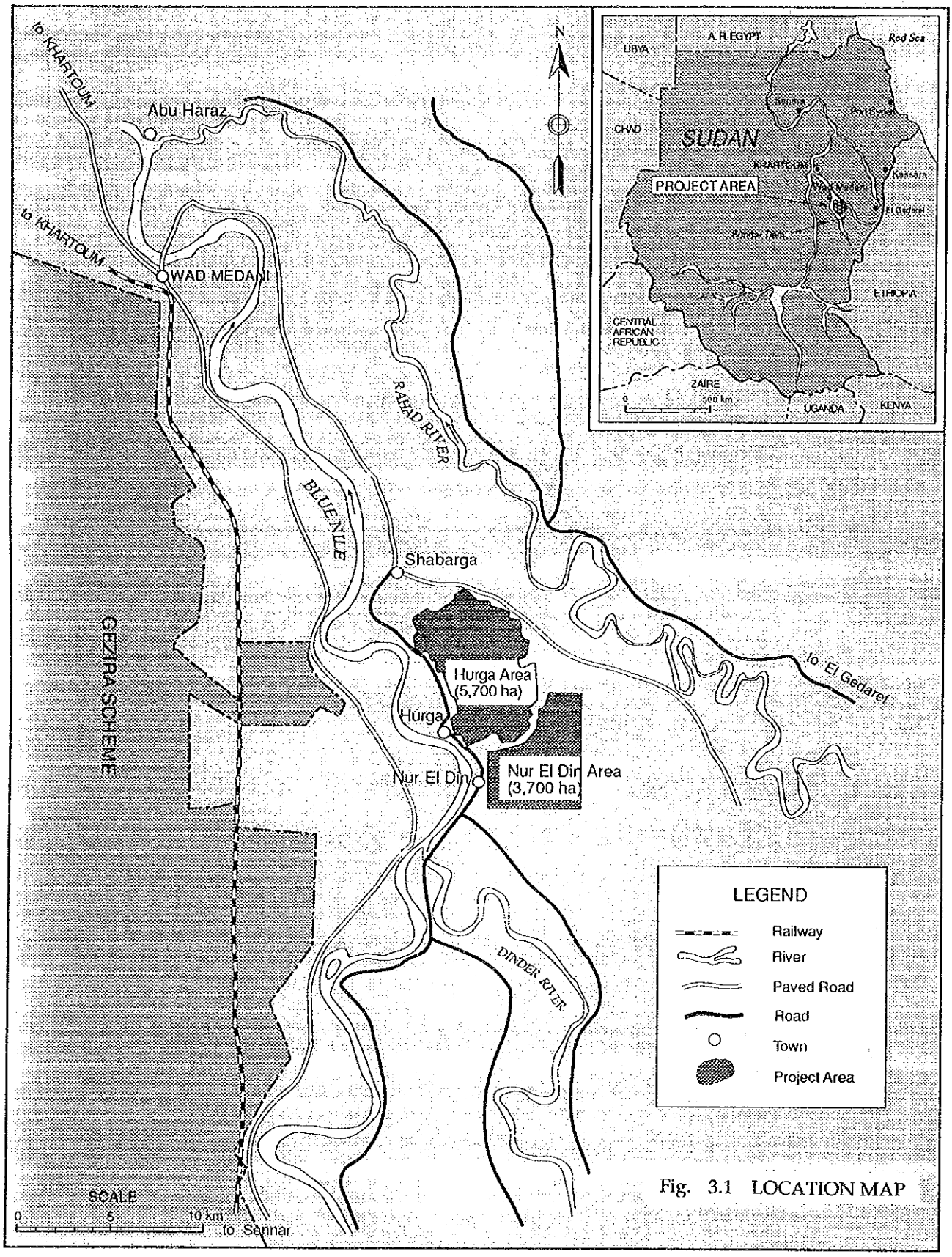


Fig. 3.1 LOCATION MAP

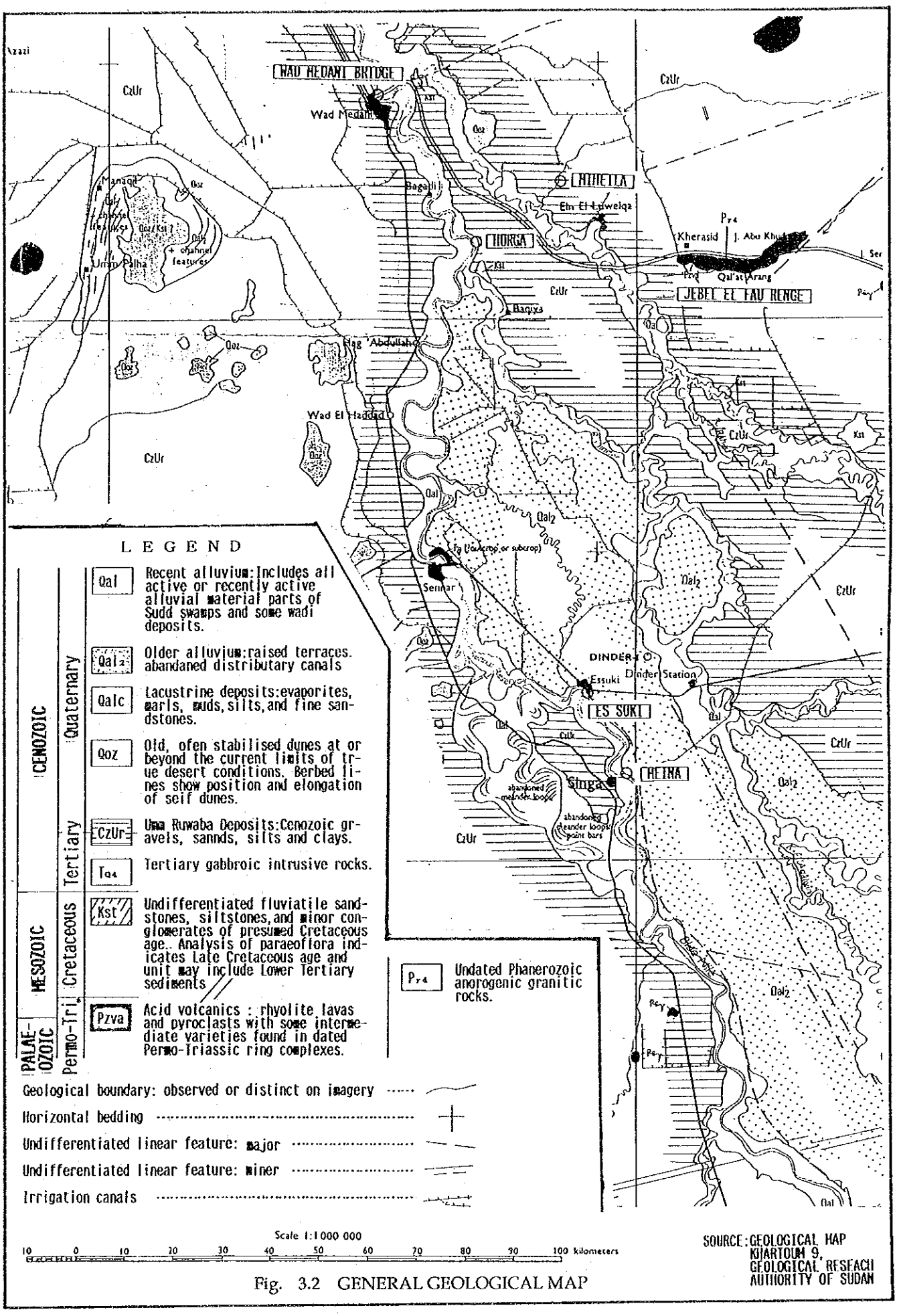
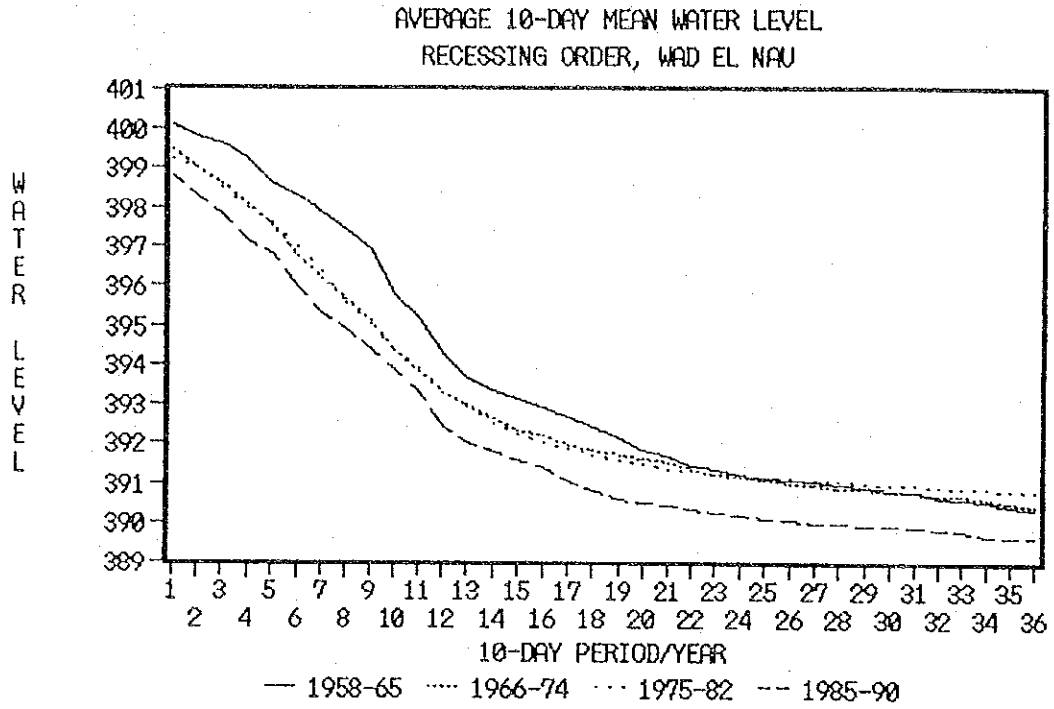


Fig. 3.2 GENERAL GEOLOGICAL MAP



AVERAGE 10-DAY MEAN WATER LEVEL
RIVER DATUM (RECESSING ORDER)

10-DAY	1958-65	66-74	75-82	85-90	10-DAY	1958-65	66-74	75-82	85-90
1	400.06	399.45	399.23	398.77	20	391.83	391.60	391.47	390.51
2	399.82	399.03	399.00	398.30	21	391.64	391.50	391.37	390.45
3	399.64	398.62	398.52	397.80	22	391.45	391.36	391.29	390.35
4	399.22	398.07	398.00	397.14	23	391.34	391.22	391.23	390.23
5	398.61	397.55	397.58	396.82	24	391.20	391.16	391.18	390.20
6	398.31	396.76	396.97	395.96	25	391.11	391.07	391.14	390.11
7	397.85	396.19	396.36	395.27	26	391.08	390.99	391.12	390.05
8	397.39	395.65	395.57	394.88	27	391.03	390.93	391.10	389.99
9	396.90	395.11	395.03	394.42	28	390.97	390.87	391.02	389.97
10	395.79	394.36	394.35	393.86	29	390.92	390.85	390.99	389.95
11	395.14	393.81	393.94	393.32	30	390.84	390.79	390.95	389.92
12	394.28	393.29	393.31	392.41	31	390.76	390.76	390.93	389.90
13	393.66	392.93	392.96	392.00	32	390.65	390.70	390.89	389.86
14	393.34	392.62	392.52	391.80	33	390.61	390.67	390.86	389.82
15	393.12	392.34	392.24	391.58	34	390.54	390.61	390.84	389.65
16	392.88	392.21	392.03	391.37	35	390.44	390.51	390.80	389.61
17	392.66	391.95	391.89	391.03	36	390.34	390.40	390.78	389.61
18	392.42	391.84	391.71	390.81					
19	392.16	391.70	391.58	390.59	AVERAGE	393.61	393.04	393.08	392.18

