 50 yrs, i = 10%)

2/ ; civil works x 0.02 + equipment x 0.05

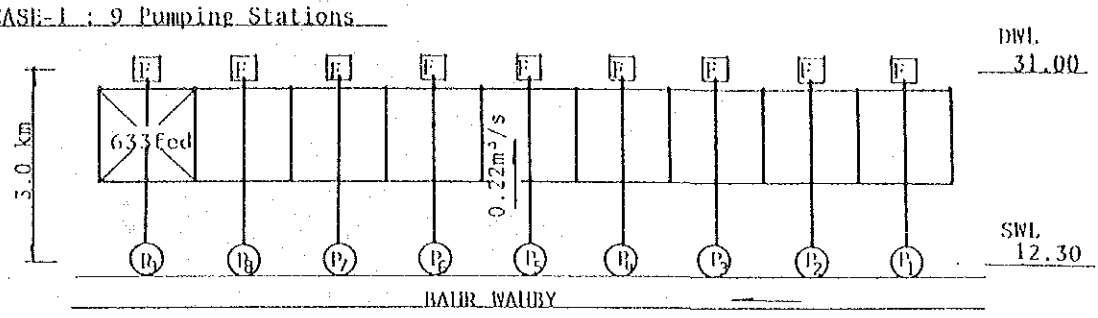
3/ ; 0.1009 x 0.6135 x main pump (n = 10 yrs, i = 10%)

4/ ; Case A, 19,570 HR x 90 kw x 0.0245 kwH

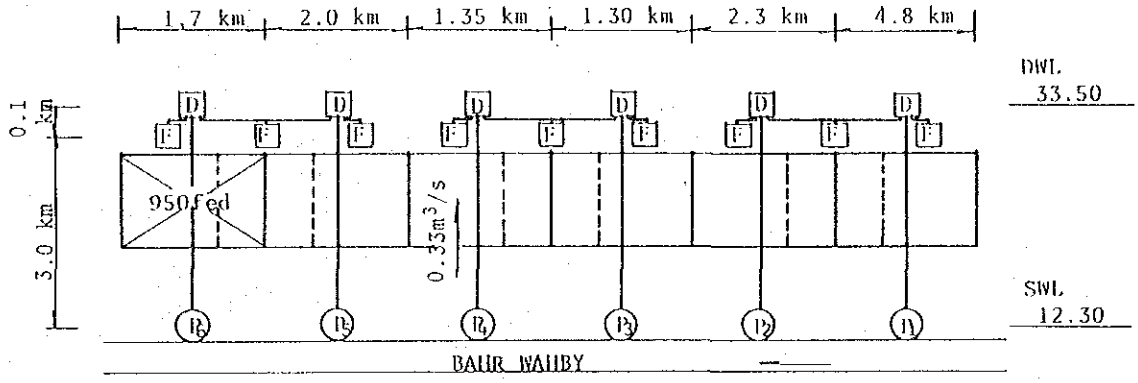
Case B, 20,680 HR x 30 kw x 0.0245 kw/LE +
16,380 HR x 30 kw x 0.0245 kw/LE +
16,400 HR x 37 kw x 0.0245 kw/LE +
16,380 HR x 30 kw x 0.0245 kw/LE

Fig. III-1 Illustration of Comparative Study A

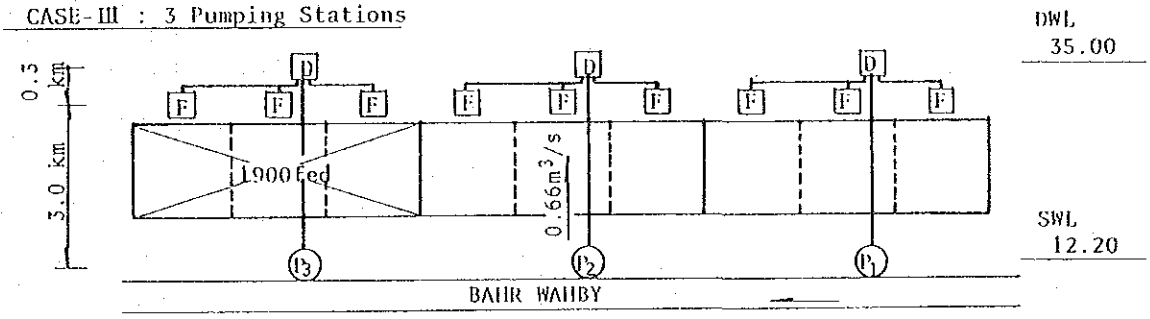
CASE-I : 9 Pumping Stations



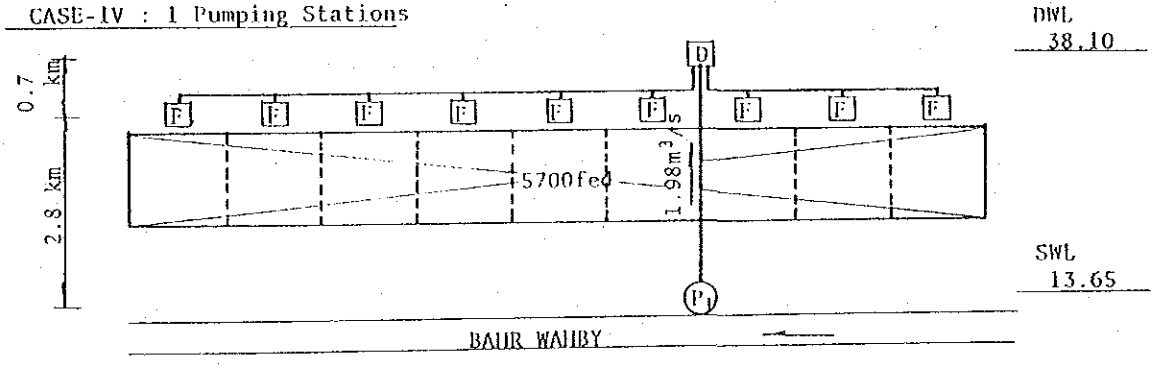
CASE-II : 6 Pumping Stations



CASE-III : 3 Pumping Stations



CASE-IV : 1 Pumping Stations



LEGEND : (P) : Pumping Station [D] :Distribution Tank [F] : Farm Pond

H-2. Basic Data of Hydraulic Calculation

H-2.1. Design Discharge

(1) Unit Water Requirement

Base upon the on-farm design and also intake conditions of 24 hour intake from the water resources, the unit water requirement are estimated as follows;

1) Only irrigation area; Irrigation system except P6

Considering each pump station have to irrigate at least three irrigation blocks per two days through 24 hour operation due to the intake condition,

$$qdo_1 = \frac{1.02\ (A + B) \times 3}{0.95 \times 684\ \text{feddan}} \times \frac{16\ \text{hr}}{24\ \text{hr}}$$

$$= 0.0268\ \text{cu.m/min/feddan (for net area)}$$

where;

- A : Irrigation water requirement from on-farm facility demand, 8.358 cu.m/min/16 hour
- B : Water requirement for windbreak 0.164 cu.m/min/16 hour
- 0.95: Conveyance loss factor
- 648 : Net area of three rotational blocks from the model
- 1.02: 2% of (A + B) will be considered for miscellaneous water

2) Cattle Breeding and Fattening Farm
(only P6 irrigation system)

Considering only sprinkler method will be applied and water requirement for cattle,

$$qdo2 = \frac{1.02}{0.95 \times 684} ((A + B) \times 3 \times \frac{16}{24} + C)$$
$$= 0.0352 \text{ cu.m/feddan/min}$$

where, A : Irrigation water requirement from on-farm facility demand (Sprinkler method only) 10.944 cu.m/min/16 hours

B : Water requirement for windbreak 0.164 cu.m/min/16 hours

C : Water requirement for cattle 0.181 cu.m/min/24 hours

0.95: Conveyance loss factor

684 : Net area of three rotational blocks from the Model

1.02: 2 % of the total which is considered as miscellaneous water

(2) Design Discharge for Pumps and Pipelines

The design discharge for pumps and pipelines can be calculated as follows

$$Q_1 = qdo_1 \text{ or } qdo_2 \times A$$

Where;

qdo_1, qdo_2: Water Duty (cu.m/min/feddan)

A: Net irrigation area in feddan for pump

The unit discharge of each pump are estimated, based upon the number of pumps and the operation method of each pump is 16 hour-on and 8 hour-off due to the restriction of intake condition (24 hour intake) as follows;

No. of Pump Units	Unit Design Discharge
6	1/4 Q_T
9	1/6 Q_T

Note: $Q_T = qdo_1$ or $do_2 \times A$

Where, A: Total net irrigation area.

The unit discharge of each pump at each pumping station is presented in Table H3-4 and H3-5.

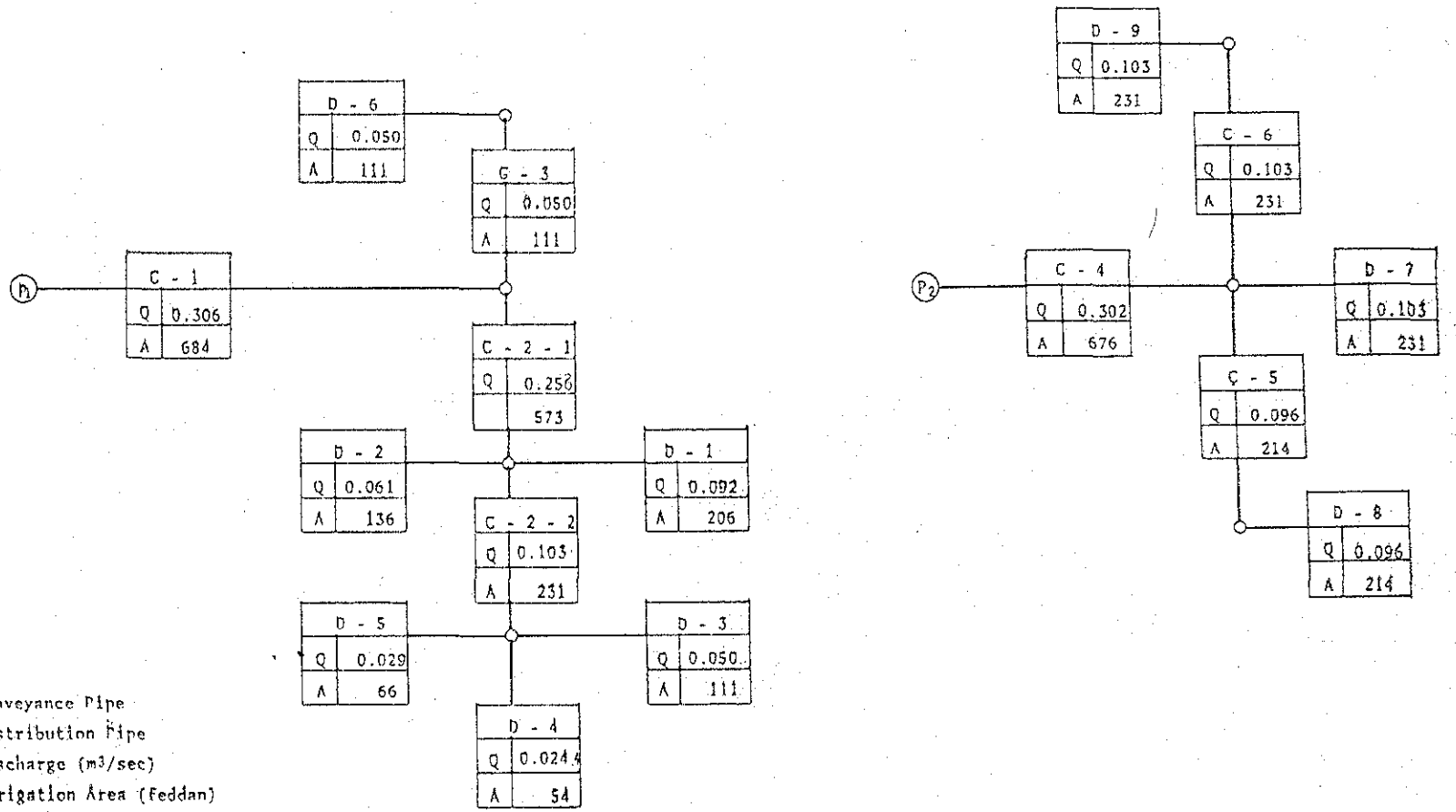
H-2.2. Schematic Diagram of Irrigation System

Based upon the design discharge and the pipe alignment shown in the Drawings, the schematic diagram of each irrigation system are made.

The results are shown in Fig. H2-1 to Fig. H2-4.

It should be noted that the design discharge of each distribution pipe shows that of total amount and its details are shown in the profile of each pipeline in the Drawings.

Fig. H2-1. Irrigation Diagram (1/4)



Legend

C - 1 : Conveyance Pipe
D - 1 : Distribution Pipe
Q : Discharge (m^3/sec)
A : Irrigation Area (Feddan)

Fig. H2-2. Irrigation Diagram (2/4)

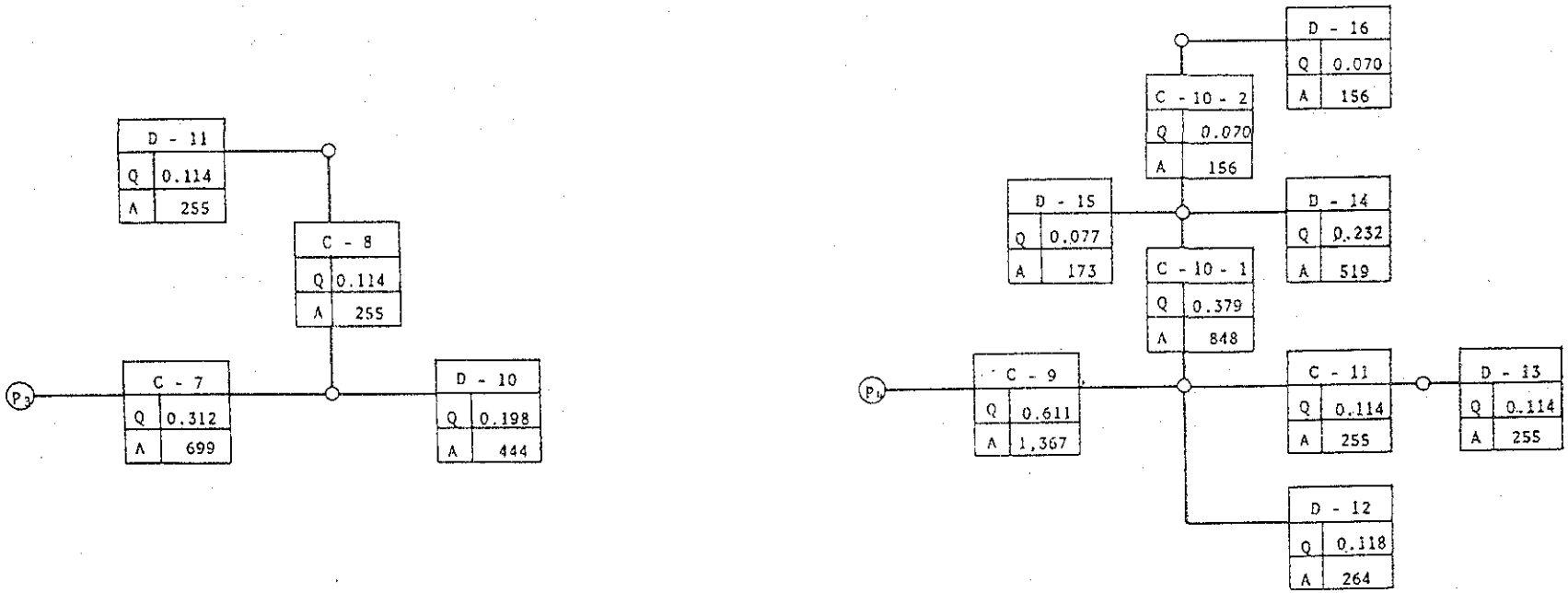
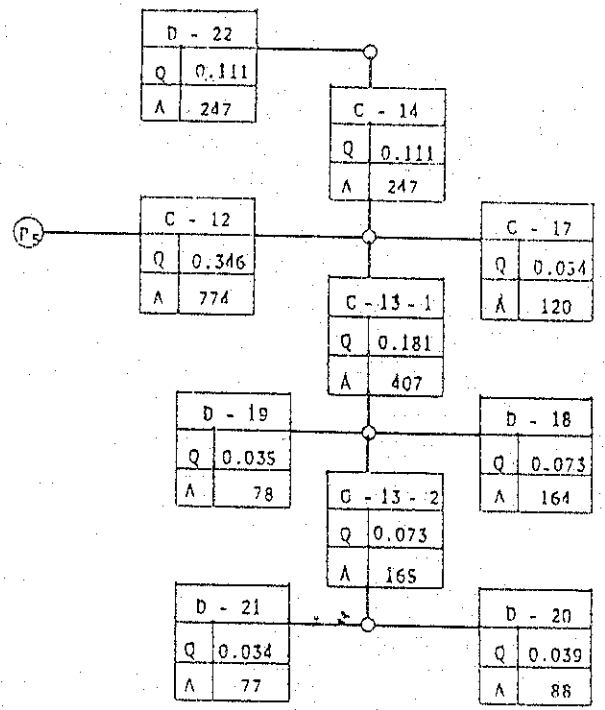


Fig. H2-3. Irrigation Diagram (3/4)



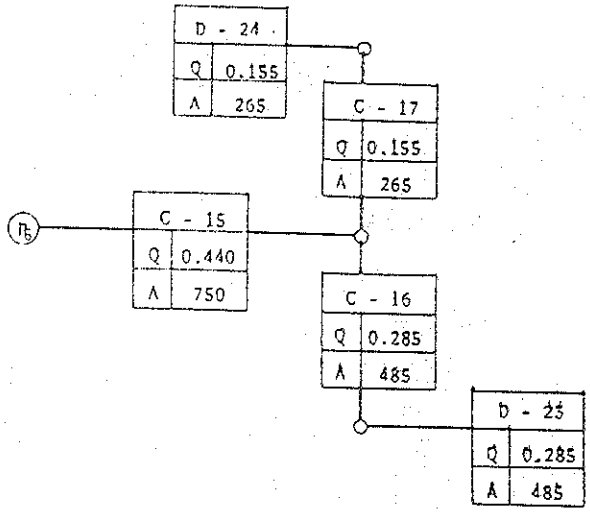
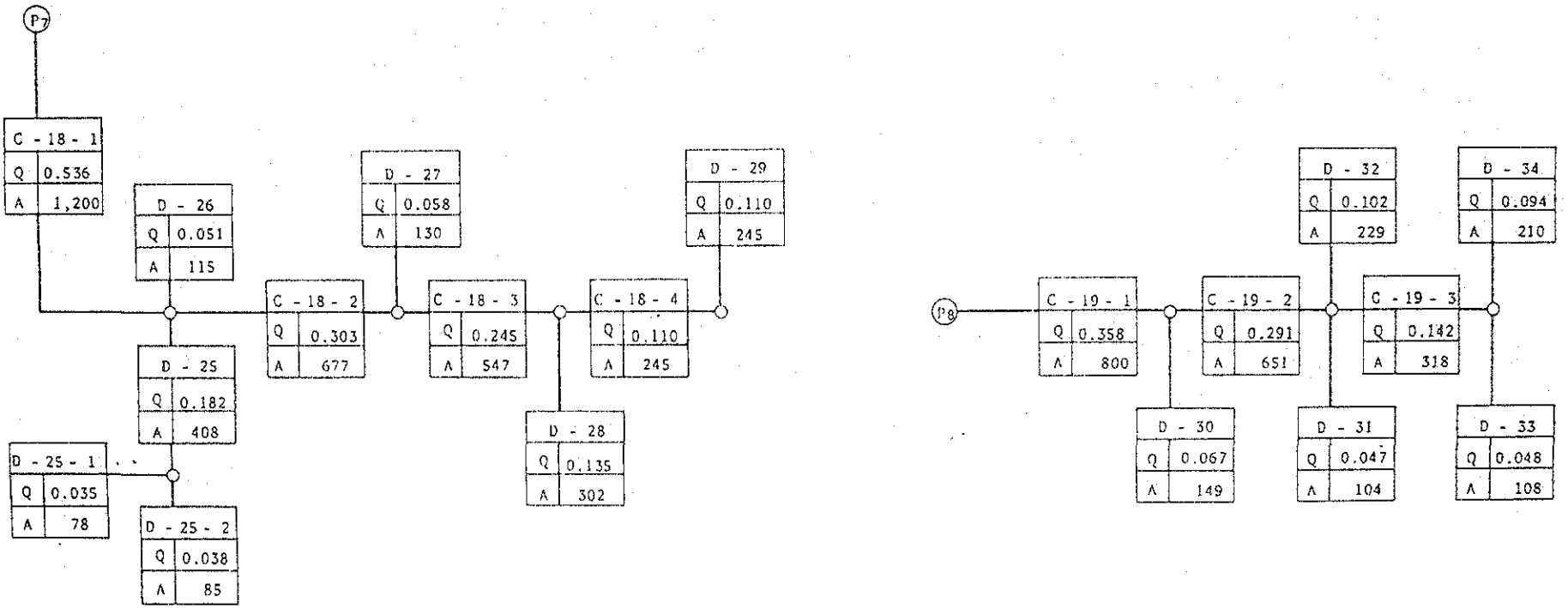


Fig. H2-4. Irrigation Diagram (4/4)



H-3. Major Irrigation Facilities

H-3.1 Intake Facilities

(1) Intake

Based upon the design discharge of each intake and having the layout of each intake (refer to the Drawings), the hydraulic calculation of each intake has been performed.

The design velocity of pipe culverts is adopted at around 1.0 m/sec in order to avoid the sedimentation inside of the pipes.

The continuity equation and Manning's formula are applied for the hydraulic calculations.

The results are shown in Tables H3-1 and H3-2.

It should be noted that each design intake water level are estimated from the longitudinal profile provided by MOI, Fayoum without a consideration of increase amount of irrigation water from the Batts Drain.

The wet masonry type structures is adopted for the both inlet and outlet transitions, while the reinforced concrete type structure in adopted for the both inlet and outlet boxes.

As for the pipe culvert, the precast reinforced concrete pipe is adopted.

(2) Feeder Canals

Each feeder canals are designed as a earth canal from the economical reason and cross-section of each feeder canal is designed after Kennedy formula, considering the velocity of each canals shall be fallen within the non-silting and non-eroding velocity.

Based upon the above, the design discharge and also having the following conditions,

* Side slope of canal : 1 : 1.5
* Roughness coefficient (n): 0.030

The hydraulic calculations have been performed, applying the continuity equation and Manning's formula.

As a result, the canal dimensions which have the bottom width of 1.0 m and the bottom slope of 1/2,000 is adopted. (refer to the Drawings)

Hydraulic calculation for each feeder canal is presented in Table H3-3 and the longitudinal profile for each feeder canal are shown in the Drawings.

The side slope of canals (1 to 1.5) is decided from the soil condition and the 1.0 meter berm at both sides of canal will be provided for the canals, of which height is more than 4.0 m.

Moreover, the 4.0 m width of maintenance road at the both sides of canal will be provided.

H-3.2. Pumping Stations

(1) Suction Pit

The suction pit are provided after feeder canals or intakes (P6 and P7 pump station).

The shape of plan and longitudinal section are designed as shown in Fig.H3-1, considering the vortex in the pit (cause of cavitation) shall not be appeared during the pump operation.

Based upon the above, the layout of suction pit is performed, the typical drawings and the dimension table for each suction pit are shown in the Drawings.

Trashracks (screen) are provided at each suction pit.

The suction water level (SWL) for each pump is estimated as follows;

$$SWL = WS_4 - 0.05m$$

where, WS_4 : Water level in m at the end of each feeder canal

0.05: Head loss in m due to trashracks

(2) Pump Facilities

1) Design Discharge

The unit design discharge of each pump is estimated based upon the rotational operation of pumps under the condition the operation time of each pump is 16 hour-on and eight hour-off due to 24 hour intake;

6 Units (a, b, c, d, e, f)

First 8 hr	Second 8 hr	Third 8 hr
a, b	a, b	c, d
c, d	e, f	e, f

9 Units (a, b, c, d, e, f, g, h, i)

First 8 hr	Second 8 hr	Third 8 hr
a, b, c	a, b, c	d, e, f
d, e, f	g, h, i	g, h, i

From the above, the unit discharge of each pump is estimated as follows;

No. of Pump Unit	Unit Discharge
6	1/4 Q_T
9	1/6 Q_T

Note: Q_T = q x A (total Discharge)

where;

q: Water duty in (cu.m/min/feddan)

A: Total net irrigation area in feddan of each pumping station

Based upon the above, the design discharge per pump for each pumping station is estimated as presented in Tables H3-4 and H3-5.

2) Suction water level, discharge water level and actual head

a. Suction water level (SWL) in m for each pump

$$SWL = WS_4 - 0.05 \text{ m}$$

where;

WS_4 : Water level in m at the end of each feeder canal

0.05: Head loss in m due to trashracks

b. Discharge water level (DWL) in m for each pump

DWL = Highest ground elevation at each sprinkler's outlet plus 40 m as required head of delivering point to on-farm facilities.

c. Actual head (AH) in m

$$AH = DWL - SWL$$

Suction water level, discharge water level and actual head for each pump are presented in Table H3-4 and Table H3-5.

3) Total Head Required

Total head (TH) required in m for each pump is estimated as follows;

$$TH = AH + HL + 2.0 \text{ m} \pm$$

where, AH : Actual head in m for each pump
HL : Head loss in m of pipeline
2.0 : Head loss in m of suction pipe, pipe inside of pump house and so on.

Total head required are chosen those for the most critical line among each irrigation system and head loss of pipeline for the estimation of total head required on each pump are presented in Tables H3-6 and H3-7.

Based upon the above formula, the total head required for each pump are estimated and presented in Tables H3-4 and H3-5.

4) Power Required

Power required for each pump are estimated by the following equation;

$$Preq = 0.163 \text{ SG q Ht } (1 + F)/PE$$

where;

Preq	:	Power required (KW)
SG	:	Specific gravity of water (1.0)
q	:	Design discharge per pump in (cu.m/min)
H_T	:	Total head required in m
F	:	Safty factor (0.1)
PE	:	Pump efficiency (0.75)

Based upon the above formula, the power required for each pump are estimated and presented in Tables H3-4 and H3-5. The pump efficiency shall be checked, having the characteristic curve of each pump during the following detail design.

5) Selection of Number of Pump in Each Pumping Station

Considering no discharge control of each pump in the design from the viewpoint of energy saving and also seasonal fluctuations of water requirement, the numbers of pump at each pumping station are also decided at six units or nine units.

In order to select the number of pumps in each pumping station, the following two cases are also examined at No.3 pumping station;

* 16 hour operation
* 24 hour operation

From the above, the number of pumps required for each cases are;

* 16 hour operation; 7 units (6 units plus 1 stand-by)
* 24 hour operation; 5 units (4 units plus 1 stand-by)

Investment costs and replacement costs for each case are presented in Tables H3-8 and H3-9.

Economic comparison are performed on the conditions of an annual interest rate of 10 percent and a project life span of 50 years, considering especially the lift span of pump equipments. The results are presented in Table H3-10.

As a result, it is found out that 16 hour operation is more advantageous than 24 hour operation, in case the replacement of pump equipment on 24 hour operation are taken place in less than once seven years.

On the other hand, planning of pump operation through 24 hour continuous operation are generally adopted for relatively short period, say one month during peak demand, in order to protect the troubles (burn out etc.) from motors and to save the life span of motors by long period with continuous operation of pumps. In case of 24 hour operation with four units at peak demand, each pump shall be obliged to operate continuously for three months, considering one-stand-by unit in rotation. Therefore, 24 hour operation is not recommendable from the above-mentioned.

Consequently, 16 hour operation of each pump is adopted in the design, considering the economical point of view, safetiness of facilities and also operation and maintenance point of view.

Further studies shall be required during the detailed design stage based upon the final figures of each irrigation system.

6) Installation Height of Pump

The installation height of pumps at such pumping station are designed at around 4.0 m above the suction water level in the design.

The installation height of each pump shall be checked on cavitation, having the characteristic curve of each pump during the detailed design stage.

7) Pressure Tank

The manual operation, one-man control, and on-off control with pressure tank are applied in the design.

The capacity of around three minutes of peak discharge of pressure tanks are provided at each pumping station in the design, considering the design pressure of on-off for each pump at the same level and sequential parallel operation of pumps by timer.

However, the capacity of pressure tank shall be re-examined, having the characteristic curve of each pump during the detailed design stage.

H-3.3. Water Conveyance and Distribution Facilities

(1) Pipeline

1) Hydraulic calculation

Based upon the schematic diagram of each irrigation system, the hydraulic calculation has been performed (refer to Appendix H-2.1).

The diameter of pipes are determined taking into consideration that the design velocity is around 1.5 m/sec to 2.0 m/sec.

The Hazen-Williams formula is applied for the friction loss calculation as follows;

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

where, D : Pipe diameter (m)
hf: Friction loss (m)
Q : Discharge (cu.m/sec)
L : Length of pipe (m)
C : Coefficient of velocity depending on the kinds of pipes
C = 130 (Ductile iron pipe with mortar lining)
C = 140 (PVC pipe)

The results for each pipeline are shown in the Drawings.

2) Water Hammer Analysis

The water hammer analysis have been performed for the P7 irrigation system as a model under the following conditions;

* Sudden power cut has been taken place under the operation at peak demand

* The water is taken only at the end point of each distribution line

Considering the above conditions, the water hammer analysis have been performed applying the electronic computer.

As a result, referring to the Drawings of P7 Irrigation System, it is found out the negative water pressure of 14 m is taken place at the C-18-1 conveyance pipeline, while the maximum water pressure of about 25 m from the ground surface is taken place at 4.0 km from the pumping station in the line C-18 and D-29.

Consequently, it can be considered the installation of two to three high speed air valve in the C-18-1 line will be solved out for the problem of such negative water pressure and the design water pressure applied for the pipe design will be taken only static water pressure of the each pipeline.

However, 40 percent of static pressure are taken into consideration in the design from the viewpoint of safety of the system and also considering the analysis are made only one case at one irrigation system.

Further studies shall be carried out for each irrigation system during the detail design stage.