Note: Based on Irrigation Datum

Fig. 3.3 AVERAGE 10-DAY MEAN WATER LEVEL AT WAD EL NAU

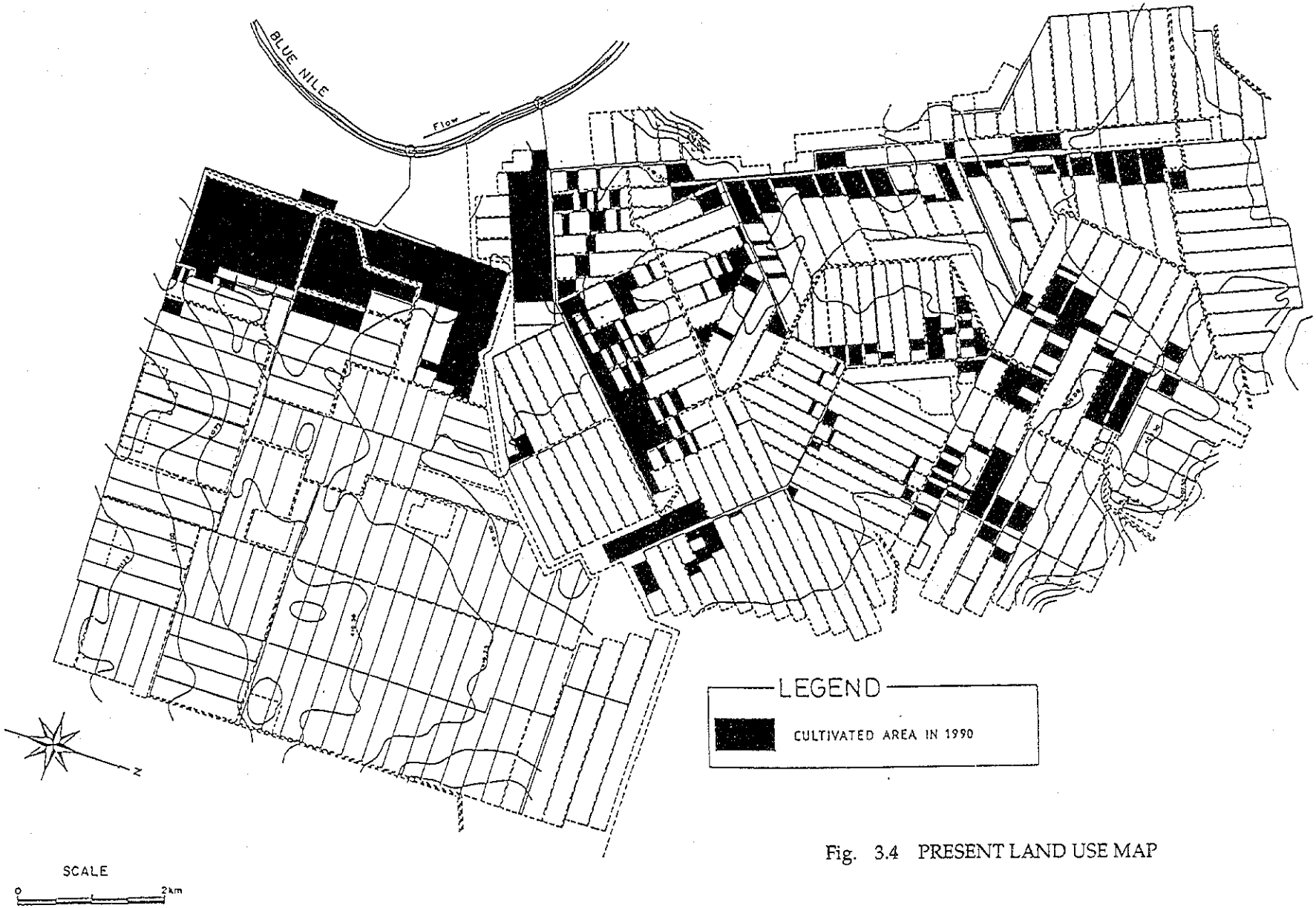


Fig. 3.4 PRESENT LAND USE MAP

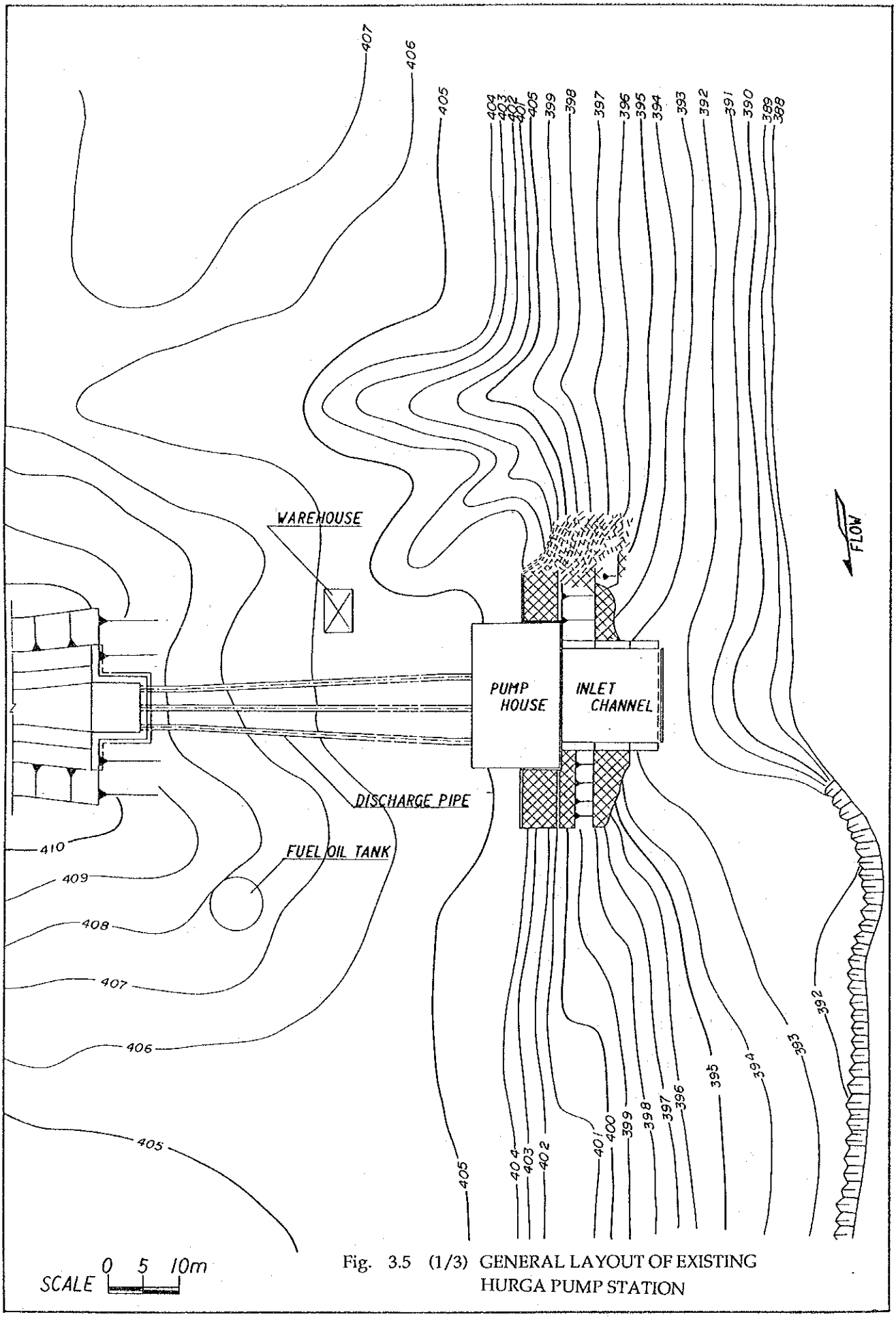


Fig. 3.5 (1/3) GENERAL LAYOUT OF EXISTING HURGA PUMP STATION

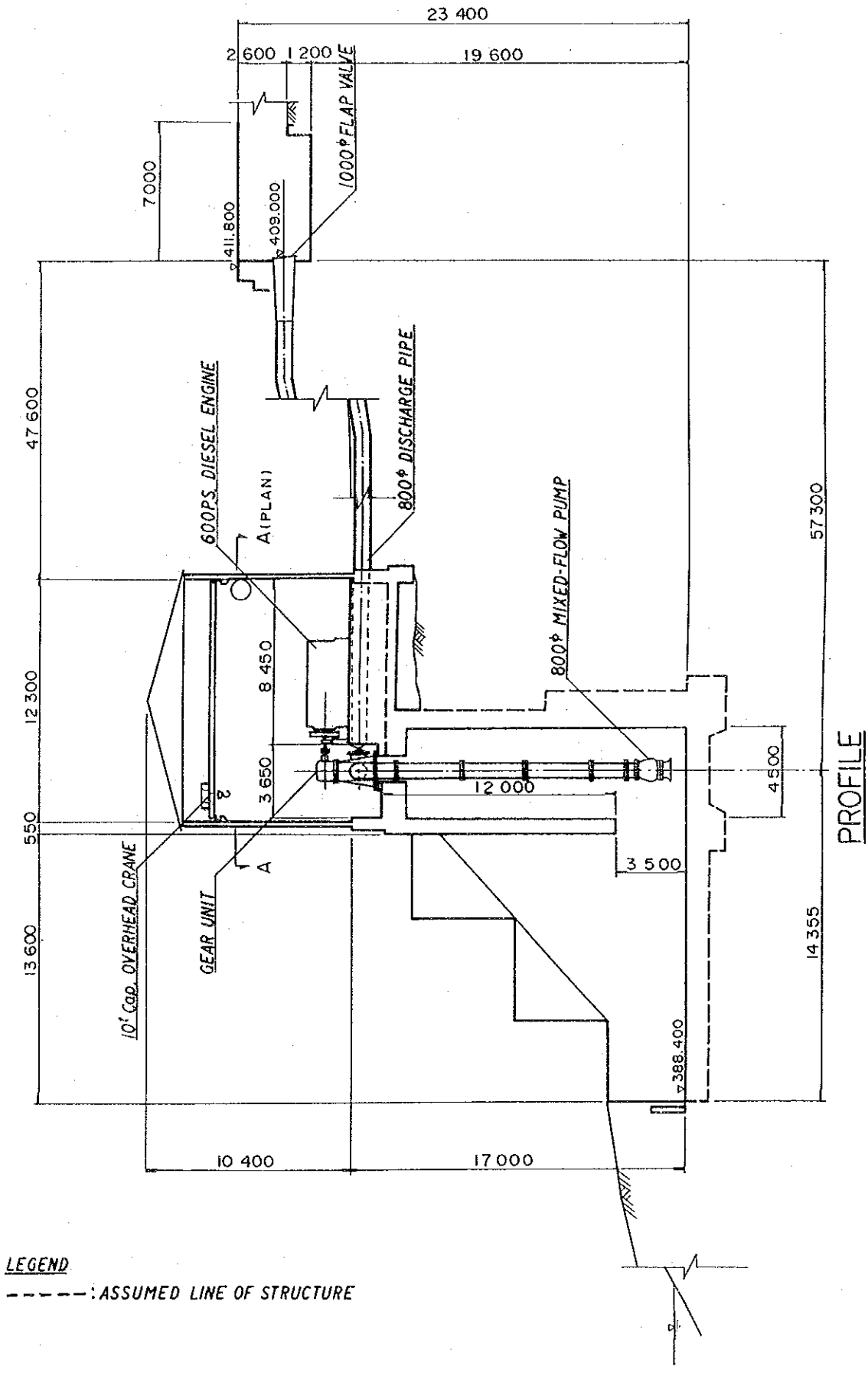


Fig. 3.5 (2/3) GENERAL LAYOUT OF EXISTING HURGA PUMP STATION