3) Uniform Water Distribution of Irrigation System

The pressure and discharge control facilities shall be provided in order to distribute the irrigation water uniformly since the long pipelines are employed in the systems. The pressure relief valves such as Serena new auto valve, etc. are provided at the head of each irrigation block or each distribution pipeline, while the orifice plates are provided at each farm block, each field lot for three year rotational area and forage area and each 7.5 feddan for fruit area.

Table H3-1 Head Loss Calculation of Intakes

P.S	Qd m^3/s	D mm	A m^2	V m/s	$V^2/2g$ m	hi.o m	hf m	Hf m	Hf applied m
P_1	0.306	600	0.283	1.08	0.06	0.09	0.02	0.11	0.15
P_2	0.302	600	0.283	1.07	0.06	0.09	0.02	0.11	0.15
P_3	0.312	600	0.283	1.10	0.06	0.09	0.02	0.11	0.15
P_4	0.611	900	0.636	0.96	0.05	0.08	0.01	0.09	0.10
P_5	0.346	700	0.385	0.90	0.04	0.06	0.01	0.07	0.10
P_6	0.440	700	0.385	1.14	0.07	0.11	0.02	0.13	0.15
P_7	0.536	800	0.503	1.07	0.06	0.09	0.01	0.10	0.10
P_8	0.358	700	0.385	0.93	0.04	0.06	0.01	0.07	0.10

Note : Hi.o : shows head loss due to inlet and outlet.
$1.5 \frac{V^2}{2g}$

hf : friction loss

Hf : hi.o + hf

n : roughness coefficient
0.013 for pipe

Table H3-2 Hydraulic Calculation of Intakes

P.S	Qd m^3/s	WS_1 m	WS_2 m	WS_3 m
P_1	0.306	13.75	13.55	13.40
P_2	0.302	13.70	13.50	13.35
P_3	0.312	13.60	13.40	13.25
P_4	0.611	12.50	12.30	12.20
P_5	0.346	10.60	10.40	10.30
P_6	0.440	9.05	8.90	8.75
P_7	0.536	9.00	8.85	8.75
P_8	0.358	8.85	8.70	8.60

Note : WS_1 : Shows design water level at inlet without consideration of re-use water from Batts Drain
WS_2 : Vents type 54 WS_1 - 0.20 m
- do - 36 WS_1 - 0.15 m
WS_3 : WS_2 - Hf spplied

Table H3-3 Hydraulic Calculation of Feeder Canals

P.S.	Qd (m/sec)	b (m)	$b^{8/3}$ (m)	$I^{1/2}$	$\frac{Qd \cdot n}{b^{8/3} \cdot I^{1/2}}$	d/b	d (m)	A (m^2)	V (m/sec)	Va (m/sec)
P_1	0.306	1.00	1.00	0.0224	0.410	0.505	0.505	0.888	0.34	0.30 ~ 0.39
P_2	0.302	"	"	"	0.404	0.501	0.501	0.878	0.34	0.30 ~ 0.39
P_3	0.312	"	"	"	0.418	0.510	0.510	0.900	0.35	0.30 ~ 0.39
P_4	0.611	"	"	"	0.818	0.713	0.713	1.476	0.41	0.37 ~ 0.48
P_5	0.346	"	"	"	0.463	0.537	0.537	0.970	0.36	0.31 ~ 0.40
P_8	0.358	"	"	"	0.479	0.546	0.546	0.993	0.36	0.31 ~ 0.41

Note: m = 1.5 (side slope)
n = 0.030 (roughness coefficient)
L = 1/2,000

Va is estimated after Kennedys formula: $Va = C \cdot D^{0.64}$

where; Va : Non-silting and non-eroding velocity (m/sec)

C : Coefficient depended upon soil
0.46 (fine sandy soil), 0.60 (hard soil)

D : Water depth (m)

Table H3-4 Type and Diameter of Pumps (1/2)

Pumping Sta.	Area Served Feddans	Design Discharge cum/min/fed.	Total Discharge(Q) cum/min	No. of Pumps units	Discharge Per Pump (q) cum/min/unit
P_1	684	0.0268	18.33	7	4.58
P_2	676	"	18.12	"	4.53
P_3	699	"	18.73	"	4.68
P_4	1,367	"	36.64	10	6.11
P_5	774	"	20.74	7	5.19

Pumping Sta.	Suction Water level m	Discharge Water level m	Actual Head m	Head Loss(HL) m	Total Head required(TL)
P_1	11.95	64.00	52.05	27.95	80.00
P_2	12.75	66.00	53.25	18.75	72.00
P_3	12.90	72.00	59.10	17.90	77.00
P_4	11.30	69.00	57.70	21.30	79.00
P_5	9.00	68.00	59.00	26.00	85.00

Pumping Sta.	Pump Diameter mm	Power required kw	Type of Pumps
P_1	200	90	Horizontal Axis Single Suction Multi-stage Volute Pump
P_2	"	90	"
P_3	"	90	"
P_4	250	120	"
P_5	200	110	"

Note : 1. Since the rotational operation of pump shall be considered, discharge per pump (q) are estimated as follows;

For 6 units : $\frac{Q}{4}$, For 9 units : $\frac{Q}{6}$

2. Head loss is estimated as follows;
HL = Head loss of pipeline + 2.00 m +
where, 2.00 m + is for loss head of suction pipe, pipe inside of pump house and so on.
3. Discharge water level is highest ground elevation at each sprinkler's outlet +40 m as required head of delivering point to on-farm facilities.
4. No. of pumps are included one stand-by unit.

Table H3-5 Type and Diameter of Pumps(2/2)

Pumping Sta.	Area Served feddans	Design Discharge cum/min/fed.	Total Discharge cum/min	No. of Pumps	Discharge per Pump cum/min/unit
P_6	750	0.0352	26.40	7	6.60
P_7	1,200	0.0268	32.16	7	8.04
P_8	800	"	21.44	7	5.36

Pumping Sta.	Suction Water level m	Discharge Water level m	Actual Head m	Head Loss m	Total Head required m
P_6	8.70	70.00	61.30	16.70	78.00
P_7	"	66.00	57.30	25.70	83.00
P_8	7.90	"	58.10	23.90	82.00

Pumping Sta.	Pump Diameter mm	Power required kw	Type of Pumps
P_6	250	130	Horizontal Axis Single Suction Multi-stage Volute Pump
P_7	250	160	"
P_8	200	110	"

Table H3-6 Head Loss of Pipe Lines for Total Head Culculation of Pumps (1/2)

PS	Location	Head Loss Q m³/s	D mm	L m	V m/s	HL m	WL m
P_1	D-3	0.050	200	345	1.59	4.50	
	C-2-2	0.103	300	1,630	1.46	11.30	
	C-2-1	0.256	400	815	2.04	7.50	
	C-1	0.306	450	345	1.92	2.50	
	Total					25.80	
P_2	D-8-2	0.047	250	330	0.96	1.30	
	D-8-1	0.096	300	180	1.36	1.10	
	C-5	0.096	300	1,650	1.36	10.00	
	C-4	0.302	450	550	1.90	3.90	
	Total		550			16.30	
P_3	D-10-5	0.024	200	330	0.76	1.10	
	D-10-4	0.057	250	330	1.16	1.90	
	D-10-3	0.104	300	330	1.47	2.40	
	D-10-2	0.151	350	330	1.57	2.20	
	D-10-1	0.198	400	180	1.58	1.10	
	C-7	0.312	450	880	1.96	6.60	
	Total					15.30	

PS	Location	Head Loss Q m³/s	D mm	L m	V m/s	HL m	WL m
P_4	D-16-4	0.025	200	330	0.80	1.20	
	D-16-3	0.045	200	330	1.43	3.60	
	D-16-2	0.059	250	330	1.20	2.00	
	D-16-1	0.070	250	180	1.43	1.50	
	C-10-2	0.070	250	815	1.43	6.70	
	C-10-1	0.379	600	815	1.34	2.20	
	C-9	0.611	700	345	1.59	1.10	
	Total					18.30	
P_5	D-20	0.039	200	180	1.24	1.50	
	C-13-2	0.073	250	1,465	1.49	13.00	
	C-13-1	0.181	350	815	1.88	7.50	
	C-12	0.346	500	350	1.26	1.90	
	Total					23.90	

Table H3-7 Head Loss of Pipe Lines for Total Head Calculation of Pumps (2/2)

PS	Location	Head Loss Q m/s	D mm	L m	V m/s	HL m	WL m
	D-23-5	0.042	250	330	0.86	1.10	
	D-23-4	0.088	300	330	1.25	1.70	
	D-23-3	0.143	400	330	1.14	1.10	
P_6	D-23-2	0.203	450	330	1.28	1.10	
	D-23-1	0.285	500	180	1.45	0.70	
	C-16	0.285	500	1,400	1.45	5.30	
	C-15	0.440	600	1,100	1.56	3.80	
	Total					14.80	
	D-29-3	0.038	200	320	1.21	2.50	
	D-29-2	0.083	300	380	1.17	1.80	
	D-29-1	0.110	300	200	1.56	1.60	
P_7	C-18-4	0.110	300	650	1.56	5.10	
	C-18-3	0.245	450	815	1.54	3.90	
	C-18-2	0.303	500	815	1.54	3.50	
	C-18-1	0.536	700	1,910	1.39	4.50	
	Total					22.90	

PS	Location	Head Loss Q m/s	D mm	L m	V m/s	HL m	WL m
	D-33	0.048	200	180	1.55	2.20	
P_8	C-19-3	0.142	350	1,630	1.48	9.60	
	C-19-2	0.291	450	700	1.83	4.60	
	C-19-1	0.358	500	930	1.82	5.40	
	Total					21.80	

Table H3-8 Investment Cost

(Unit: LE1,000)

Item	Rate(LE)	7 units	5 units
Pump ϕ200	8,000	56.00	40.00
Motor 90kW	3,900	27.30	19.50
Auxiliary Equipment	L.S.	9.80	8.30
Pipe & Valves	"	30.20	25.70
Control Pannel & Cable	"	40.10	34.10
Sub-station 450kVA	"	38.40	38.40
Generator 125kVA	"	50.00	50.00
Pressure Tank	"	31.90	31.90
Strainer	1,000	7.00	5.00
Miscellaneous	L.S.	9.30	8.50
Transport & Installation	"	60.00	50.60
Total		360.00	312.00

Table H3-9 Replacement Cost

7 units (once/25 years)

1. At 12.5 and 37.5 years after operation

   15% of Pump Cost only with contingency of 10%
   0.15 x 56,000LE x 1.1 = 9,240LE

2. At 25 years after operation

   80% of Pump Cost and Motor Cost with contingency of 10%
   0.80 x 83,300LE x 1.1 = 73,304LE

5 units (once/5 or 7 years)

1. At 2.5, 7.5, 12.5, 17.5, 22.5, 27.5, 32.5, 37.5, 42.5 47.5 or 3.5, 10.5, 17.5, 24.5, 31.5, 38.5, 45.5 years after operation

   15% of Pump Cost only with contingency of 10%
   0.15 x 40,000LE x 1.1 = 6,600LE

2. At 5, 10, 15, 20, 25, 30, 35, 40, 45 or 7, 14, 21, 28, 35, 42, 49 years after operation

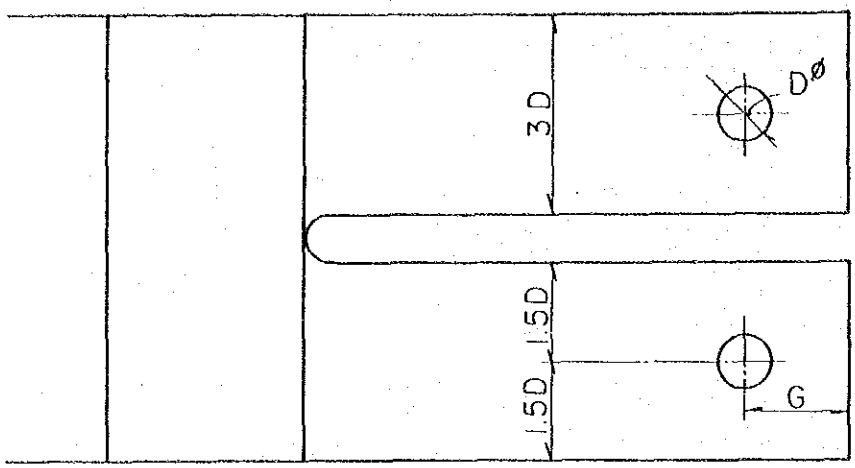
   80% of Pump Cost and Motor Cost with contingency of 10%
   0.80 x 59,500LE x 1.1 = 52,360LE

Table H3-10 Economic Comparison

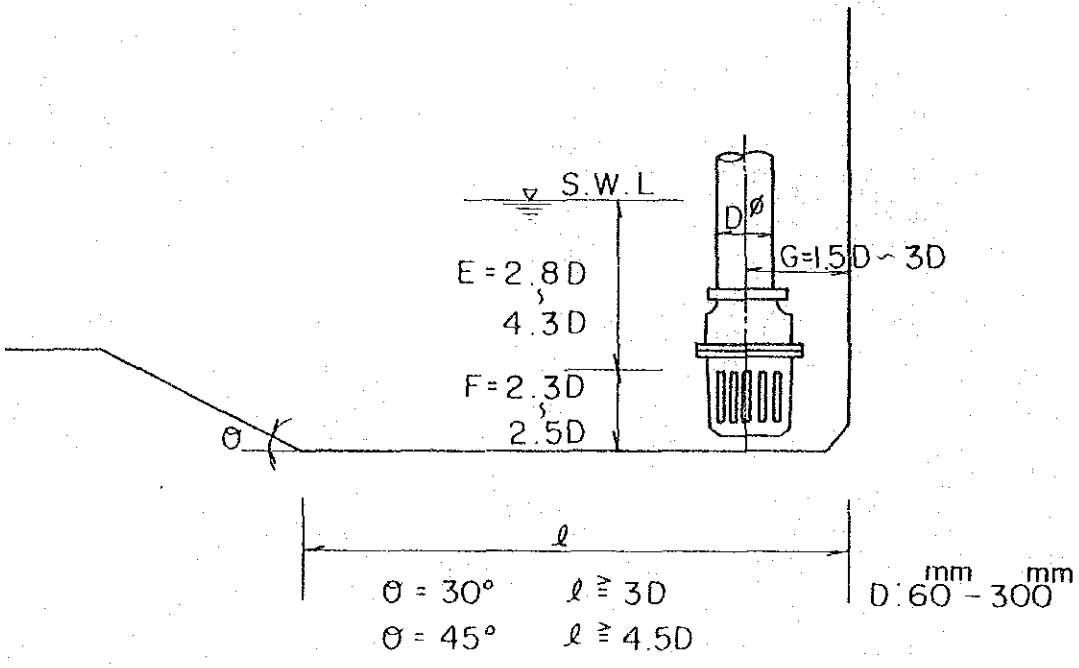
Description	7 units (1/25 years)			5 units (1/5 years)			5 units (1/7 years)		
	n year	Cost L.E.	Present Worth L.E.	n year	Cost L.E.	Present Worth L.E.	n year	Cost L.E.	Present Worth L.E.
1. Investment Cost	1	360,000	360,000	1	312,000	312,000	1	312,000	312,000
2. Replacement Cost	12.5	9,240	2,808	2.5	6,600	5,200	3.5	6,600	4,725
	25.0	73,304	6,743	5	52,360	32,515	7	52,360	26,860
	37.5	9,240	258	7.5	6,600	3,227	10.5	6,600	2,428
			389,809	10	52,360	20,210	14	52,360	13,770
			(1.0)	12.5	6,600	2,006	17.5	6,600	1,247
				15	52,360	12,514	21	52,360	7,068
				17.5	6,600	1,247	24.5	6,600	640
				20	52,360	7,801	28	52,360	3,612
				22.5	6,600	772	31.5	6,600	330
				25	52,360	4,817	35	52,360	1,884
				27.5	6,600	481	38.5	6,600	165
				30	52,360	2,984	42	52,360	942
				32.5	6,600	297	45.5	6,600	85
				35	52,360	1,884	49	52,360	471
				37.5	6,600	184			376,227
				40	52,360	1,151			(1.02)
				42.5	6,600	112			
				45	52,360	733			
				47.5	6,600	72			
						410,207			
						(1.11)			

Note: 1. Present worth are estimated on the conditions of an annual interest of 10 percent and a project life span of 50 years.
2. Constructionn cost of civil works and O & M cost are excluded in the comparison by the reason those difference for each case are regarded as negligible small.
3. Comparison are performed on No.3 pumping station (P3).