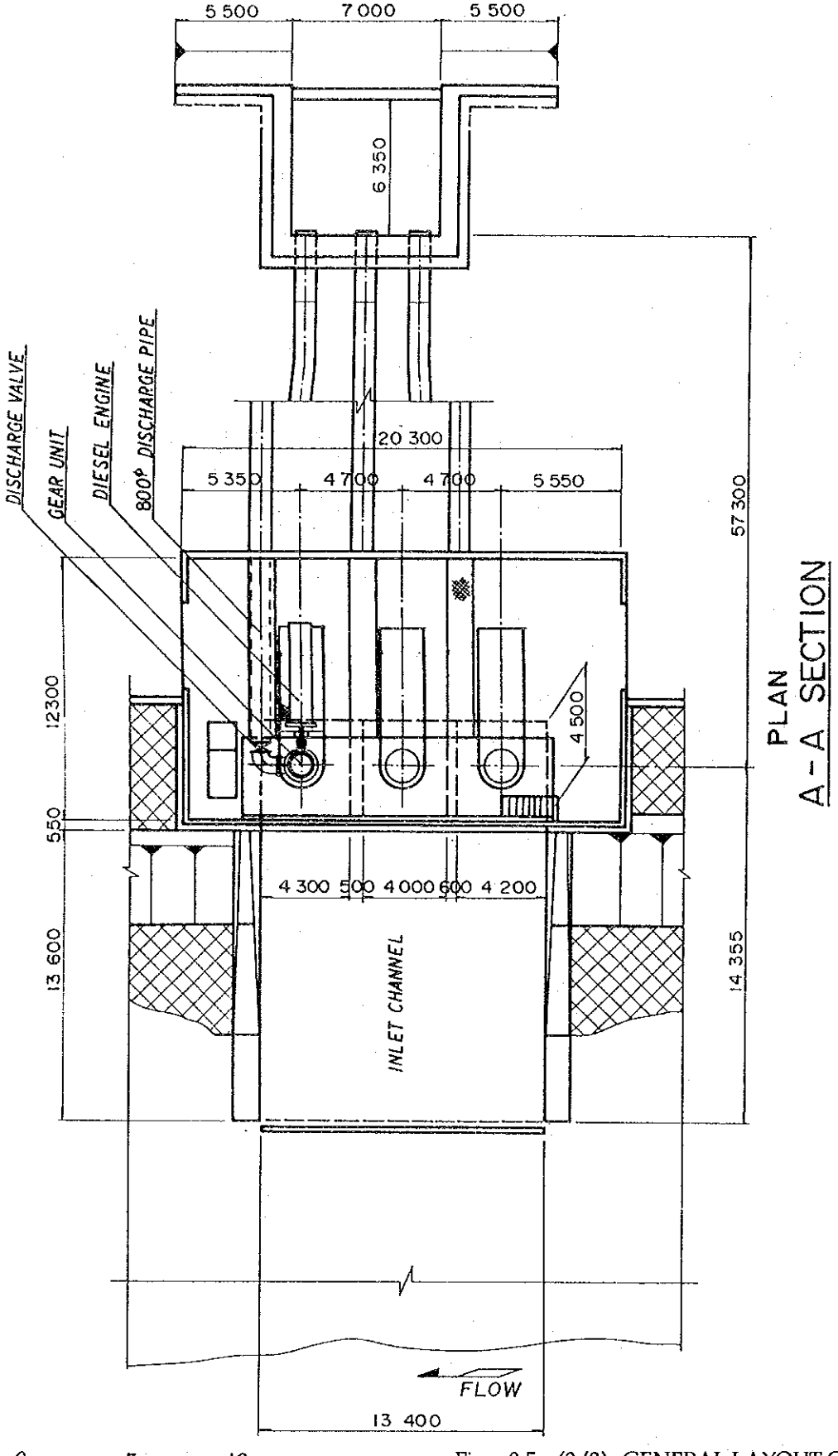


Fig. 3.5 (3/3) GENERAL LAYOUT OF EXISTING HURGA PUMP STATION

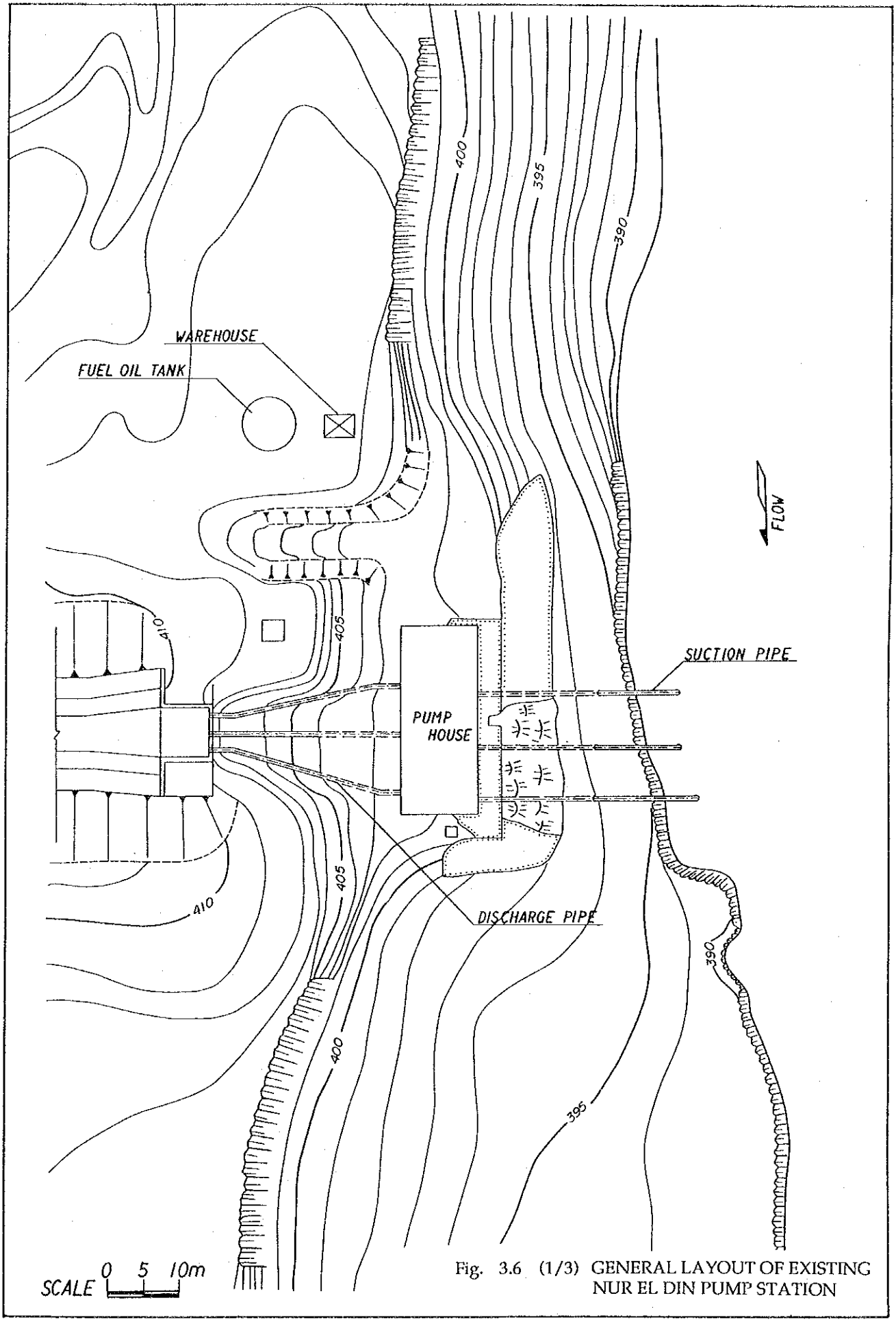


Fig. 3.6 (1/3) GENERAL LAYOUT OF EXISTING NUR EL DIN PUMP STATION

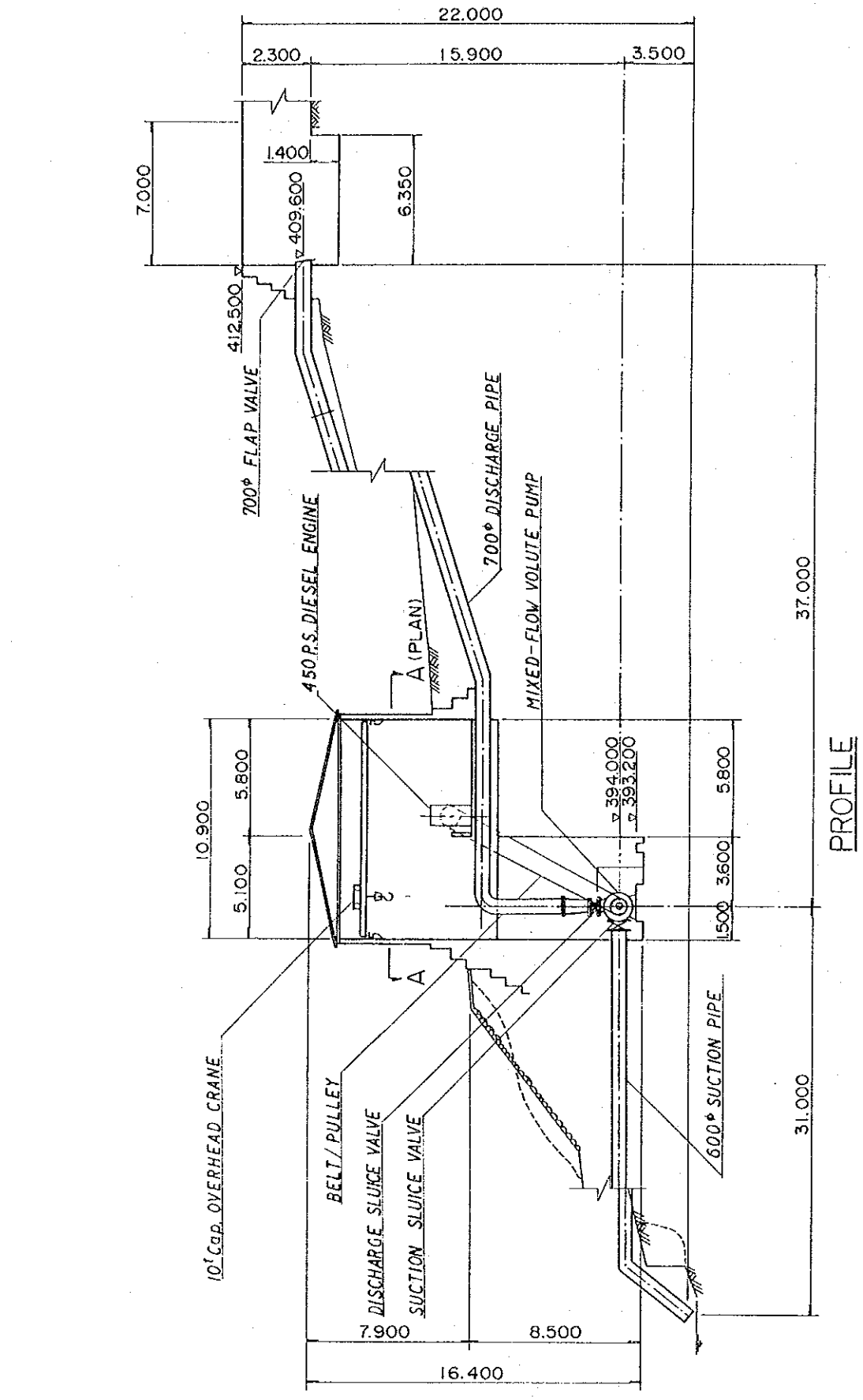


Fig. 3.6 (2/3) GENERAL LAYOUT OF EXISTING NUR EL DIN PUMP STATION

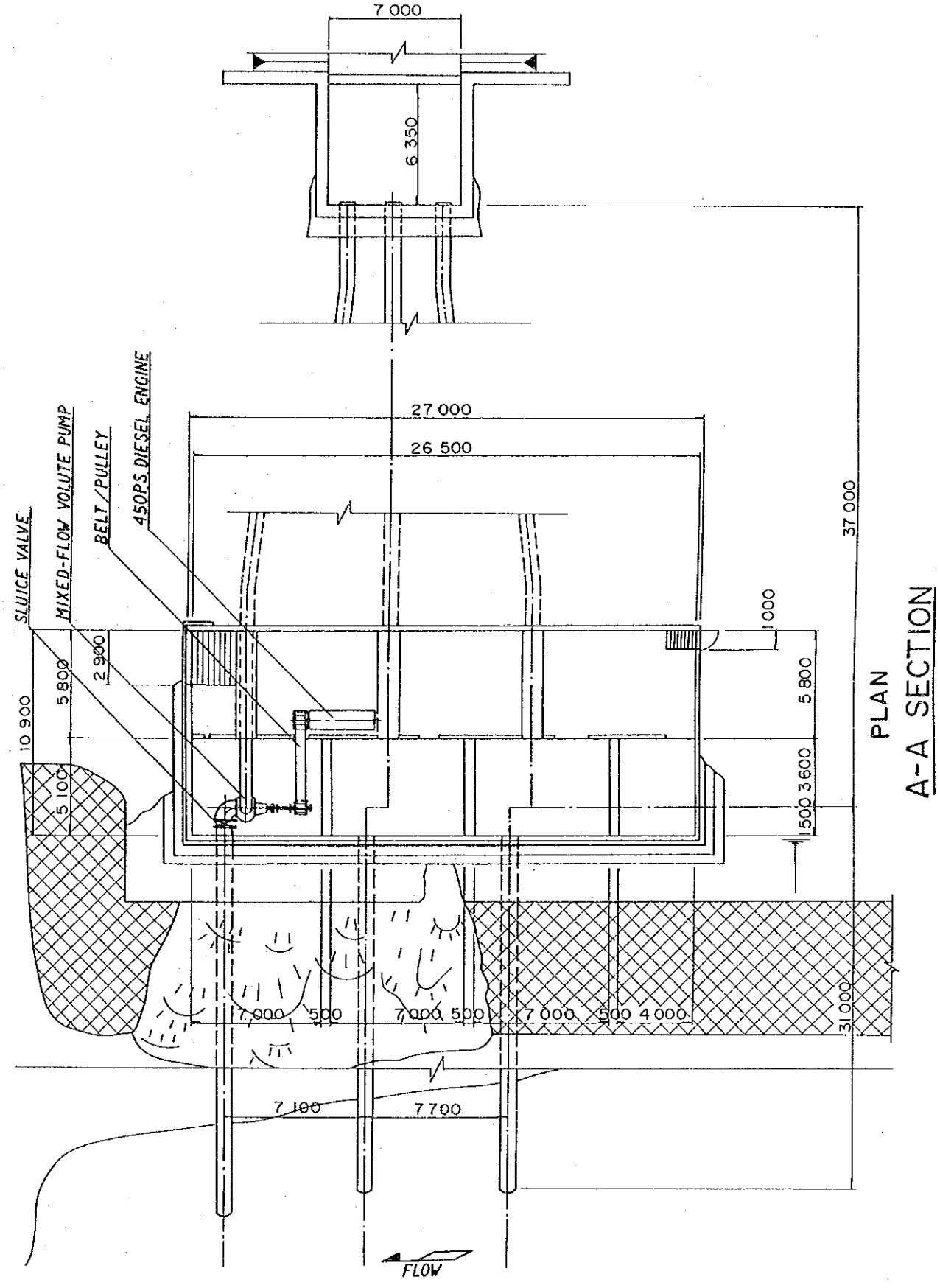


Fig. 3.6 (3/3) GENERAL LAYOUT OF EXISTING NUR EL DIN PUMP STATION

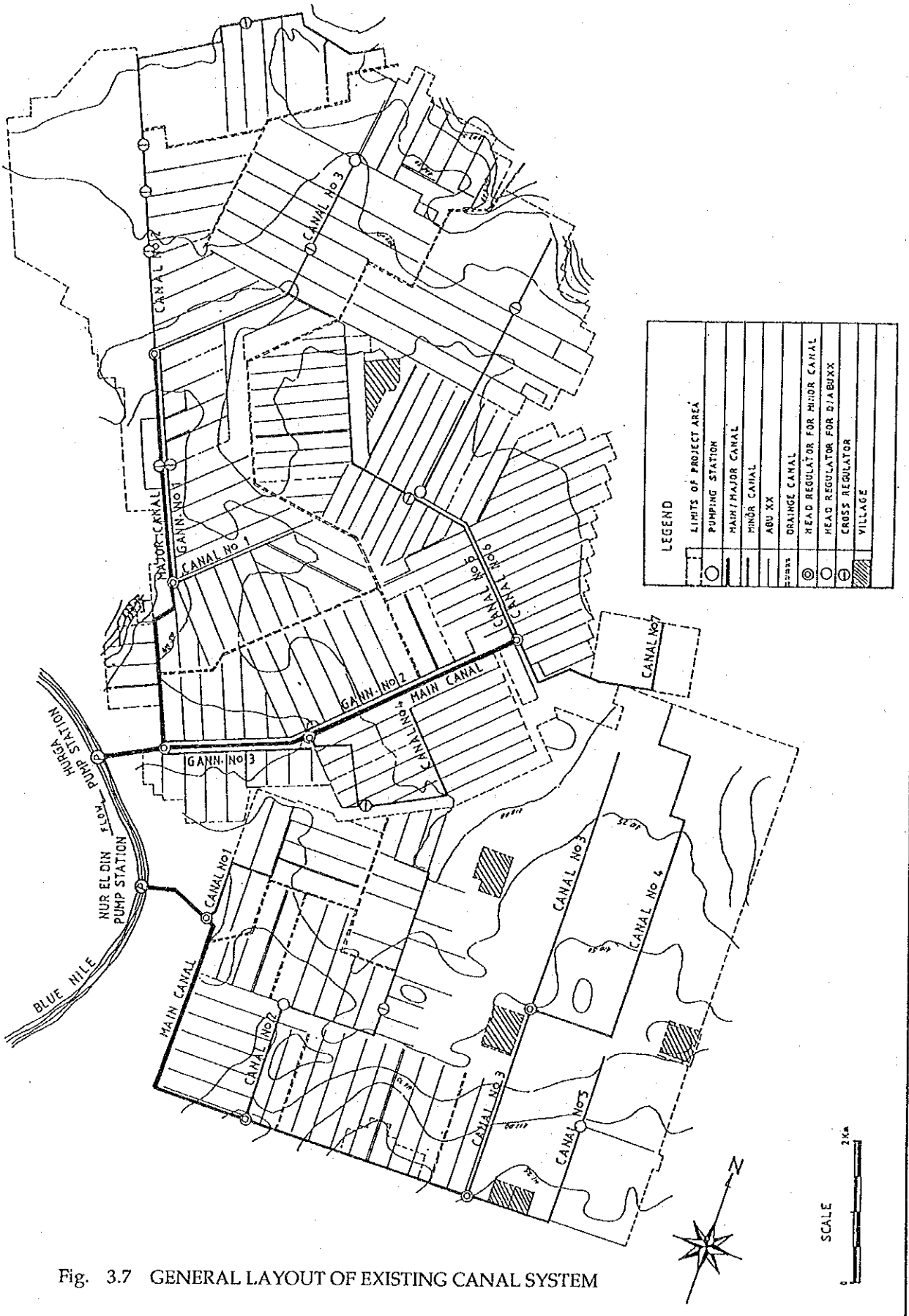


Fig. 3.7 GENERAL LAYOUT OF EXISTING CANAL SYSTEM

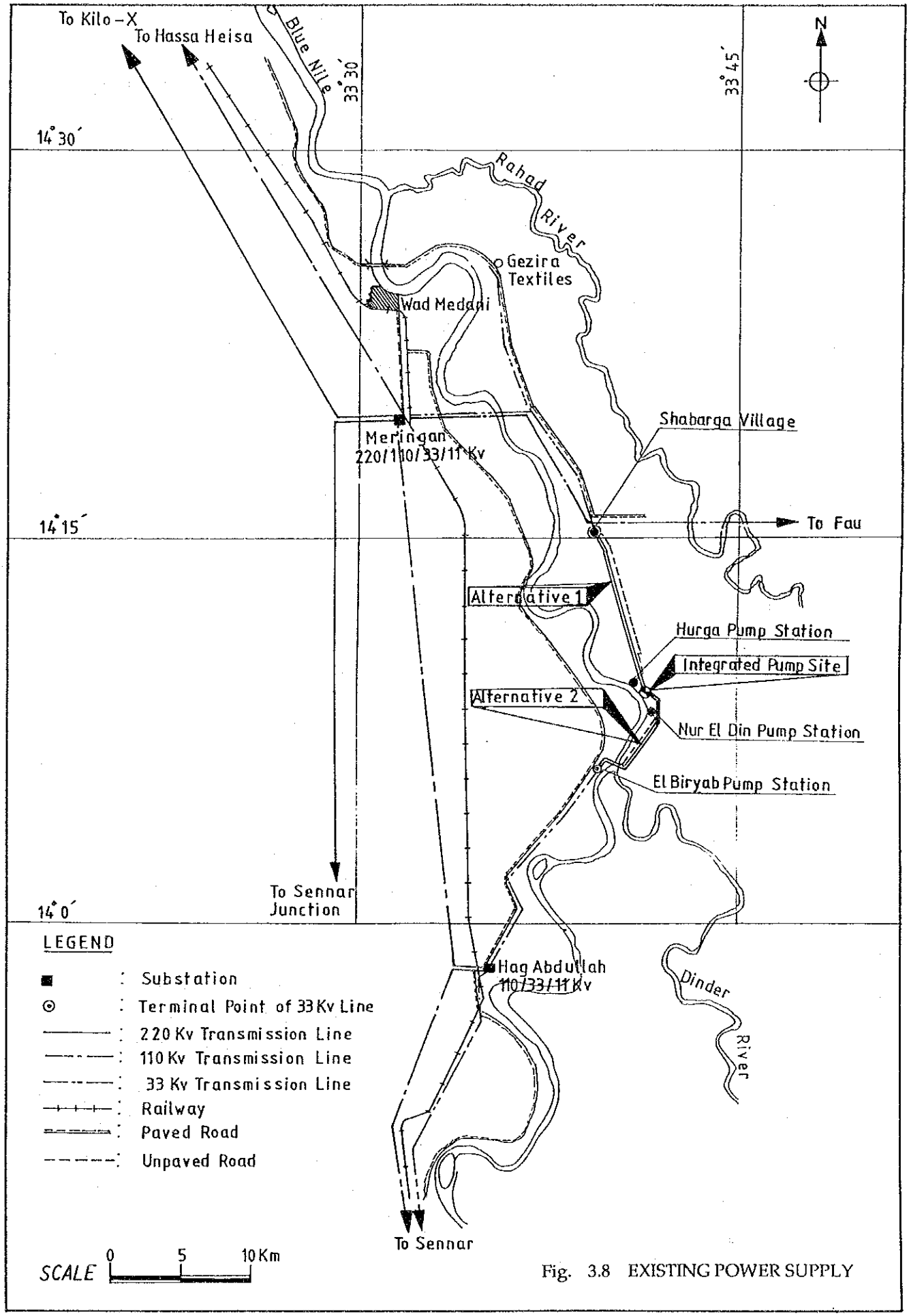


Fig. 3.8 EXISTING POWER SUPPLY

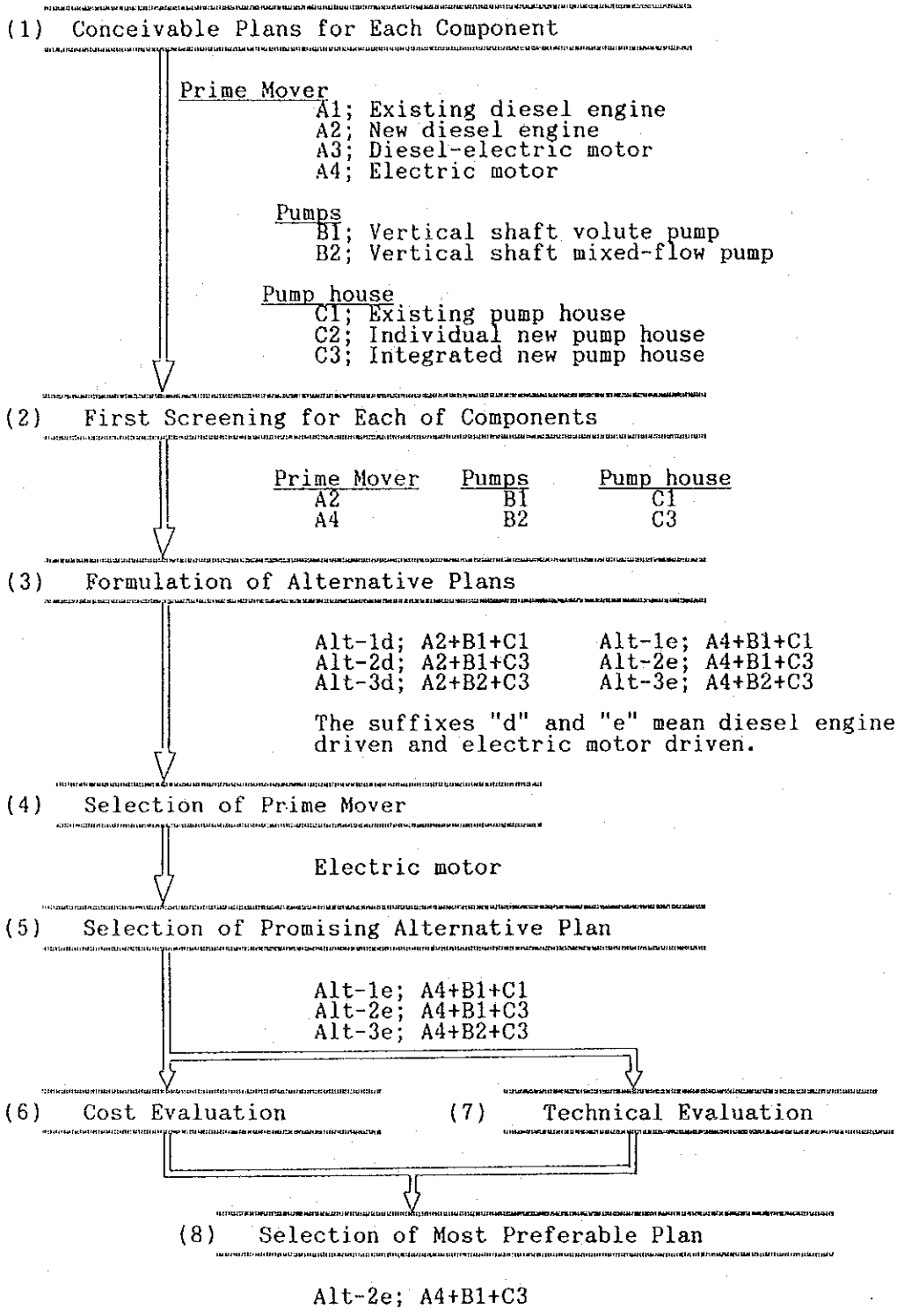
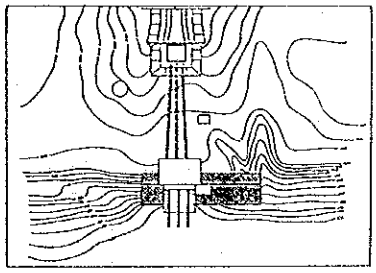