Fig. H3-1 Shape of Suction Pit.



PLAN



PROFILE

H-4. On-farm Facilities

H-4.1. Farm Consolidation

(1) Farm Consolidation

To decide the minimum sized unit for farming, called a field lot, the following factors were taken into consideration use of farm machinery, laborers working efficiency, irrigation methods, topographic conditions and land tenure.

1) Use of Farm Machinery

It can generally be said that the longer the length of the field, the higher the working efficiency. Land preparation by use of a tractor (65 PS) would require a field length of about 100 m to 150 m for efficient operation.

2) Laborers Working Efficiency

The main factors to regulate the shape and the scale of the field from the viewpoint of laborers working efficiency are disease protection and harvesting. According to the cropping pattern of three year rotational cultivation, one-third of the total cultivated area is for vegetables. The vegetable cultivation requires a large labor force. The length of the field should be less than 100 m for labor-intensive farming especially for harvesting and transporting of products from the field to the road.

A sprayer (600 liters) will be used for disease protection of crops. Pesticides will be sprayed by a spray gun with a long hose in the field. Since powdered medicine reaches a distance of about 50 meters, when the work is done from both sides, a field length of less than 100 m is desirable.

3) Irrigation Method

Sprinkler and drip irrigation system will be introduced to the Project. As for the sprinkler irrigation system, the maximum length of the lateral pipe is regulated by the hydraulic conditions. The pressure difference of both edges of the lateral pipe should be within 20 percent to keep the balance of water discharge. The maximum length of the lateral pipe is as follows:

Diameter of the Pipe	Maximum Length
25 mm	25 m
50 mm	100 m
75 mm	200 m

A lateral pipe with a diameter of less than 50 mm is generally used. As for the drip irrigation system, on the other hand the length of the drip tube is generally 50 m to 150 m.

4) Topographic Conditions

The directions of the length of the field should be paralleled to the contour line. If the field is located on undulated land slope and needs levelling, its length will naturally be limited to facilities for manual labor. However, the North Wahby and Com Osheem areas is nearly flat, so any limitation may not occur.

5) Land Tenure

The land tenure of a small farm household is five (5) feddan. However, there is a plan that 25 percent (1.25 fed.) of the land is for fruit cultivation at a different place in cooperation with several farmhouseholds. The remaining 75 percent (3.75 fed.) is used for three year rotational cultivation.

The field lot where the same crop is cultivated should be one-third (1/3) of the 3.75 feddan or 1.25 feddan (5,250 sq.m). From the viewpoint of the sprinkler setting interval (generally 14 m or 18 m), the length and width of the field required for an area of 5,250 sq.m is as follows:

	14 m Interval			18 m Interval	
	Width	Length		Width	Length
No.1	14 m	375 m	No.6	18 m	291.7 m
2	28	187.5	7	36	145.8
3	42	125.0	8	54	97.2
4	56	93.8	9	72	72.9
5	70	75.0			

Judging from the range of the sprinkler (middle pressured type), No.4 and No.8 are suitable.

Consequently, 100 m is adopted as the length of the field lot mainly involving the laborers working efficiency for vegetable cultivation and the hydraulic conditions of irrigation methods. The width of the field is set at 52.5 m. Three (3) field lots form a farm lot which belongs to a farm household. (refer to Fig. H4-1)

Furthermore, the shape of a farm block which is comprised of several farm lots is decided taking into consideration the following points.

* One side of the farm lot should be adjacent to the farm road.
* Each side of the farm block should be adjacent to a main, branch or farm road.
* Length of the farm block would be better less than one kilometer considering farmers' daily travel to and from their land.
* Economic allocation of pipelines in the field.

Consequently, the shape of the farm block has been decided at 315 m x 800 m, that is 60 feddan which is comprised of 16 farm lots (refer to Fig. H4-2).

The largest unit is called an irrigation block which is comprised of four (4) farm blocks (240 feddan). An area of 60 feddan is for fruit cultivation and an area of 180 feddan is for three year rotational cultivation.

The irrigation block is managed by one hamlet which has 24 small farm households, four (4) middle-scale farmhouseholds and three (3) large farm households. (refer to Fig. H4-3)

(2) Road

Roads in the both new reclamation areas are classified as trunk roads, branch roads and farm roads depending on their respective functions as follows:

1) Trunk Road

The main function of the trunk road is to connect with the other areas and roads, and also with villages. The effective width is eight meters paved with gravel and the total width is 12 m. The total length is estimated at 16 km in North Wahby area and 8.3 km in Com Osheem area.

2) Branch Road

The main functions of the branch road is to connect between the trunk road and villages which are not adjacent to the trunk road. The effective width is six meters paved with gravel and the total width is eight meters. The total length is estimated at 1.7 km in North Wahby area and 3.8 km in Com Osheem area.

3) Farm Road

The main functions of the farm road is for access to the cultivated land and to connect with the trunk or branch roads. The effective width is four meters and the total width is 5.5 m. The total length is estimated at 106.3 km in the North Wahby area and 98.0 km in the Com Osheem area.

A cultivation passway will be prepared at the side of the farm lot which is not adjacent to any roads for making the field work go smoothly. Allocation of each road in and around the farm block is shown in Fig. H4-4.

(3) Windbreak

According to the climatological data, the monthly mean wind velocity in the both reclamation areas ranges from 1.6 to 3.2 m/s throughout the year. Strong winds called "Khamasine" blow in early spring from the direction of north or northwest.

Windbreaks will be provided to protect the strip of adjacent land and crops from strong wind. Furthermore, other functions are expected such as to decrease evapotranspiration and to control temperature and humidity through diminution of wind velocity.

The area which can be effectively protected by the windbreak is relative to its height and also depends on the formation of the trees and their location.

It can generally be said that the windbreak is effective for a distance of 10 to 15 times of its height. The windbreak will be located along the roads and the cultivation passways with a width of four meters and two meters as shown in Fig. H4-5.

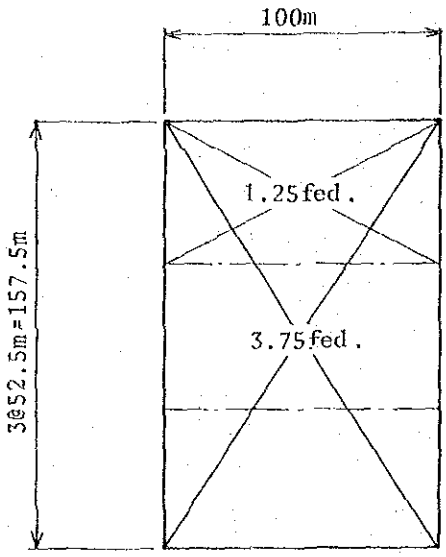


Fig. H4-1 Shape of Field lot(1.25fed.) and Farm lot(3.75fed.)

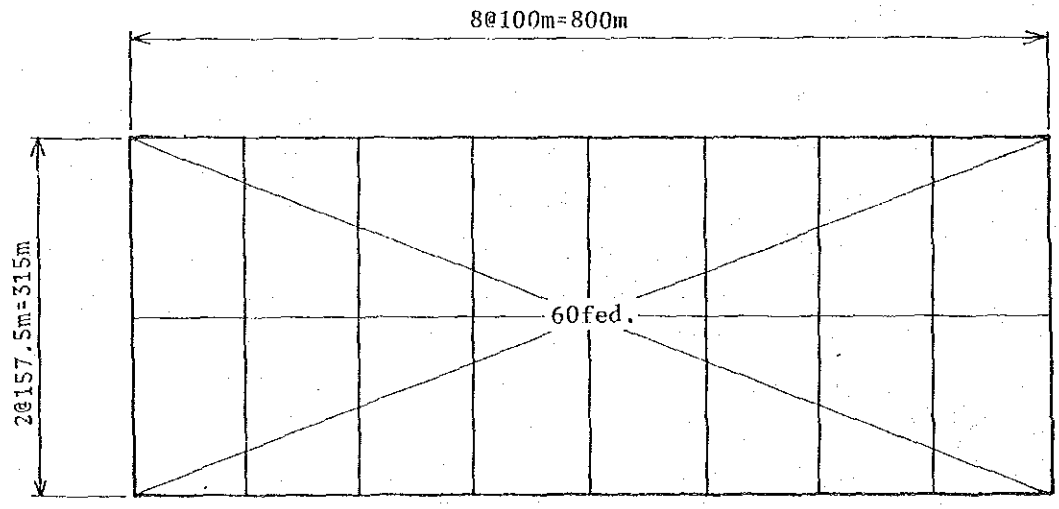


Fig. H4-2 Shape of Farm block (60fed.)