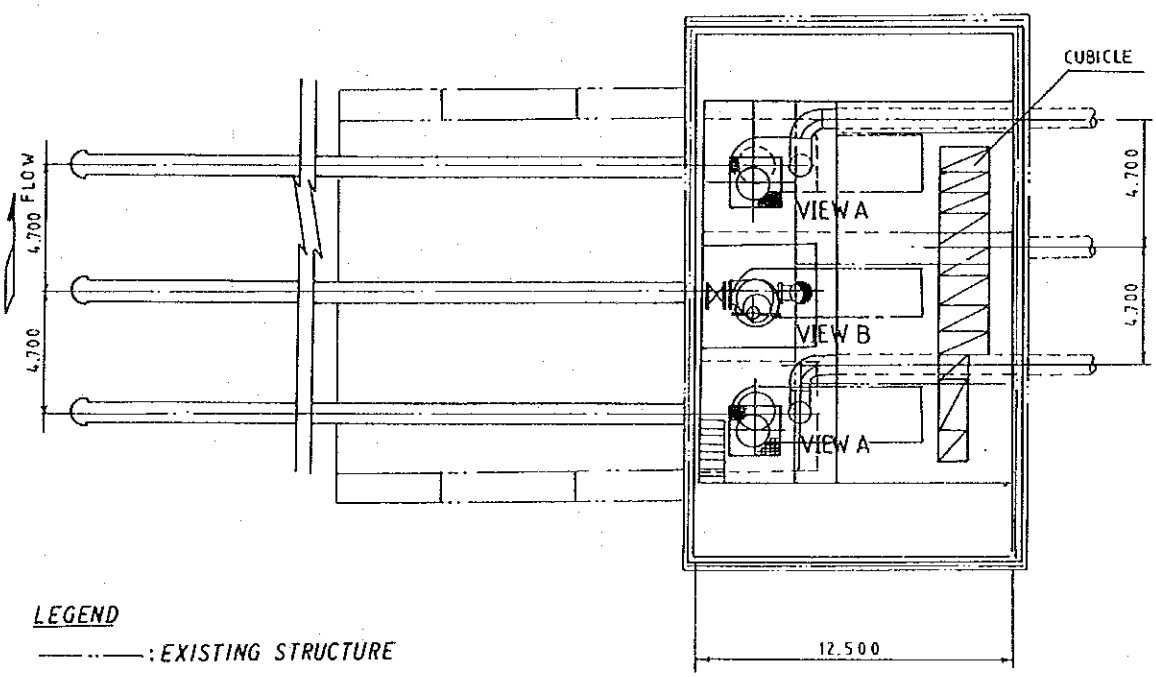


Fig. 4.1 FLOW OF ALTERNATIVE STUDY FOR PUMPING STATION



KEY PLAN

PROFILE



PLAN

SCALE 0 5 10 m.

Fig. 4.2 (1/2) GENERAL LAYOUT OF ALTERNATIVE PLAN-1c (HURGA PUMP STATION)

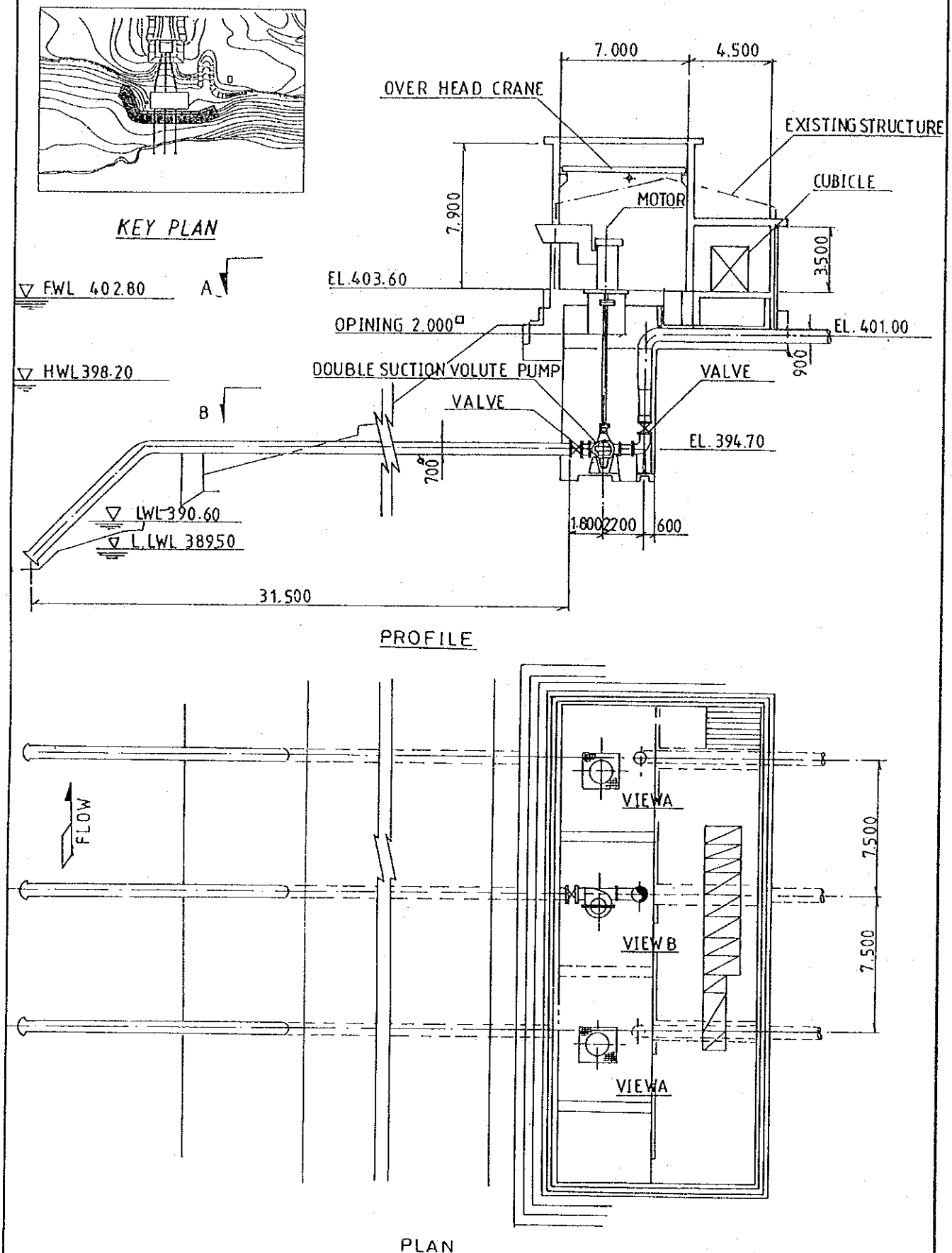


Fig. 4.2 (2/2) GENERAL LAYOUT OF ALTERNATIVE PLAN-1e (NUR EL DIN PUMP STATION)

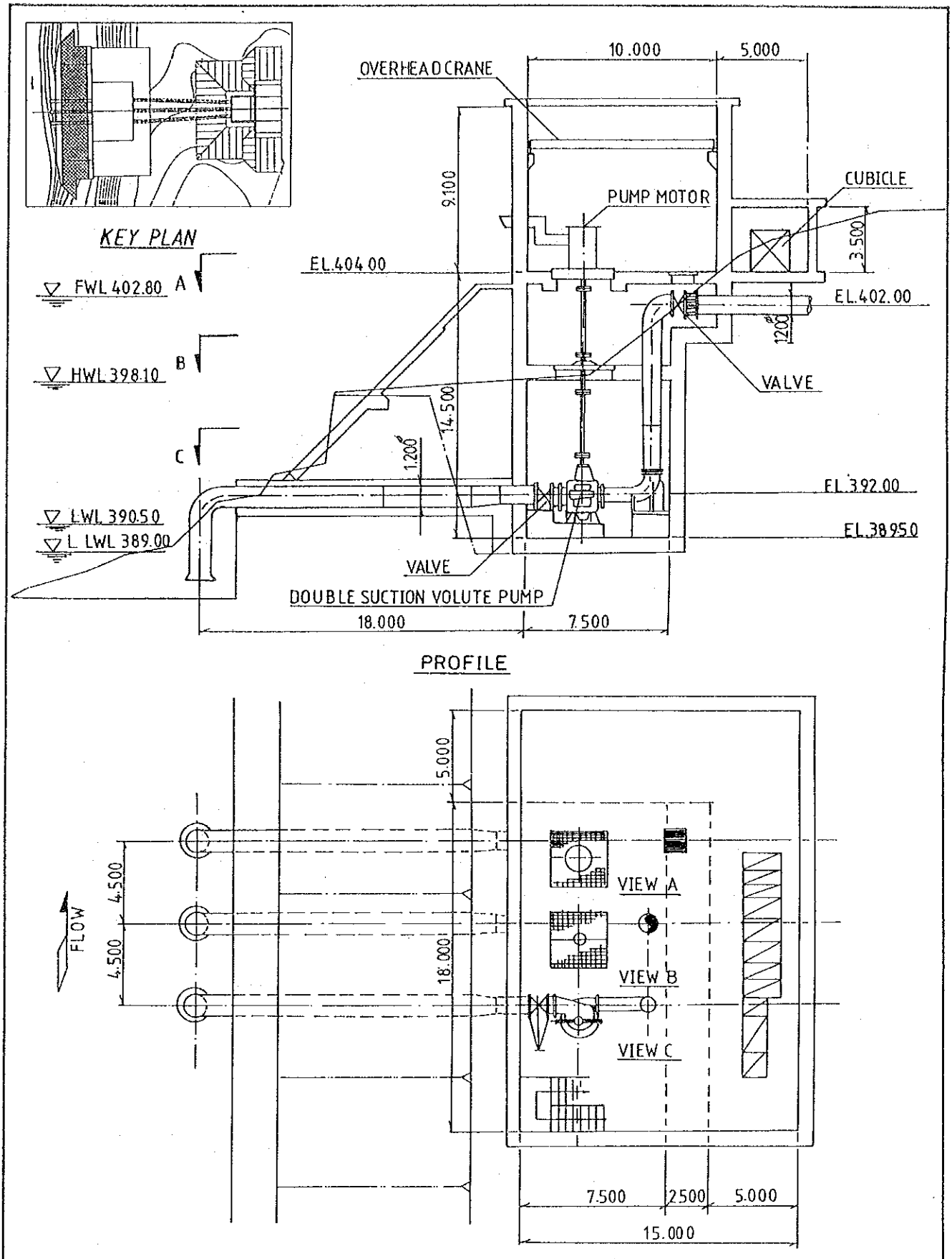


Fig. 4.3 GENERAL LAYOUT OF ALTERNATIVE PLAN-2e

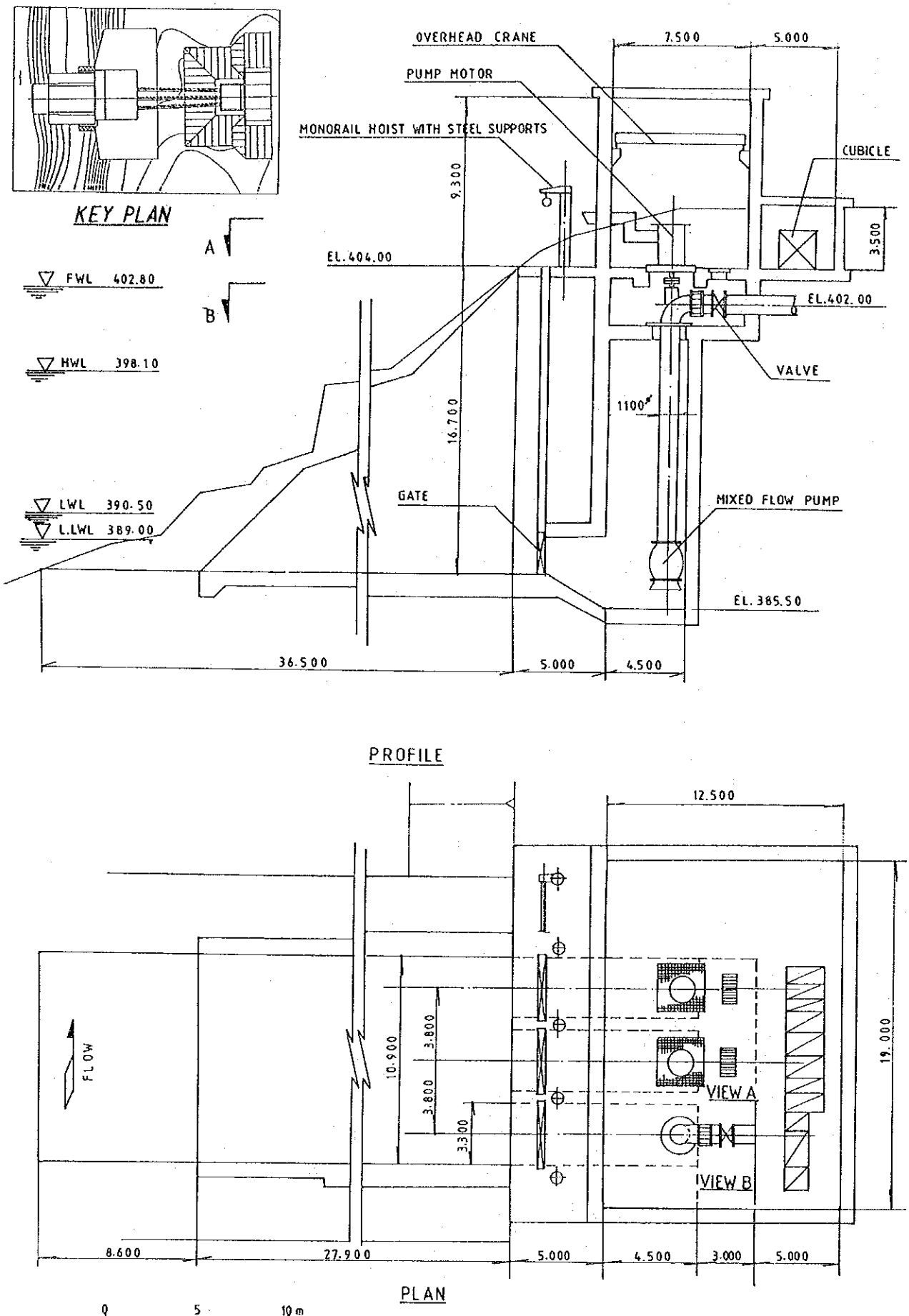


Fig. 4.4 GENERAL LAYOUT OF ALTERNATIVE PLAN-3e

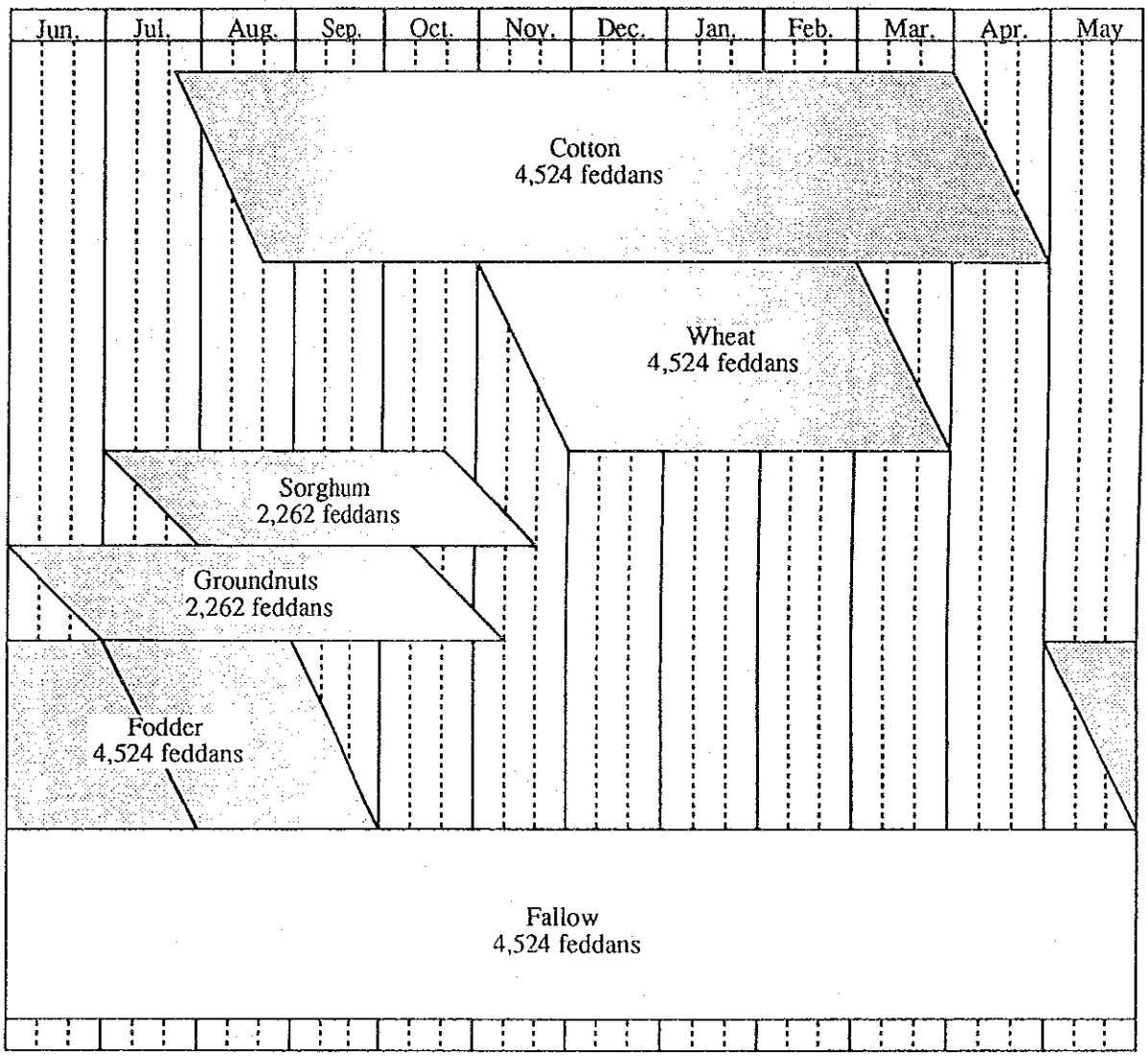


Fig. 5.1 PROPOSED CROPPING PATTERN

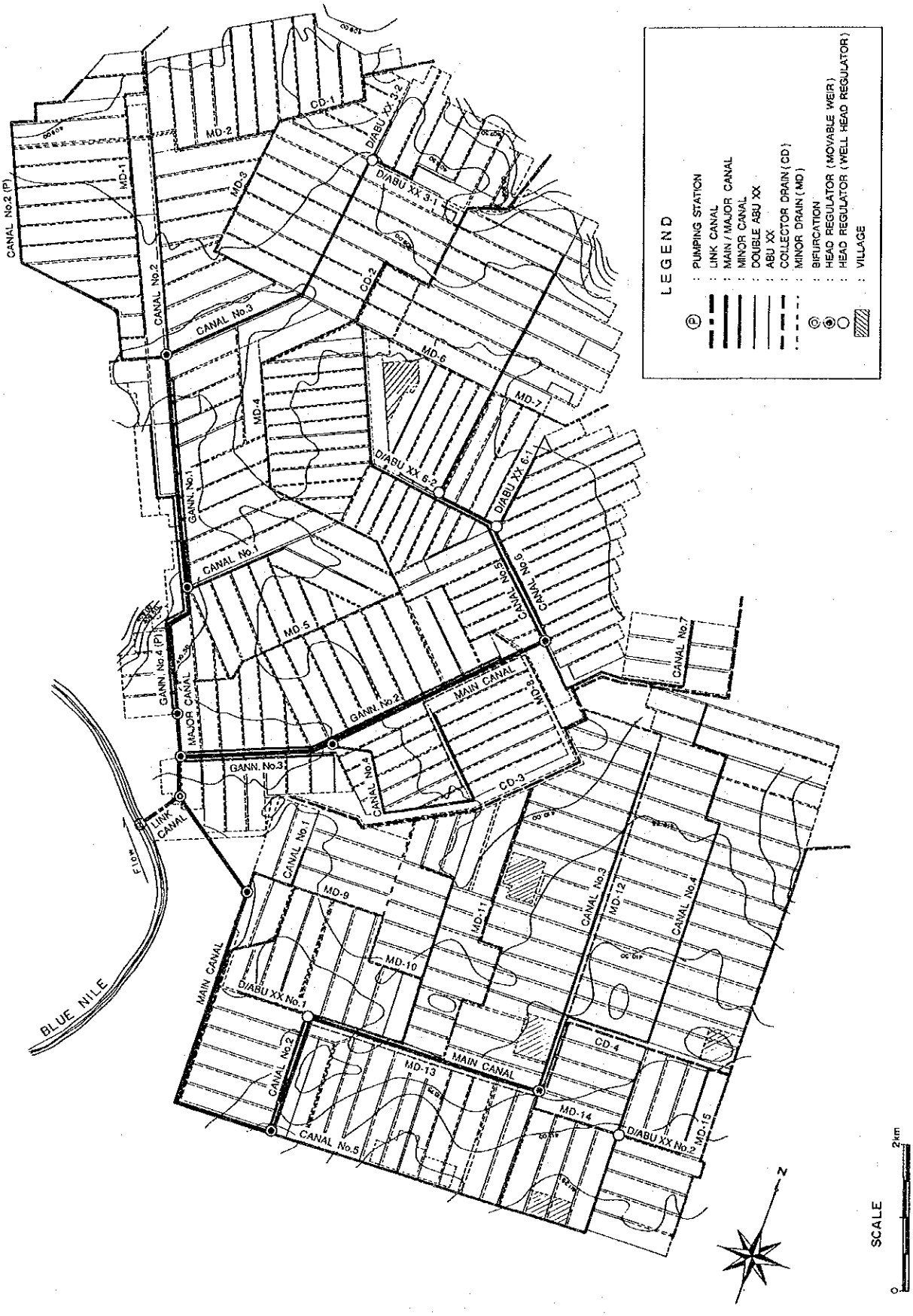