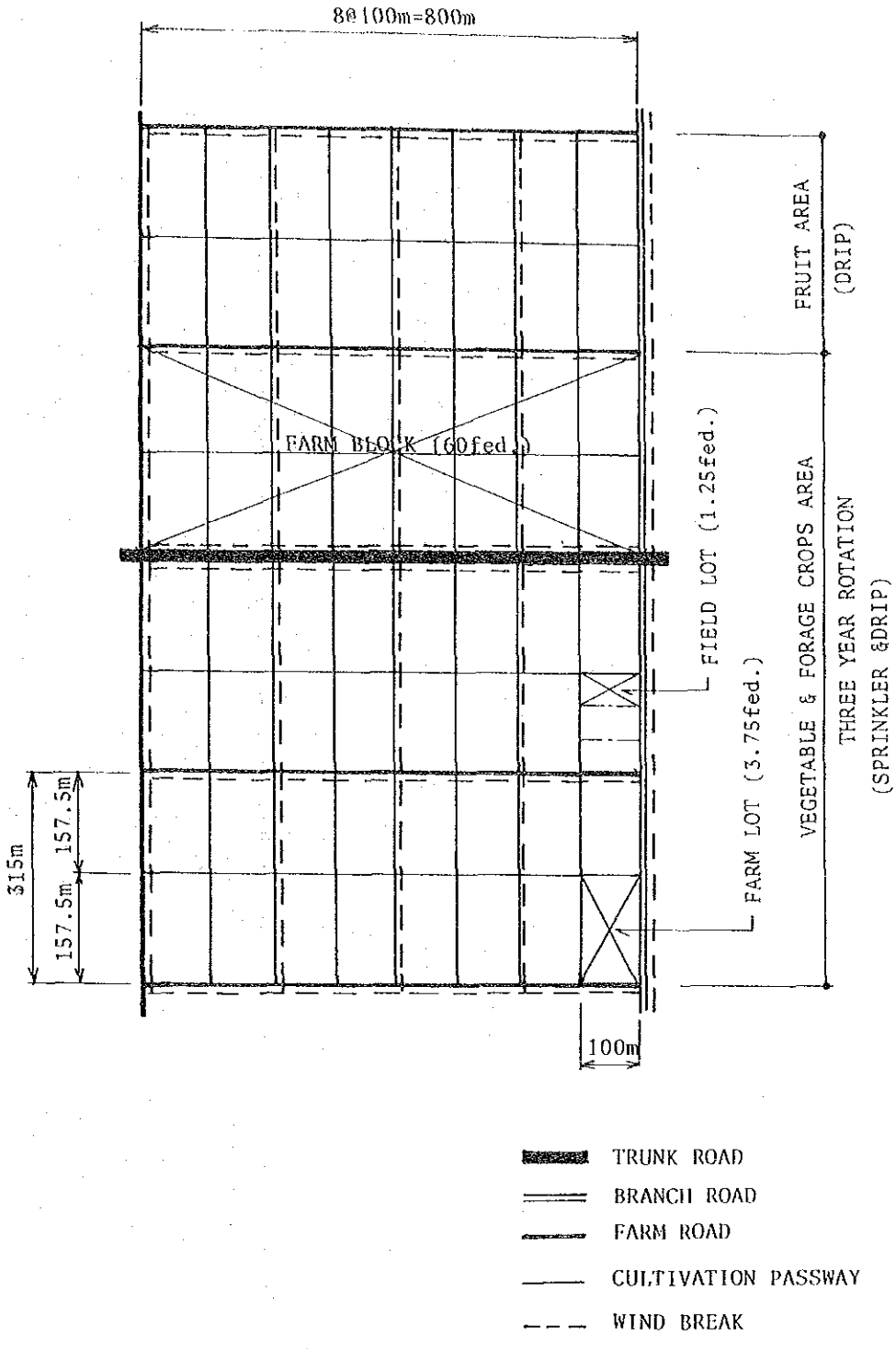


Fig.H4-3 Shape of Irrigation Block

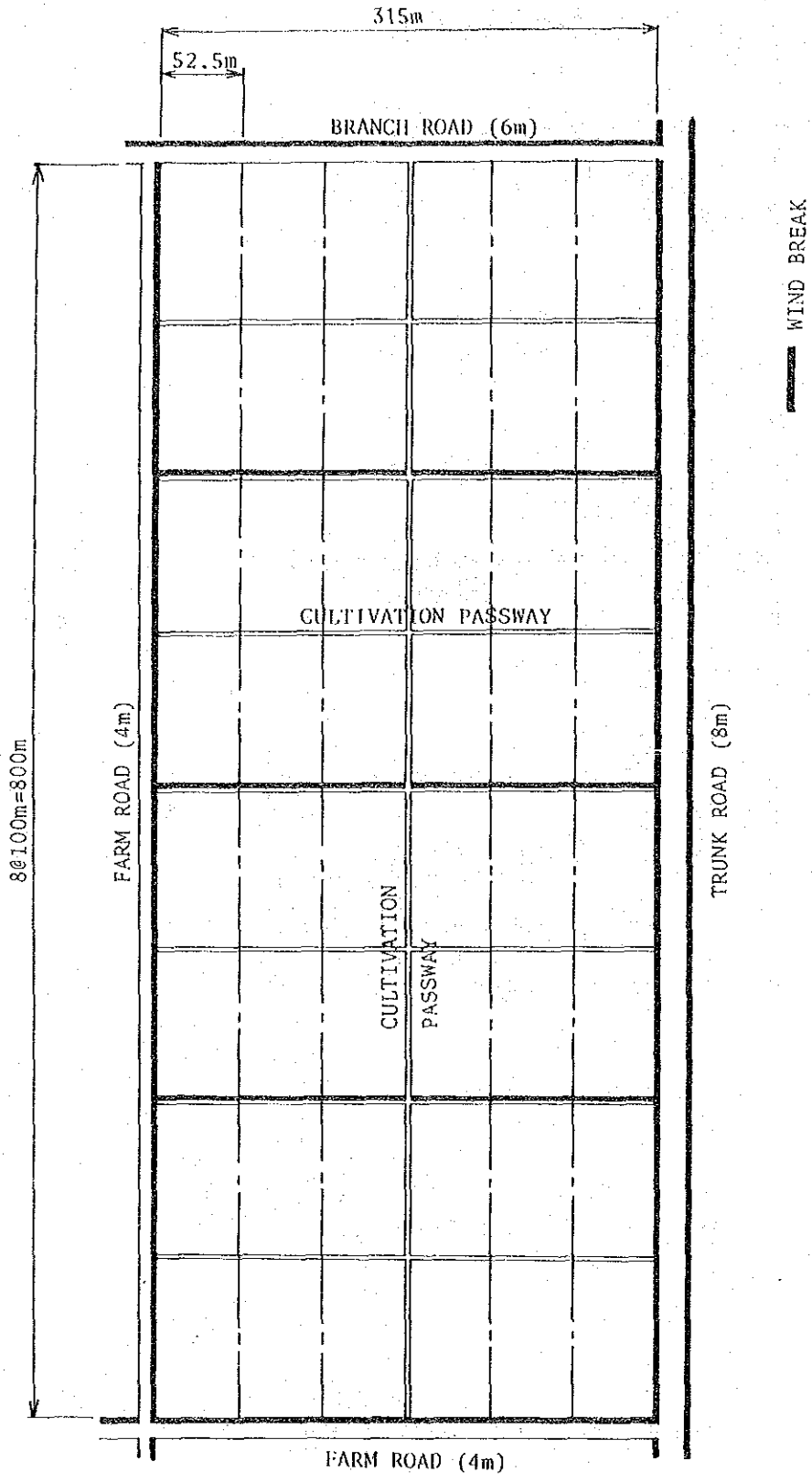


Fig.H4-4 Allocation of Each Road

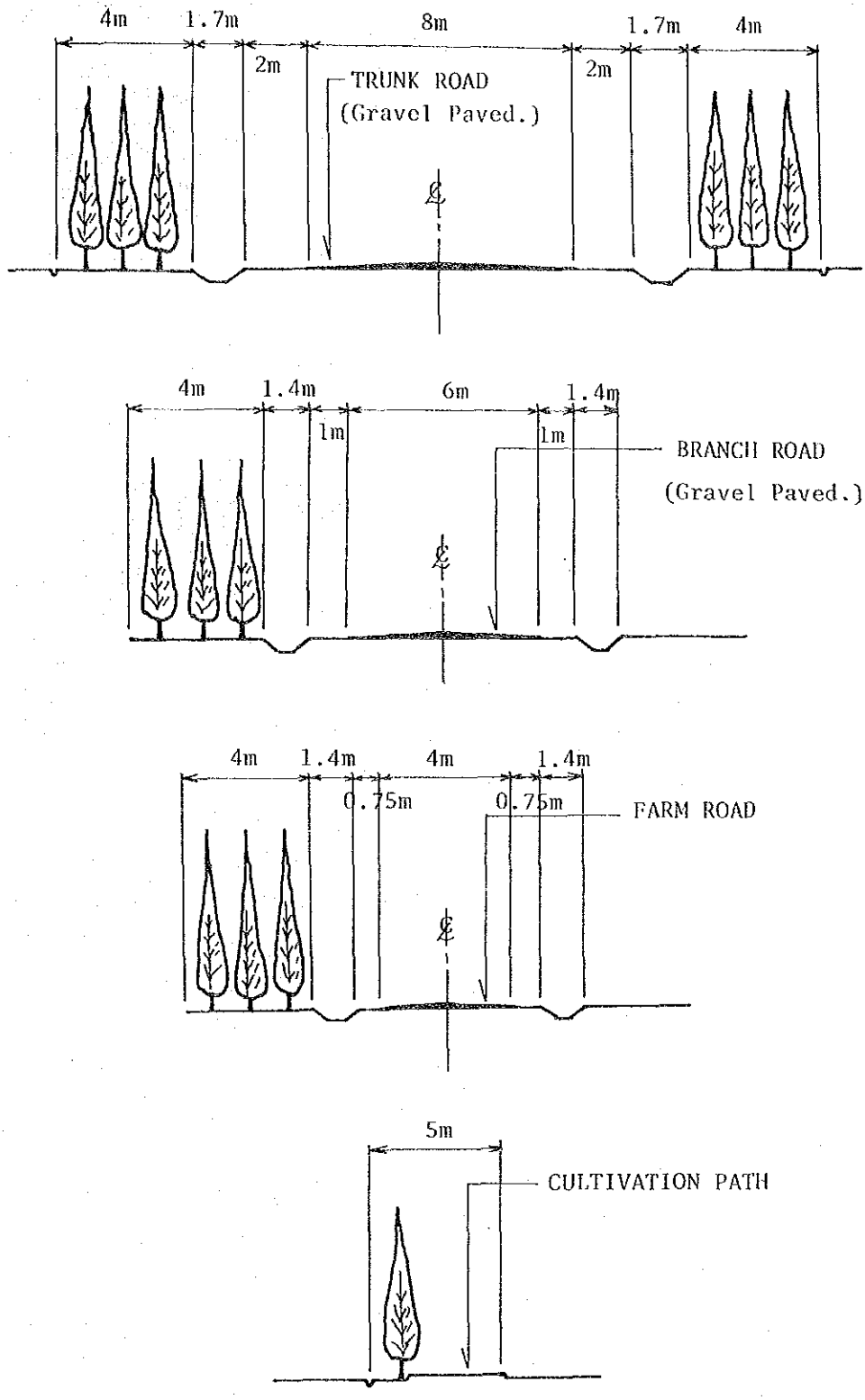


Fig. H4-5 Cross Section of each Road and Allocation of Wind Break

H-5. Field Irrigation Facilities

H-5.1. Selection of Irrigation Methods

(1) Irrigation Methods

In general, irrigation methods are categorized as follows:

- Surface irrigation ..... (Furrow method
  (Border method
  (Basin method
- Sprinkler irrigation ..... (Hand moved type
  (Solid type
  (Side wheel type
  (Central pivot type
- Drip irrigation

To select a suitable method for the Project, the factors of topographic conditions, wind, crop varieties, quantity of water, construction cost and so forth should be taken into consideration.

(2) Main Features and Application of Irrigation Method

1) Surface Irrigation

This method can be used for almost the crops cultivated in flat land. If the land is undulated, levelling work will be required. This method costs less than the other methods and is generally used in Egypt. However, a large quantity of irrigation water is required as about more than 20 percent of the other methods, and that causes salt accumulation. Careful water control is necessary due to the conditions of soil and crops, and soil erosion may occur.

2) Sprinkler Irrigation

This method can be adopted even on undulated land so that the cost for land levelling is not necessary. Easy water control and water saving owing to the efficient system can be expected. This method is suited to forage crops and others.

Pipelines should be installed for sprinkler irrigation so that there will be little waste land in the field. However, this method costs more than the surface irrigation methods to facilitate pumps, pipelines and spraying equipments. And, strong wind produces a harmful effect on regular spraying.

3) Drip Irrigation

Same as the sprinkler irrigation method, drip irrigation method can be adopted even on undulated land, and there will be little waste land. The cost of this method is the highest compared with the other methods, but it has the highest water application efficiency. It limits the growth of infestating grasses and salt accumulation because the water is applied only to the part near the root of the crops. It is suited to fruit trees and vegetables but is not recommended for forage crops.

Water saving should be the main point considered when selecting the irrigation methods for the Project because the water quantity to be used for the both new reclamation areas is limited. It also have another function such as not to involve some risk of raising the groundwater level in the future. And also, the limitation of salt accumulation should be considered for agriculture in the areas.

From those points and the advantages of introducing a modernized agricultural system, the sprinkler and the drip irrigation methods are selected to be introduced for the

Project. Considering the application to the crops to be cultivated in the areas, it is decided that the sprinkler irrigation method is for forage and field crops, and the drip irrigation method is for fruits and vegetables.

H-5.2. Basic Criteria of Irrigation

(1) Application Efficiency and Irrigation Water Requirement

Crop water requirement of each crop in summer peaks is at 8.44 mm for sorghum, 5.66 mm for groundnuts, 6.32 mm for watermelon and 5.22 mm for fruit. Application efficiency of each irrigation method is 0.85 for sprinkler and 0.90 for drip irrigation. Therefore, the water requirements in the field for designing the on farm facilities are calculated as follows:

Sorghum (Sprinkler irrigation)

8.44 mm/day / 0.85 = 9.93 mm/day

Watermelon (Drip irrigation)

6.32 mm/day / 0.90 = 7.02 mm/day

Fruit (Drip irrigation)

5.32 mm/day / 0.90 = 5.80 mm/day

(2) Rooting Depth

According to the data of FAO Irrigation and Drainage Paper No.24, the rooting depth of the crops are as follows:

Sorghum	1.0 - 2.0 m
Groundnuts	0.5 - 1.0 m
Melons	1.0 - 1.5 m
Tomatoes	0.7 - 1.5 m
Grapes	1.0 - 2.0 m
Olive	1.2 - 1.7 m

Considering efficient use of irrigation water, economical aspect of irrigation facilities and irrigation hours, the minimum

rooting depth should be taken. As for upland crops, one meter is the minimum rooting depth which covers groundnuts, sorghum, melons and tomatoes. As for fruits, 1.2 m is the minimum rooting depth.

(3) Irrigation Interval

Assuming that the soil in the Project Area belongs to Medium textured soils, its available soil water in mm/m soil depth would be 140. Fraction of available soil water for Sorghum is 0.55 x 0.7 = 0.385. This means that Readily available soil water is 140 x 0.385 = 54 mm/m. Correction for ETcrop is 0.7 and the rooting depth of Sorghum is assumed at 1.0 m. ETcrop of Sorghum is 8.44 mm/day, this means that Irrigation interval is 37.4/8.44 mm = 4 days.

In case of other summer crops, the irrigation intervals are calculated as follows;

Groundnuts	:	7 days
Melon	:	5 days
Fruit	:	8 days

For easy irrigation operation, the irrigation interval would be better the same period in the field and the shortest one should be taken. For the Project, 4 days interval is applied.

*	Available soil water (Sa)	140 mm/m
*	Fraction of available soil water (P)	0.55 x 0.7 = 0.385
*	Readily available soil water (P.Sa)	54 mm/m

Assuming that the soil in the Project Area belongs to Medium textured soils, its available said water in mm/m soil depth would be 140. This means that readily available soil water is 140 x 0.385 = 54 mm/m.

* Correction for ETcrops 0.7
* Rooting depth (D) 1.0 m
* Readily available soil water 37.8 mm

Correction is assumed at 1.0 m. This means that the depth of irrigation application is 54 x 0.7 x 1.0 = 37.8 mm.

* ETcrop 8.44 mm/day
* Irrigation interval 4 days

ETcrop of Sorghum is 8.44 mm/day, this means that Irrigation interval is 37.8/8.44 = 4 days

(4) Water Requirement per Irrigation

Water requirement per irrigation is determined by the irrigation water requirement in the field and the irrigation interval.

Sorghum	9.93 mm/day	x	4 days	= 39.7 mm
Watermelon	7.02 "	x	4 "	= 28.0 mm
Fruit	5.80 "	x	4 "	= 23.2 mm

(5) Irrigation Hours

During the peak irrigation period, the maximum irrigation hours are estimated to be 16 hours per day taking into consideration working hours of the laborers, electric consumption and so forth.

H-5.3. Rotation Irrigation

An intermittent operation will be carried out for the Project as the peak irrigation interval is four days in summer. To easy water management and to decrease the construction cost, rotation irrigation should be carried out. In the fruit area, a drip irrigation system is introduced, and one rotation block will be 15 feddan comprised of four farm lots.

In the vegetable area, the drip irrigation system is also introduced, and one rotation block will be 2.5 feddan. In the forage crops area, a sprinkler irrigation system is introduced, and one rotation block will be five feddan. Two sprinkler lines are set in the block, and is rotated three times per day.

The location of the drip line for vegetables and sprinklers should be changed every year according to the three year rotational cultivation. However, at the place for livestock breeding in Com Osheem area, only the sprinkler irrigation system is introduced for forage crops. Therefore, one rotation block will be 15 feddan and will be designed six sprinkler lines. A layout of each rotation block is shown in Fig. H4-6.

H-5.4. Typical Plan of Irrigation

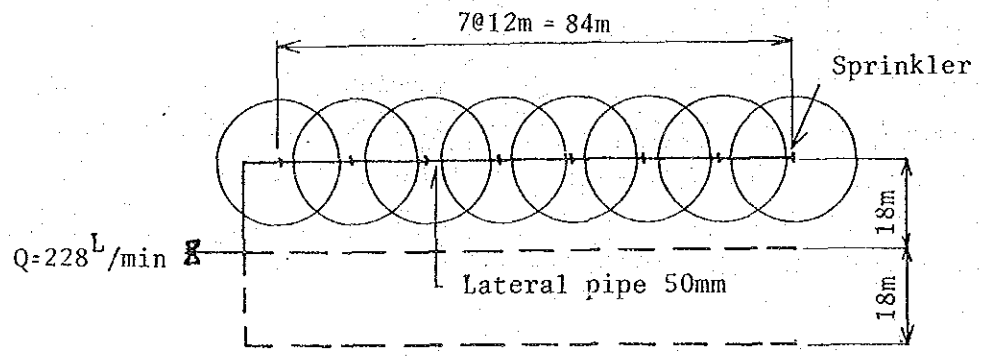
Allocation of pipelines and irrigation facilities in the field is shown in Fig.H5-2.