Fig. 5.2 GENERAL LAYOUT OF PROPOSED CANAL SYSTEM

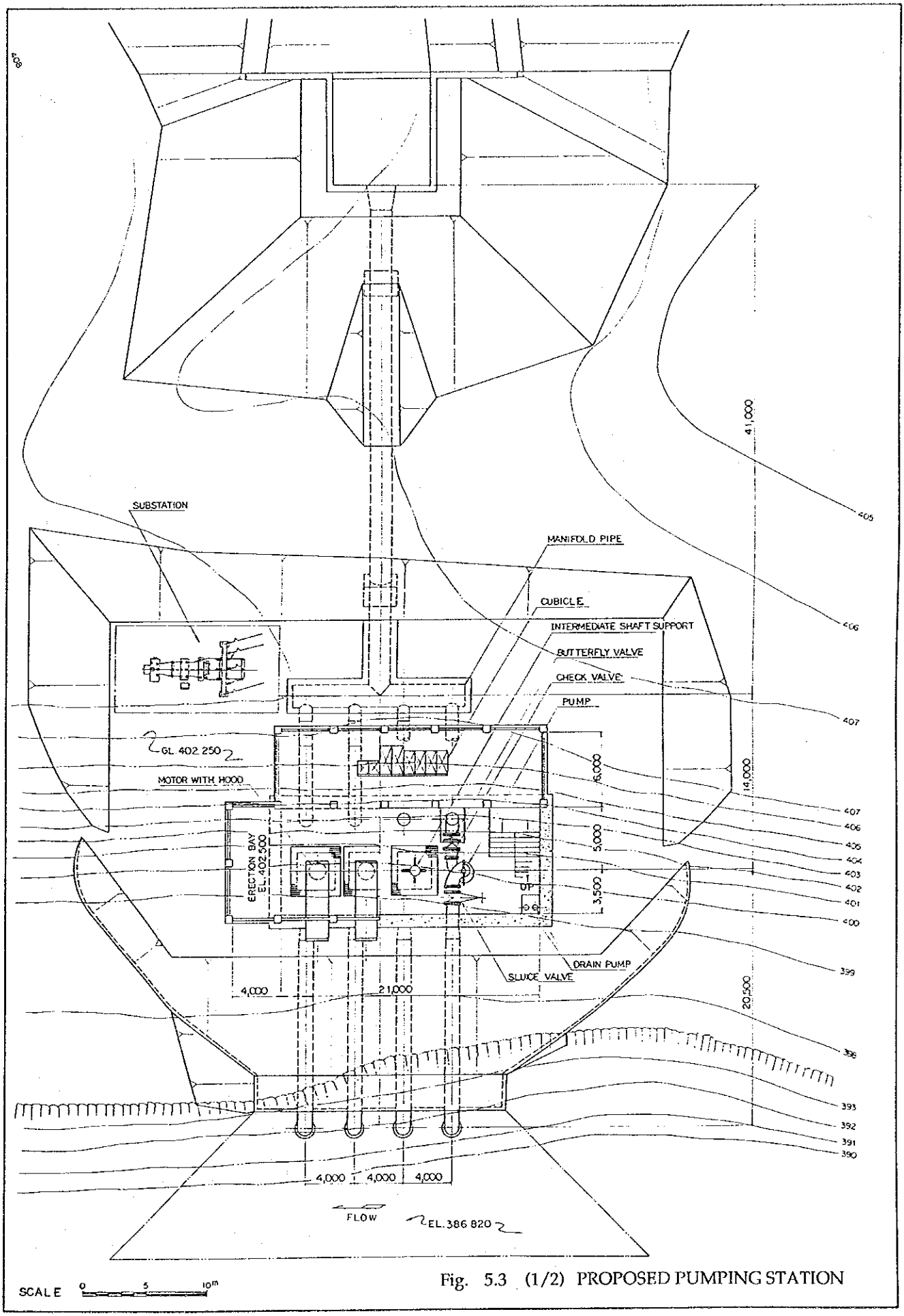


Fig. 5.3 (1/2) PROPOSED PUMPING STATION

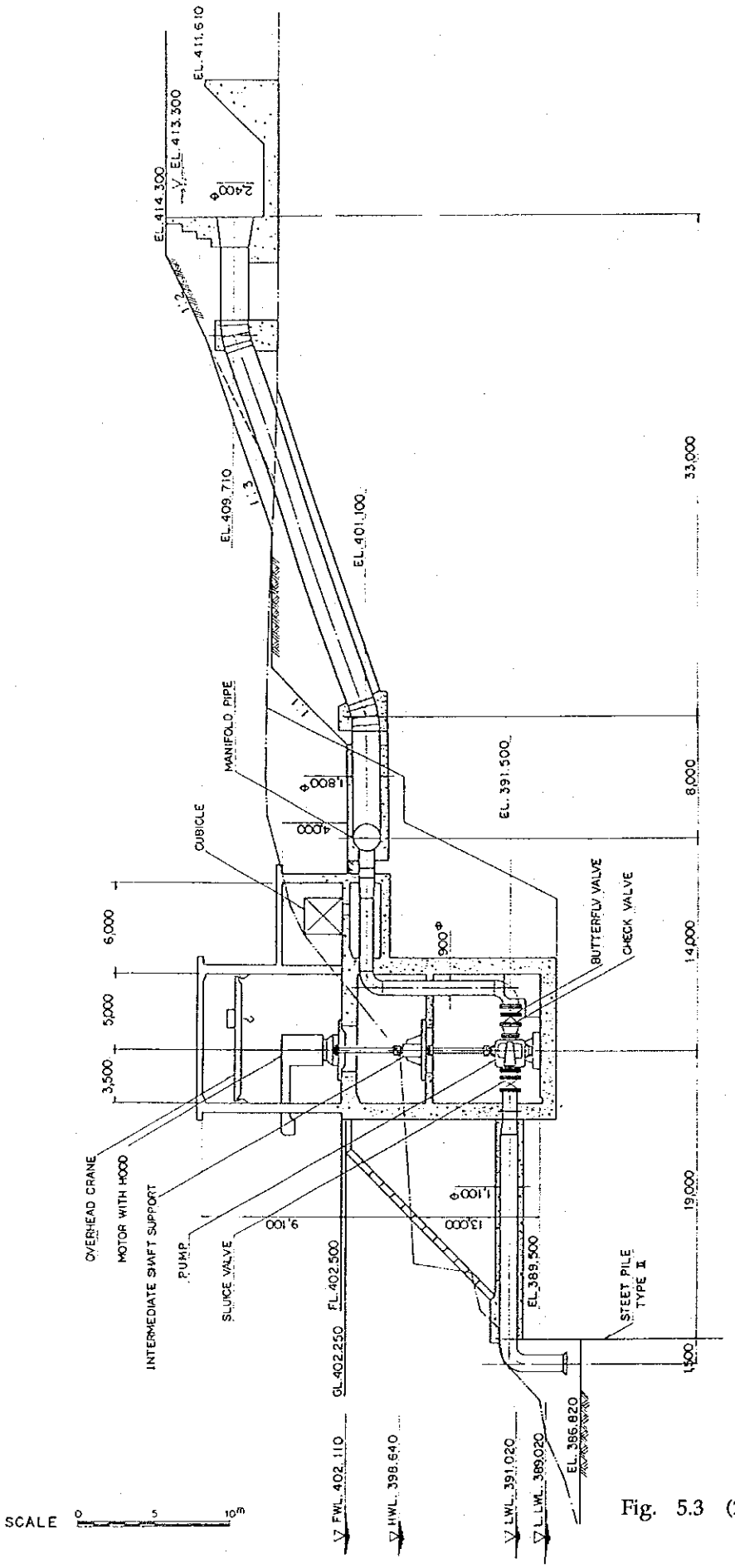


Fig. 5.3 (2/2) PROPOSED PUMPING STATION

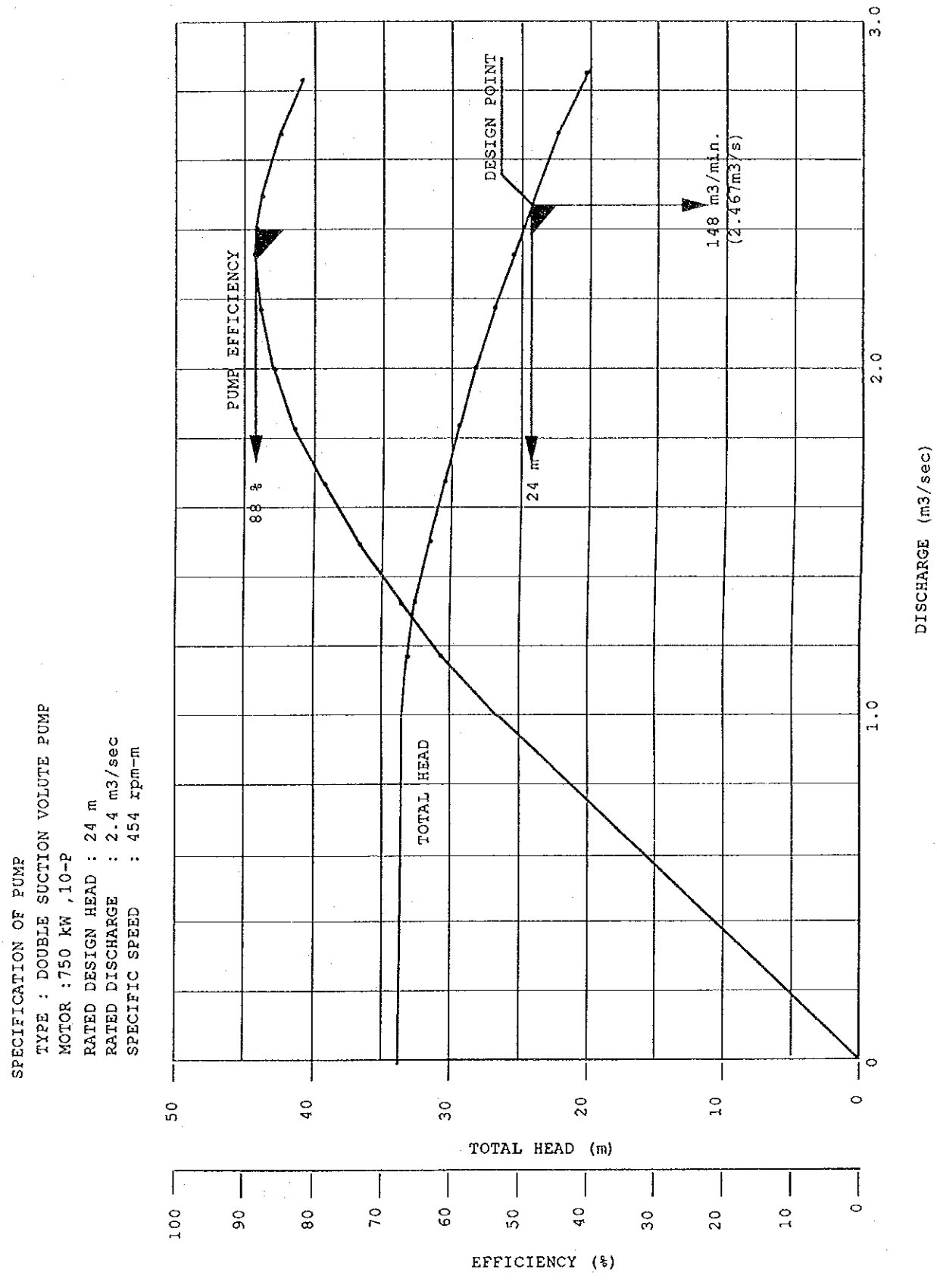


Fig. 5.4 CHARACTERISTIC CURVE OF PUMP