(1) Sprinkler irrigation

* Sprinkler type

q = 28.5 lit./min P = 2.5 kg/sq.cm D = 28.7 m

* Sprinkler interval



* Irrigation intensity

$$I = \frac{60 \times 28.5}{12\ m \times 18\ m} = 7.9\ mm/hr$$

* Irrigation hours per placement

16 hr / 3 times = 5.33 hr

* Irrigation area per day

1.25 feddan

* One rotation block

1.25 x 4 = 5.0 feddan

(2) Drip Irrigation for Vegetables

* Plant interval

1.2 m x 0.5 m

* Emitter capacity

2.0 lit./hr

* Amount of flowing per one line

360 lit./hr = 6.0 lit./min

* Irrigation hours per placement

16 hr / 2 times = 8 hr

* Irrigation area per day

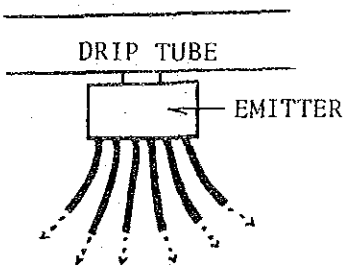
0.625 feddan

* One rotation block

0.625 x 4 = 2.5 feddan

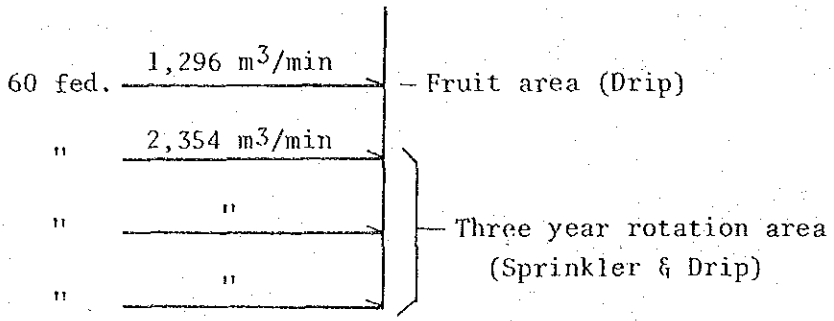
(3) Drip Irrigation for Fruit

* Plant interval 5m x 5m
* Emitter capacity 36 lit./hr (6 x 6)



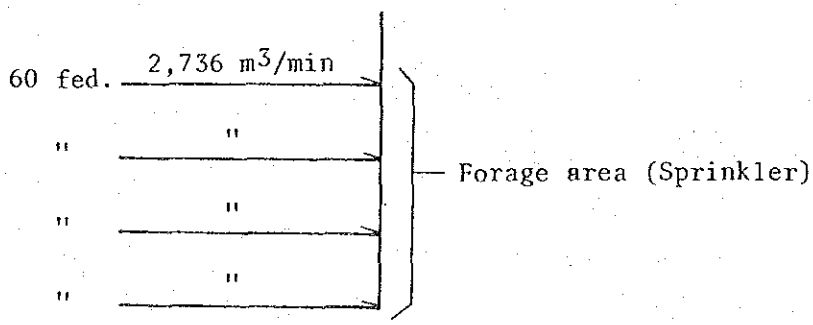
* Amount of flowing per line 648 lit./hr = 10.8 lit./min
* Irrigation hours per placement 16 hr
* Irrigation area per day 3.75 feddan
* One rotation block 3.75 x 4 = 15 feddan

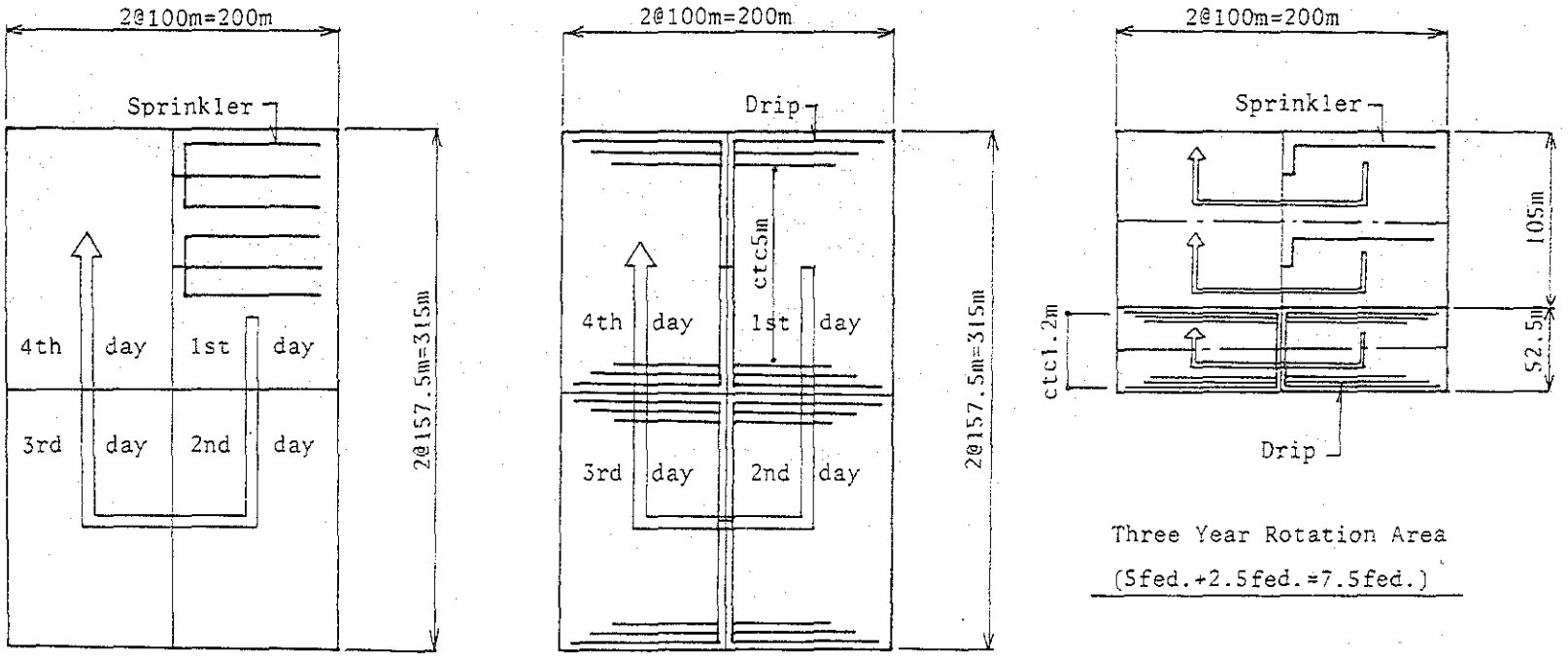
(4) Water Requirement per Farm Block



(5) Sprinkler Irrigation in the Livestock Breeding Area

* Sprinkler type, sprinkler interval, irrigation intensity and irrigation hours per placement are the same.
* Irrigation area per day 3.75 feddan
* One rotation block 3.75 x 4 = 15 feddan
* Water requirement per farm block





Forage Crops Area (15fed.)

Fruit Area (15fed.)

Three Year Rotation Area
(5fed.+2.5fed.=7.5fed.)

Fig.H5-1 One Rotation Block

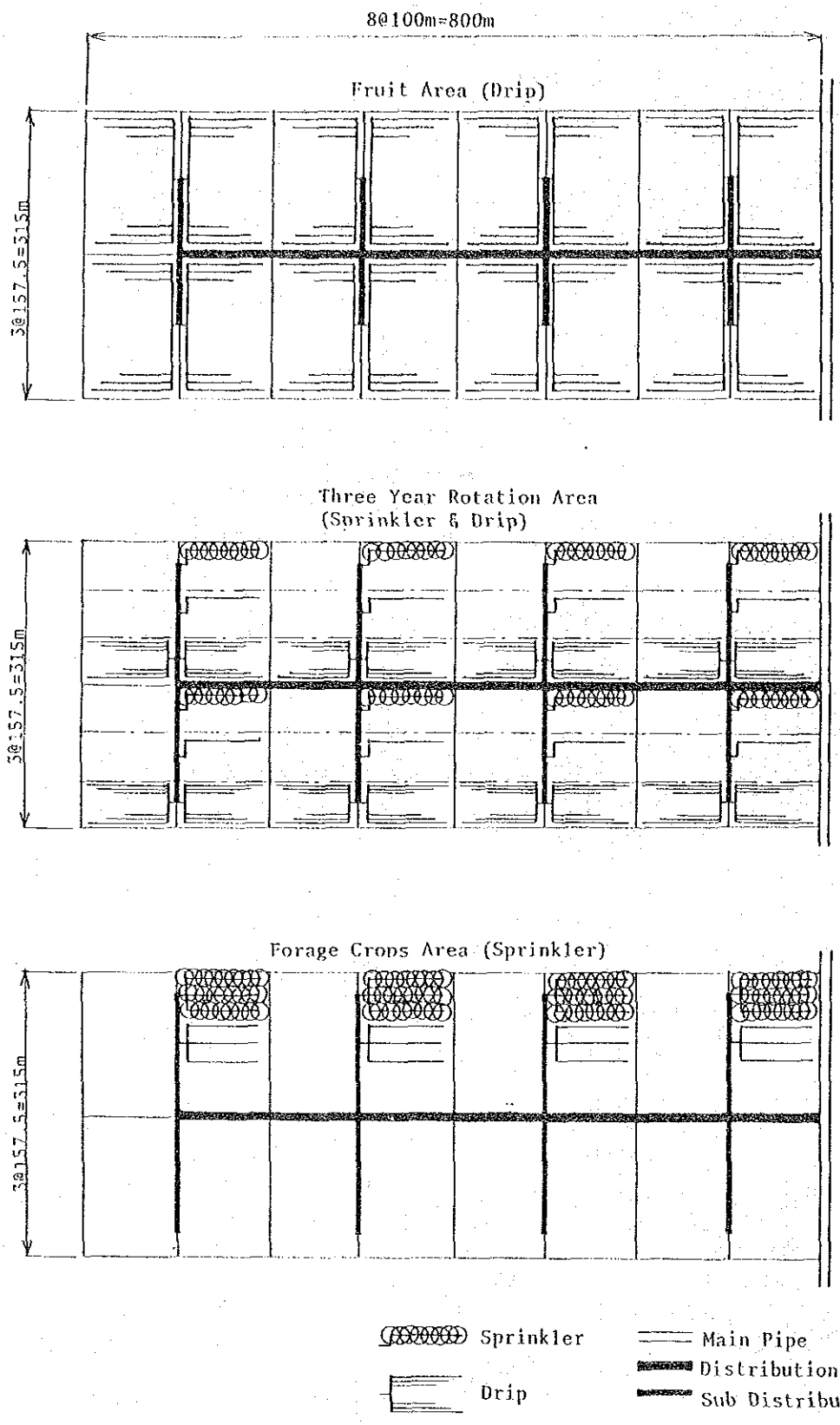


Fig.H5-2 Allocation of Pipelines and Irrigation Facilities

H-6. Wahby Downstream Area

As discussed in Appendix F-4, improvement of the irrigation system would be made on the following canals and canal structures:

(1) Main Canal

Bahr Wahby	:	Length	: 21.30 km (46.8 - 68.1 km)
Canal Structures:		Weir	: 42 places
		Vent	: 41 places
		Intake	: 8 places
		Bridge	: 10 places

(2) Branch Canals

Canals	Length (km)	Check Weir (Place)	Vent (Place)	Intake (Place)	Bridge (Place)
Bahr Unsi	2.10	-	5	1	-
Bahr Green	2.54	2	4	1	-
Bahr Fanous	5.48	14	13	3	9
Com Osheem Canal	3.33	3	4	1	1
Gomhoria Canal	14.61	4	23	3	-
Total	28.06	23	49	9	10

(3) Lateral/Sub-lateral Canals

Canals	Length (km)	Check Weir (Place)	Vent (Place)	Other (Place)
Bahr El Khadrawy	3.68	17	20	1
Bahr Garnabiet	1.15	-	4	-
Bahr Khore el-Sheer	0.16	-	3	-
Bahr Kaheel	4.33	7	9	2
Bahr El Malaab	3.40	1	13	2
Bahr Hayar	6.16	1	7	2
Bahr El Koddoba	2.81	6	11	5
Total	21.69	32	67	12

Aside from the improvement of the irrigation system, construction of additional lateral canals are proposed as follows:

a. New Hayar Canal (Earth Canal)

Length : 2.85 km
Service Area: 1,666.1 feddan
Discharge : 1,666.1 x 30 x 1/86,400 = 0.58 cu.m/sec
Canal Structures:

Syphon	:	Length 20 cm RC Pipe ϕ1.00 m
Vertical Drop:		12 places
Other Structures:		5 places

b. New Koddoba Canal (Earth Canal)

Length : 3.56 km
Service Area: 2,294.3 feddan
Discharge : 2,294.3 x 30 x 1/86,400 = 0.80 cu.m/sec
Canal Structure:

Syphon	:	Length 20 cm RC Pipe ϕ1.00 m
Vertical Drop	:	10 places
Other Structures:		5 places

c. Ganabiah Canals (Earth Canal)

Ganabiah G-1:	Extension of Garnabiet	Length:	1.1 km
" G-2:	Downstream Bahr Green	Length:	2.2
" G-3:	Downstream of Bahr Fanous	Length:	2.0
" G-4:	Downstream of Com Osheem	Length:	2.6
" G-5:	Downstream of New Koddoba	Length:	2.1
Total Length			10.0 km

Meanwhile Ministry of Irrigation, Fayoum Office of Irrigation Department has a plan to construct pumping station at Kasr Rashuwan to supplement irrigation water from Batts Drain to the area of Hayar and Koddoba canals. However, it is considered that the said pumping facilities will be transferred to the other after completion of the Project.

H-7. South Area of Lake Qarun

Improvement of the facilities in the South Area of Lake Qarun is composed of pump stations, dike and main drain, and lateral/sub-lateral drain as discussed in Appendix F-5.

(1) Pump Stations

Taking into consideration the total dynamic head of 5.5 meters and discharge of drainage, the type of pump would be selected as mixed flow volute pump. For convenience of operation and maintenance, size of the pump is also unified as follows:

Pump Station	Discharge (cu.m/min)	Mixed Flow Volute Pump
Abu el-Rahman	3.6	ϕ200 mm 9 PS 2 sets
Abu Harawa	10.8	ϕ250 mm 18 PS 3 sets
Bats Said	20.3	ϕ250 mm 18 PS 4 sets
Abu Tarfaya	11.9	ϕ250 mm 18 PS 3 sets
Khor el-Hitan	6.4	ϕ250 mm 18 PS 2 sets

Note: One set of stand-by pump is included each in pump station.

(2) Main Drain

Main drain is located in parallel with the Qarun Dike and is collecting drainage water from the area below the elevation of (-)40 meters. Water level of the main drain should be maintained about two meters below from the ground surface which is an elevation of (-)45 meters. Elevation of the bottom of the main drain would be (-)47 meters and low water level would be (-)46 meters or water depth of one meter. According to Tables F5-6 and F5-7 in Appendix F-5, the total volume of drainage water per day is about 13,000 cu.m/day in Abd el-Rahman and Abu Harawa sub-area and about 25,000 cu.m/day in other sub-areas. It is proposed that the pumps are planned to operate in a half day and the capacity of the main drain is given at double of the said volume when water depth of the main drain is at 1.00 meter.

(3) Lateral/Sub-lateral Drain

The existing lateral drain has about 1.5 meters depth while that of the sub-lateral drain is about one meter depth. Top soil in the area has relatively high contents of salt because of no effective leaching and supply of salted irrigation water. Leaching salt at the top soil of the cultivated land can be expected by lowering grounwater table. For the purpose, the lateral drain and sub-lateral drain should be dredged by 1.5 meters and one meter, respectively as shown in the Drawings. By this way, the groundwater table can be kept lower than 1.5 meters and one meter for the lateral drain and sub-lateral drain, respectively. Along the contour line of (-)40 meters, the sub-lateral drain would be excavated to catch the upstream surface drain.

As for the improvement of the area, according to Ministry of Irrigation, Fayoum Office of Irrigation Department, the General Authority for Covered Drainage Projects at Beni Suef Governorate is conducting implementation study for this drainage pump station. When the said plan is realized, this proposal will be revised during the detailed design.

H-8. Model Farm

H-8.1. Introduction

Model Farm in the agricultural development project aims to promote the situations in engineering and in sociology for the development. Fayoum Agricultural Development Project is composed of two components which are the reclamation project in the desert area and the improvement project in cultivated land and these two components are quite different development. For successful implementation of the Project, establishment of a model farm is proposed. The model farm should be constructed in the reclamation area and handles training and practice on the modernized irrigation facilities and farming techniques in the reclaimed area and showing farmers in the Project Area modernized farming with proper water management as a show window.

H-8.2. Model Farm

The Model Farm covers a reclamation area of 310 feddan (130 ha) in gross and arable land of 250 feddan (105 ha).

The reclamation of the Project in North Wahby and Com Osheem areas aims to develop the desert area by introducing modernized irrigation method such as sprinkler irrigation and drip irrigation. However, farmers to be engaged and engineers concerned have no experience on the said facilities. The training and practices on this matter are quite important role for successful development of the Project on time.

For the purpose, provision of the following facilities of the Model Farm is proposed:

(1) Reclamation Works

Reclamation of the area of 250 feddan (105 ha) in advance to the implementation of the Project should be made by conducting deep harrowing by making cross ripping and the initial leaching by spreading water. Execution of the reclamation by this way at trial is one of tasks for the Model Farm.

(2) Construction of Irrigation Facilities

1) Water Requirement

Irrigation water requirement of the crops in the Model Farm or sprinkler irrigation and drip irrigation for 16 hours are 2.736 cu.m/min/60 feddan and 1.590 cu.m/min/60 feddan, respectively.

For the Model Farm of 250 feddan, drip irrigation of 60 feddan which is minimum farm block for the Project and sprinkler irrigation of the 190 feddan are proposed. The total water requirement is estimated at 6.98 cubic meters per minute based on 24 hours a day operation by considering crop irrigation requirement, water demand for cattle breeding and fattening and also irrigation efficiency.

2) Pump Station

Taking into consideration seasonal fluctuation of the irrigation facilities, water requirement and experimental use of the irrigation facilities in the Model Farm, units of pump are planned at four units including a stand-by and the following dimensions are given;

Type	:	Horizontal Axis Single Suction Multi-stage Volute Pump 3 stage of 4 units
Capacity	:	2.33 cu.m/min/unit
Pump bore	:	ϕ150 mm
Total Dynamic Head	:	90 m (End pressure 40 m)
Power	:	66 KW (50 Hz)

3) Pipelines and irrigation facilities

The following facilities are proposed:

- Pipelines

Main Pipeline	ϕ300 mm	Length	1,620 m
Branch Pipeline	ϕ200 mm	Length	1,370 m
Field Pipeline	ϕ200 mm	Length	1,250 m
	ϕ150 mm	Length	840 m
	ϕ100 mm	Length	5,420 m

- Irrigation Facilities

* Sprinkler Irrigation Set for 190 feddan ..... 76 sets
(One set per 2.5 feddan)

Per set: Eight units of Sprinkler Heads

Capacity of Sprinkler Head q = 28.5 lit/min
at P = 2.5 kg/sq.cm

One line of Lateral Pipe
Aluminium ϕ50 mm 90 m long

* Drip Irrigation Set for 60 feddan ..... 48 sets
(One set per 1.25 set)

Per set: Drip line ϕ13 mm 90 m long 42 lines
Total length 3,780 m

Emitter Capacity 2 lit/hr 180 units/line
Total Emitter 7,560 units

Distribution Tube ϕ40 mm 50 m long one line

4) Intake Structure

Based on the standard design capacity of MOI, the "36" Model Vent with opening mouth of 0.31 m (310 feddan) is planned.

(3) Agricultural Machineries, Construction Machineries and Materials

For the operation of the Center, the following equipments would be procured.

Agricultural Machineries for the Model Farm

Name	Specification	Quant'y	Remarks
Tractor	65 ps	4 units	including a unit for training
Rotavator	230 cm	4 units	- do -
Moldboard Plow	14" x 2	2 units	- do -
Disc Harrow	15" x 24	2 units	- do -
Tooth Harrow	310 cm	2 units	- do -
Sprayer	600 lit.	1 unit	for training
Thresher	3 hr/fed.	1 unit	- do -
Manure-spreader		1 unit	
Forage-harvester		2 units	
Farm Wagon		2 units	
Broadcaster		1 unit	
Truck		2 units	for training

Construction Machineries

Name	Specification	Quant'y	Remarks
Bulldozer	32 ton class	1 unit	
- do -	15 ton class	3 unit	
Back-hoe	0.35 cu.m	3 units	
Back-hoe	0.10 cu.m	2 units	
Grader	2.5 m	1 unit	
Front End Roder	1.0 cu.m	1 unit	
Compaction Roller		1 unit	
Jeep & Wagon		5 units	
Micro bus		2 units	
Motorcycle	100 cc	5 units	

(4) Training and Demonstration Facilities

In the training room, visual education instrument, and other facilities would be equipped.

(5) Research Laboratory and Administrative Office Building:

The following buildings would be provided in the Center.

Office building	200 sq.m	
Training building	100 "	
Research building	100 "	
Laboratory building	50 "	
Warehouse	200 "	
Garage	120 "	
Dormitory	120 "	
Staff Quarter	250 "	(=50 sq.m x 5)

H-8.3. Alternative Facilities for Water Management

Alternative facilities for water management aims to demonstrate the ideal engineers, leaders of farmer, farmers, etc. on water management and to show farmers in the Project Area modernized farming with proper water management as the Sub-Center of the Model Farm. However, it is not proposed for implementation due to priority of the Project Components.

For a reference of the development plan, the facilities are explained as follows:

(1) Construction of irrigation facilities

- Construction of New Hayar lateral Length 2,850 m
  Receiving irrigation water directly from Bahr Wahby and connecting to the existing Bahr Hayar.

- Construction of turnout 7 places
  Instead of vent, turnout
  which is double gated type
  and has functions of measuring
  and controlling irrigation water.

- Rehabilitation of the existing Bahr Hayar, Length 3.60 km
  A part of the existing
  Bahr Hayar is used for the
  Sub-center of the model farm
  and is rehabilitated.

(2) Construction of On-farm Facilities

In generally, construction and operation and maintenance of on-farm facilities are responsible by farmers. However, due to the model farm, construction of on-farm facilities should be made by the Project. Irrigation block in the model farm is divided into five as follows:

Irrigation Block	Area (feddan)	Area (ha)	No. of Turnout (place)
1	72	30	1
2	96	40	1
3	94	40	1
4	142	60	2
5	166	70	2
Total	570	240	7

In each irrigation block covered by a turnout, main farm ditch (MFD) will be arranged and from the MFD, supplemental farm ditch (SFD) and then field ditch (FD) are connected to make the distribution of irrigation water easily and uniformly. Division box is arranged at the diversion point from the MFD to the SFD while the check will be set at the end of MFD and SFD in order to check up water level through the SFD. Total quantity of on-farm facilities in the Sub-center of the model farm are as follows:

Main Farm Ditch (MFD)	7 lines	4.55 km
Supplementary Farm Ditch (SFD)	26 lines	9.25 km
Field Ditch (FD)		6.00 km
Division Box		26 places
End Check		26 places

(3) Provision of Construction Equipment and Materials

For effective and timing construction of new lateral and on-farm facilities, the following construction equipment should be procured by the Project;

Name	Specification	Quant'y	Remarks
Back-hoe	0.10 cu.m	2 units	
Dragline	0.60 cu.m	1 unit	
Pump with engine		4 units	
Jeep & Wagon		2 units	

(4) Training and Demonstration Facilities

Visual educational instruments and other educational and training instruments should be provided.

(5) Research, Laboratory and Administrative Office Building

The following buildings would be provided in the Sub-Center.

Office building	120 sq.m
Warehouse	60 "
Garage	60 "

(6) Construction Cost

Project Cost of Sub-Center

(Unit: '000 LE)

Item		Total	Foreign	Local
(1) Civil Works				
a. Pre-Engineering		135	15	120
b. Irrigation Facilities		90	30	60
d. Training Facilities		50	10	40
Sub-total of (1)		275	55	220
(2) land Acquisition and Compensation				
a. Land Acquisition	10 Fed	40	-	40
b. Compensation	75 Fed	30	-	30
Sub-total of (2)		70	-	70
(3) Equipment		185	175	10
(4) Engineering and Administration		50	-	50
(5) Consulting Services		350	280	70
Sub-total of (1) to (5)		930	510	420
(6) Physical Contingency		90	50	40
Sub-total of (1) to (6)		1,020	560	460
(7) Price Escalation		210	70	140
Total		1,230	630	600

Breakdown of Civil Works

ITEM: Sub-Center of Model Farm

(Unit: L£)

Item No.	Description	Q'tye	Unit	Rate (LE)	Total Cost	Foreign Currency			Local Currency		
						Equipment	Materi	Total	Local Materi	Labour	Total
(1) Pre-engineering											
	Cadastral Survey	630	Fed	100	63,000	-	6,300	6,300	-	56,700	56,700
	Vertical Control	10	Km	50	500	-	100	100	-	400	400
	Pre-Construction Survey	2	Mos	2,500	5,000	-	500	500	-	4,500	4,500
	Construction Survey	12	Mos	2,000	24,000	-	2,400	2,400	-	21,600	21,600
	Hydrology	12	Mos	1,500	18,000	-	1,800	1,800	-	16,200	16,200
	Laboratory Control	12	Mos	1,500	18,000	-	1,800	1,800	-	16,200	16,200
	Negotiation for ROW	2	Mos	1,000	2,000	-	200	200	-	1,800	1,800
	Miscellaneous works		L.S		4,500	-	1,900	1,900	-	2,600	2,600
	Total				135,000	-	15,000	15,000	-	120,000	120,000
(2) Irrigation Facilities											
2-1	Construction of Turnout (7 Places - Double Orifice Type)										
	Excavation	91	cu.m	1.25	114	-	70	70	3	41	44
	Backfill	35	cu.m	1.14	40	-	2	2	1	37	38
	Embankment	56	cu.m	1.14	64	-	3	3	1	60	61
	Concrete w/S.B	13	cu.m	179.90	2,339	-	1,111	1,111	484	744	1,228
	R.C Pipe ϕ400mm	42	m	67.00	2,814	-	1,126	1,126	844	844	1,688
	Sluice Steel Gate										
	Square 600 x 350mm	7	set	1,200	8,400	-	8,400	8,400	-	-	-
	Circle ϕ500mm	7	set	2,300	16,100	-	16,100	16,100	-	-	-
	Miscellaneous		L.S		1,129	-	188	188	667	274	941
	Total				31,000	-	27,000	27,000	2,000	2,000	4,000
2-2	On-farm Facilities										
a.	Main Farm Ditch (L=4,550m)										
	Excavation	1,365	cu.m	3.39	4,627	-	-	-	-	4,627	4,627
	Embankment (Side borrow)	2,275	cu.m	2.65	6,029	-	-	-	-	6,029	6,029
	Other Works		L.S		2,131	-	-	-	-	2,131	2,131
	Sub-total				12,787					12,787	12,787
b.	Supplemental Farm Ditch (L=9,250m)										
	Excavation	2,775	cu.m	3.39	9,407	-	-	-	-	9,407	9,407
	Embankment (Side borrow)	3,700	cu.m	2.65	9,805	-	-	-	-	9,805	9,805
	Other Works		L.S		3,842	-	-	-	-	3,842	3,842
	Sub-total				23,054	-	-	-	-	23,054	23,054
c.	Field Ditch (L=6,000m)										
	Excavation	600	cu.m	3.39	2,034	-	-	-	-	2,034	2,034
	Embankment (Side borrow)	3,000	cu.m	2.65	7,950	-	-	-	-	7,950	7,950
	Other Works		L.S		1,996	-	-	-	-	1,996	1,996
	Sub-total				11,980	-	-	-	-	11,980	11,980
d.	Diversion Box (26 places, Precasted at the yard)										
	Concrete w/S.B	7	cu.m	179.90	1,259	-	598	598	260	401	661
	Hauling (280 kg/pcs)	52	pcs	30.00	1,560	-	932	932	-	628	628
	Installation	52	pcs	1.00	52	-	-	-	-	52	52
	Sub-total				2,871	-	1,530	1,530	260	1,081	1,341
e.	End Check (26 places; Precasted)										
	Concrete w/S.B	4	cu.m	179.90	720	-	342	342	149	229	378
	Hauling (280 kg/pcs)	26	pcs	30.00	780	-	468	468	-	312	312
	Installation	26	pcs	1.00	26	-	-	-	-	26	26
	Sub-total				1,526	-	810	810	149	567	716
f.	Miscellaneous		L.S		6,782	-	660	660	591	5,531	6,122
	Total				59,000	-	3,000	3,000	1,000	55,000	56,000
Total of (2) Irrigation Facilities					90,000	-	30,000	30,000	3,000	57,000	60,000
3) Training Facilities											
3-1	Building Works										
	Office Building	120	sq.m	200	24,000	-	4,800	4,800	7,200	12,000	19,200
	Warehouse	60	sq.m	100	6,000	-	1,200	1,200	1,800	3,000	4,800
	Garage	60	sq.m	100	6,000	-	1,200	1,200	1,800	3,000	4,800
	Other Facilities		L.S		3,600	-	720	720	1,080	1,800	2,880
	Appurtenant Facilities (Electricity, Water Supply, sewage and Others)		L.S		7,900	-	1,580	1,580	2,370	3,950	6,320
	Miscellaneous		L.S		2,500	-	500	500	750	1,250	2,000
	Total				50,000	-	10,000	10,000	15,000	25,000	40,000

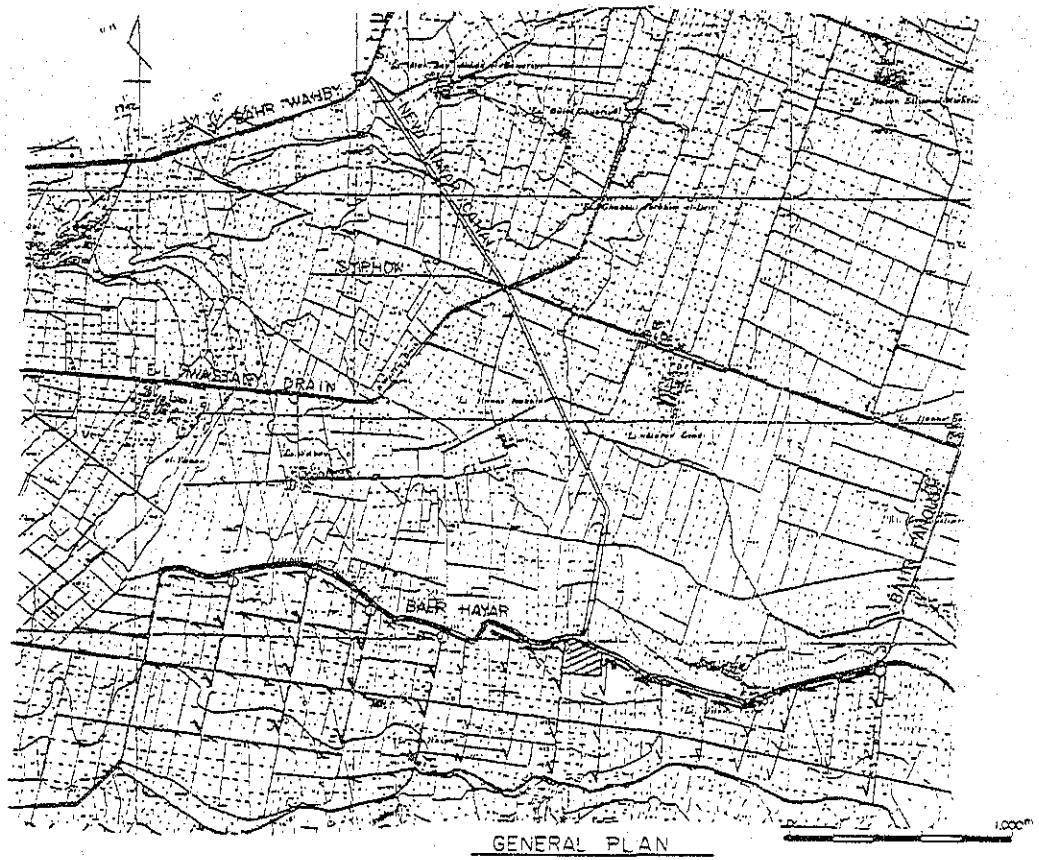
Cost of Equipment for Sub-Center

(Unit: '000LE)

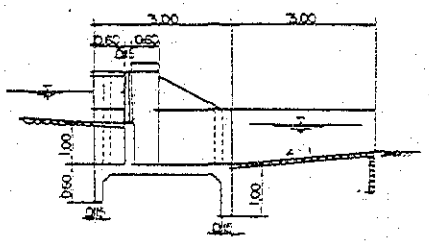
Description	Qty's	Unit Price	Total	Foreign	Local
a. Construction Equipment					
Back hoe 0.10cu.m	2 Nos	26	52	49	3
Drag Line 0.60cu.m	1 Nos	90	90	85	5
Pump w/engine	4 Nos	1	4	4	-
Miscellaneous Equipment	L.S		13	12	1
Sub-total			159	150	9
b. Vehicles					
Jeep & Wagon	2 Nos	13	26	25	1
Sub-total			26	25	1
Total			185	175	10

Cost of Consulting Services

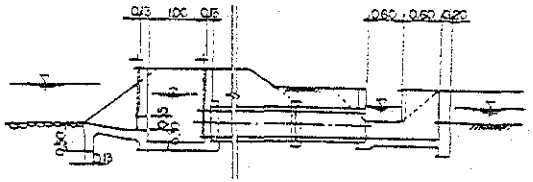
Description	Qty's	Unit Price (LE)		Cost ('000 LE)		
		Foreign	Local	Total	Foreign	Local
Consultant Remuneration (F)	15 M/M	12,000	-	180	180	-
Consultant Remuneration (L)	10 M/M	6,000	-	60	60	-
International Trips	4 Trips	3,500	-	14	14	-
Communication, Transportation & etc.	18 Mos	-	1,000	18	-	18
Per Diem Allowance	12 M/M	-	2,400	28.8	-	28.8
Other Items	18 Mos		600	10.8	-	10.8
Miscellaneous Expenditure	L.S			38.4	26	12.4
Total				350	280	70



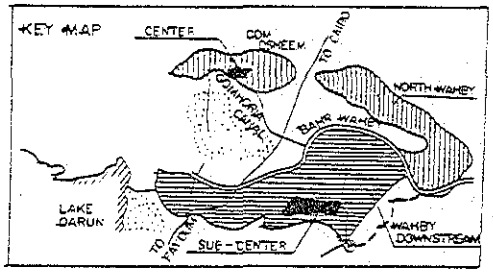
GENERAL PLAN

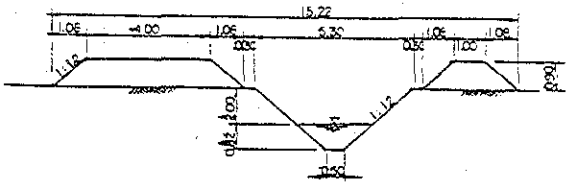


TYPICAL VERTICAL DROP

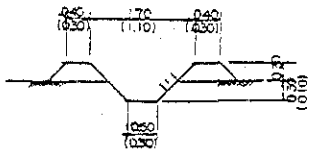


TURNOUT (DOUBLE ORIFICE TYPE)





CROSS SECTION OF NEW HAYAR CANAL



MAIN FARM DITCH AND
SUPPLEMENTAL FARM DITCH ( )

NOTE: ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED

ARAB REPUBLIC OF EGYPT FAYOUM GOVERNORATE	
FAYOUM AGRICULTURAL DEVELOPMENT PROJECT	
GENERAL LAYOUT OF MODEL FARM (SUB-CENTER)	
DATE	DWG NO.
JAPAN INTERNATIONAL COOPERATION AGENCY	

APPENDIX I.

COST ESTIMATE

APPENDIX I. COST ESTIMATION

LIST OF TABLE

I-1. Summary of Project Cost

Table I-1.1 Summary of Project Cost

(Unit: '000 LE)

Item	Total	Foreign	Local
I. Engineering for Detail Design	2,000	1,700	300
II. North Wahby and Com Osheem Area			
2.1 North Wahby Area			
2.1.1 Land Reclamation			
(1) Civil Works	11,600	8,570	3,030
(2) Land Acquisition & Compensation	150	-	150
(3) Construction Equipment	1,170	1,110	60
(4) Agricultural Development	750	530	220
(5) Project Facilities	350	80	270
(6) Engineering and Administration	1,120	-	1,120
(7) Consulting Services	1,390	1,140	250
(8) Physical Contingency	1,670	1,170	500
(9) Price Escalation	9,800	4,300	5,500
Total	28,000	16,900	11,100
2.1.2 Housing & Infrastructure			
(1) Civil Works	5,000	1,790	3,210
(2) Engineering and Administration	400	110	290
(3) Physical Contingency	500	200	300
(4) Price Escalation	4,400	600	3,800
Total	10,300	2,700	7,600
Total of North Wahby Area	38,300	19,600	18,700
2.2 Com Osheem Area			
2.2.1 Land Reclamation			
(1) Civil Works	8,280	6,140	2,140
(2) Land Acquisition & Compensation	90	-	90
(3) Construction Equipment	920	870	50
(4) Agricultural Development	550	430	120
(5) Project Facilities	210	60	150
(6) Engineering and Administration	800	-	800
(7) Consulting Services	920	760	160
(8) Physical Contingency	1,230	840	390
(9) Price Escalation	7,000	3,200	3,800
Total	20,000	12,300	7,700
2.2.2 Housing & Infrastructure			
(1) Civil Works	2,780	1,020	1,760
(2) Engineering and Administration	220	80	140
(3) Physical Contingency	300	100	200
(4) Price Escalation	2,500	400	2,100
Total	5,800	1,600	4,200
2.2.3 Agro-industry			
(1) Cattle breeding and Fattening Center	1,700	1,200	500
(2) Agricultural Products	840	710	130
(3) Animal Products	6,480	5,420	1,060
(4) Price Escalation	5,180	3,070	2,110
Total	14,200	10,400	3,800
Total of Com Osheem Area	40,000	24,300	15,700
Grand Total of Reclamation Area	78,300	43,900	34,400

(Cont'd) Table I-1.1

(Unit: '000 LE)

Item	Total	Foreign	Local
III. Wahby Downstream Area			
(1) Civil Works	2,250	675	1,575
(2) Land Acquisition and Compensation	250	-	250
(3) Construction Equipment	745	705	40
(4) Agricultural Development	200	100	100
(5) Project Facilities	195	50	145
(6) Engineering and Administration	290	-	290
(7) Consulting Services	1,420	1,170	250
(8) Physical Contingency	550	300	250
(9) Price Escalation	3,500	900	2,600
Total	9,400	3,900	5,500
IV. South Area of Lake Qarun			
(1) Civil Works	2,760	925	1,835
(2) land Acquisition and Compensation	250	-	250
(3) Construction Equipment	1,680	1,590	90
(4) Agricultural Development	100	50	50
(5) Project Facilities	200	55	145
(6) Engineering and Administration	400	-	400
(7) Consulting Services	1,170	940	230
(8) Physical Contingency	640	340	300
(9) Price Escalation	4,200	1,100	3,100
Total	11,400	5,000	6,400
V. Model Farm			
(1) Civil Works	1,540	1,110	430
(2) land Compensation	10	-	10
(3) Equipment	990	940	50
(4) Engineering and Administration	210	-	210
(5) Consulting Services	600	510	90
(6) Physical Contingency	350	260	90
(7) Price Escalation	600	380	220
Total	4,300	3,200	1,100
Grand Total of Project Cost	105,400	57,700	47,700

Table I-1.2 Project Cost of Reclamation Area
(II. North Wahby and Com Osheem Area)

(Unit: '000 LE)

Item	Total	Foreign	Local
2.1 North Wahby Area			
2.1.1 Land Reclamation			
(1) Civil Works			
a. Pre-Engineering	430	40	390
b. Pump Stations	2,805	2,125	680
c. Irrigation Networks	2,190	1,600	590
d. Drainage Networks	240	40	200
e. On-farm Facilities	4,650	4,250	400
f. Land Reclamation	1,285	515	770
Sub-total of (1)	11,600	8,570	3,030
(2) Land Acquisition & Compensation			
a. Land Acquisition 35 Fed	140	-	140
b. Compensation 50 Fed	10	-	10
Sub-total of (2)	150	-	150
(3) Construction Equipment	1,170	1,110	60
(4) Agricultural Development			
a. Agricultural Development	400	200	200
b. Agricultural Machines	350	330	20
Sub-total of (4)	750	530	220
(5) Project Facilities	350	80	270
(6) Engineering and Administration	1,120	-	1,120
(7) Consulting Services	1,390	1,140	250
Sub-total (1) to (7)	16,530	11,430	5,100
(8) Physical Contingency	1,670	1,170	500
Sub-total (1) to (8)	18,200	12,600	5,600
(9) Price Escalation	9,800	4,300	5,500
Total	28,000	16,900	11,100
2.1.2 Housing & Infrastructure			
(1) Civil Works			
a. Pre-Engineering	90	10	80
b. Housing	2,800	450	2,350
c. Road	540	250	290
d. Infrastructure	1,570	1,080	490
Sub-total of (1)	5,000	1,790	3,210
(2) Engineering and Administration	400	110	290
Sub-total of (1) and (2)	5,400	1,900	3,500
(3) Physical Contingency	500	200	300
Sub-total of (1) to (3)	5,900	2,100	3,800
(4) Price Escalation	4,400	600	3,800
Total	10,300	2,700	7,600
Total of North Wahby Area	38,300	19,600	18,700

(Cont'd) Table I-1.2

(Unit: '000 LE)

Item	Total	Foreign	Local
2.2 Com Osheem Area			
2.2.1 Land Reclamation			
(1) Civil Works			
a. Pre-Engineering	400	40	360
b. Pump Station	1,830	1,470	360
c. Irrigation Networks	2,100	1,600	500
d. Drainage Networks	210	30	180
e. On-farm Facilities	2,910	2,660	250
f. Land Reclamation	830	340	490
Sub-total of (1)	8,280	6,140	2,140
(2) Land Acquisition & Compensation			
a. Land Acquisition 20 Fed	80	-	80
b. Compensation 50 Fed	10	-	10
Sub-total of (2)	90	-	90
(3) Construction Equipment	920	870	50
(4) Agricultural Development			
a. Agricultural Development	200	100	100
b. Agricultural Machines	350	330	20
Sub-total of (4)	550	430	120
(5) Project Facilities	210	60	150
(6) Engineering and Administration	800	-	800
(7) Consulting Services	920	760	160
Sub-total of (1) to (7)	11,770	8,260	3,510
(8) Physical Contingency	1,230	840	390
Sub-total of (1) to (8)	13,000	9,100	3,900
(9) Price Escalation	7,000	3,200	3,800
Total	20,000	12,300	7,700
2.2.2 Housing & Infrastructure			
(1) Civil Works			
a. Pre-Engineering	70	-	70
b. Housing	1,470	240	1,230
c. Road	300	140	160
d. Infrastructure	940	640	300
Sub-total of (1)	2,780	1,020	1,760
(2) Engineering and Administration	220	80	140
Sub-total of (1) and (2)	3,000	1,100	1,900
(3) Physical Contingency	300	100	200
Sub-total of (1) to (3)	3,300	1,200	2,100
(4) Price Escalation	2,500	400	2,100
Total	5,800	1,600	4,200
2.2.3 Agro-industry			
(1) Cattle breeding and Fattening Center	1,700	1,200	500
(2) Agricultural Products			
a. Tomato Grading Station	840	710	130
(3) Animal Products			
a. Slaughterhouse	1,500	1,200	300
b. Milk Processing Factory	4,980	4,220	760
Sub-total of (1) to (3)	9,020	7,330	1,690
(4) Price Escalation	5,180	3,070	2,110
Total	14,200	10,400	3,800
Total of Com Osheem Area	40,000	24,300	15,700
Grand Total of Reclamation Area	78,300	43,900	34,400

Table I-1.3 Project Cost of Wahby Downstream Area
(III. Wahby Downstream Area)

(Unit: '000 LE)

Item	Total	Foreign	Local
(1) Civil Works			
a. Pre-Engineering	190	19	171
b. Rehabilitation of Facilities	1,445	418	1,027
c. Construction of Laterals	592	228	364
d. Construction of Canal Structures	23	10	13
Sub-total of (1)	2,250	675	1,575
(2) Land Acquisition and Compensation			
a. Land Acquisition 60 Fed	240	-	240
b. Compensation 10 Fed	10	-	10
Sub-total of (2)	250	-	250
(3) Construction Equipment	745	705	40
(4) Agricultural Development	200	100	100
(5) Project Facilities	195	50	145
(6) Engineering and Administration	290	-	290
(7) Consulting Services	1,420	1,170	250
Sub-total of (1) to (7)	5,350	2,700	2,650
(8) Physical Contingency	550	300	250
Sub-total of (1) to (8)	5,900	3,000	2,900
(9) Price Escalation	3,500	900	2,600
Total	9,400	3,900	5,500

Table I-1.4 Project Cost of South Area of lake Qarun
(IV. South Area of Lake Qarun)

(Unit: '000 LE)

	Item	Total	Foreign	Local
(1)	Civil Works			
	a. Pre-Engineering	400	40	360
	b. Construction of Dike	1,063	275	788
	c. Construction & Rehabilitation of Drainage Canals	1,017	390	627
	d. Pump Stations	280	220	60
	Sub-total of (1)	2,760	925	1,835
(2)	land Acquisition and Compensation			
	a. Land Acquisition 60 Fed	240	-	240
	b. Compensation 10 Fed	10	-	10
	Sub-total of (2)	250	-	250
(3)	Construction Equipment	1,680	1,590	90
(4)	Agricultural Development	100	50	50
(5)	Project Facilities	200	55	145
(6)	Engineering and Administration	400	-	400
(7)	Consulting Services	1,170	940	230
	Sub-total of (1) to (7)	6,560	3,560	3,000
(8)	Physical Contingency	640	340	300
	Sub-total of (1) to (8)	7,200	3,900	3,300
(9)	Price Escalation	4,200	1,100	3,100
	Total	11,400	5,000	6,400

Table I-1.5 Project Cost of Model Farm
(V. Model Farm)

(Unit: '000 LE)

Item	Total	Foreign	Local
(1) Civil Works			
a. Pre-Engineering	80	10	70
b. Irrigation Facilities	1,008	843	165
c. Reserch, Laboratory & Training Facilities	452	257	195
Sub-total of (1)	1,540	1,110	430
(2) land Compensation 25 Fed	10	-	10
(3) Equipment	990	940	50
(4) Engineering and Administration	210	-	210
(5) Consulting Services	600	510	90
Sub-total of (1) to (5)	3,350	2,560	790
(6) Physical Contingency	350	260	90
Sub-total of (1) to (6)	3,700	2,820	880
(7) Price Escalation	600	380	220
Total	4,300	3,200	1,100