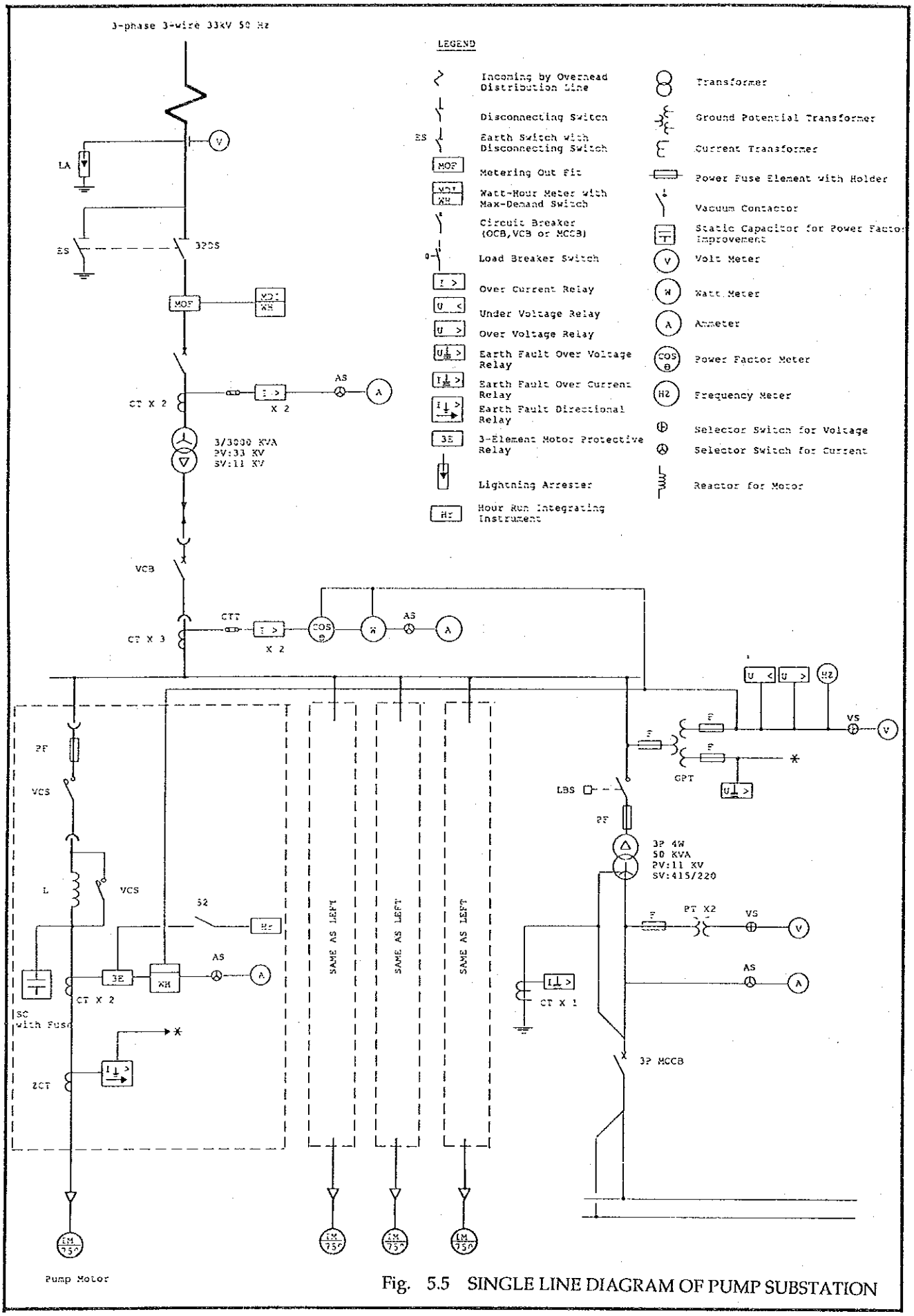


Fig. 5.5 SINGLE LINE DIAGRAM OF PUMP SUBSTATION

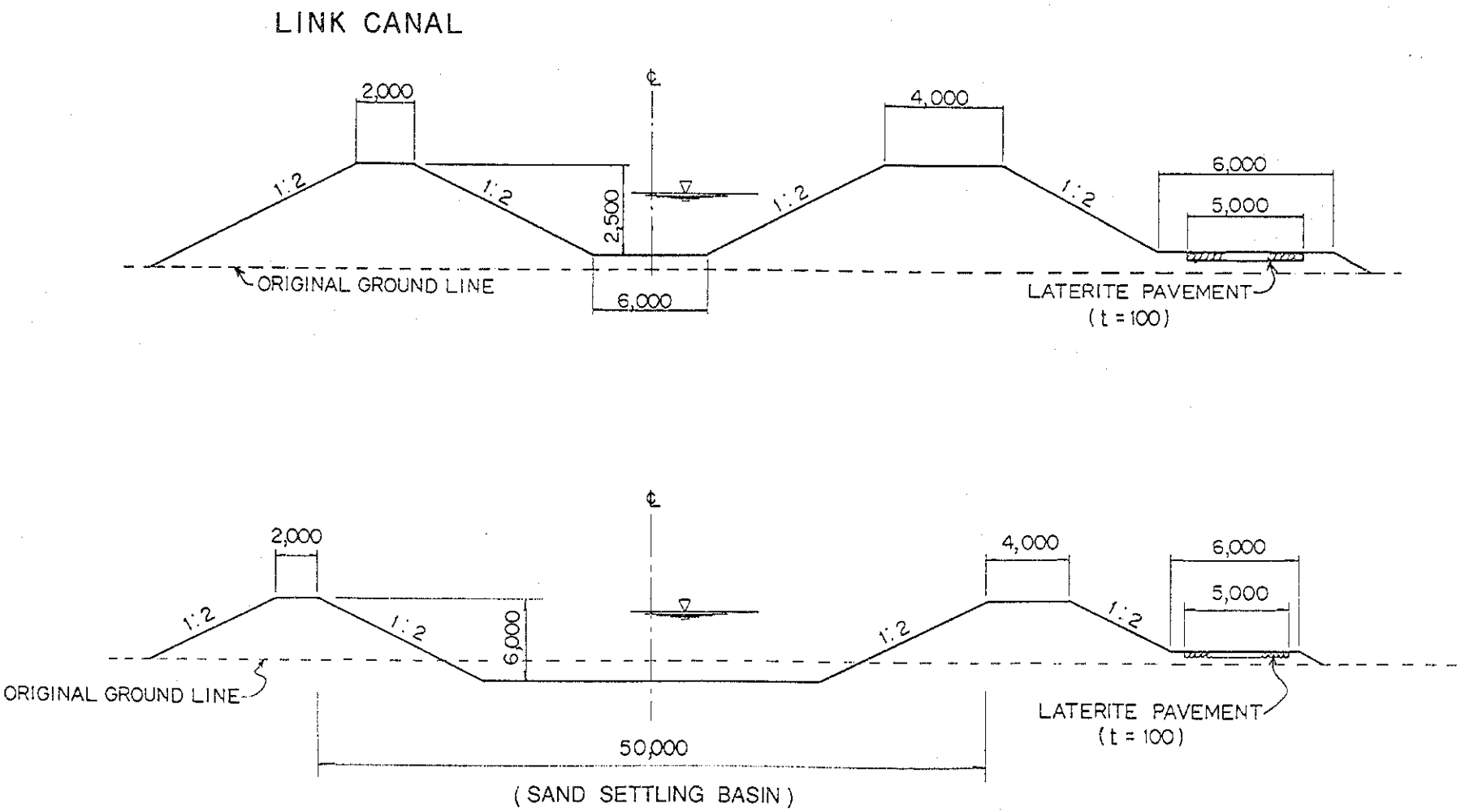
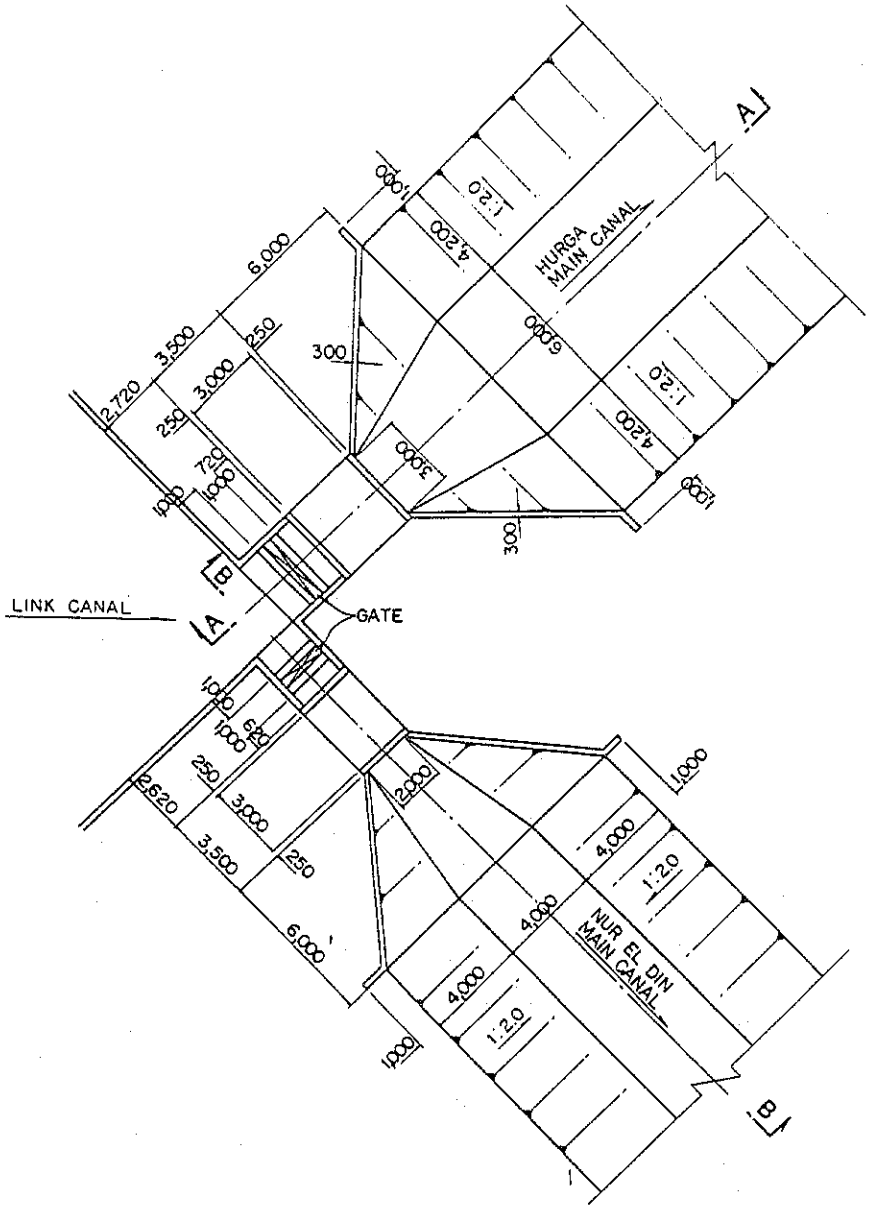
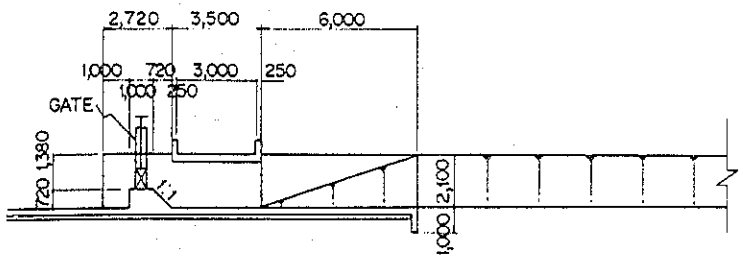


Fig. 5.6 TYPICAL CROSS SECTION OF LINK CANAL





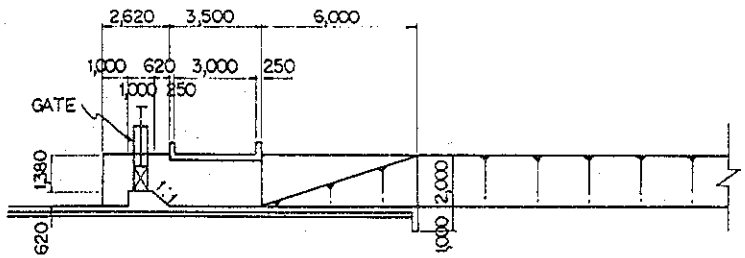
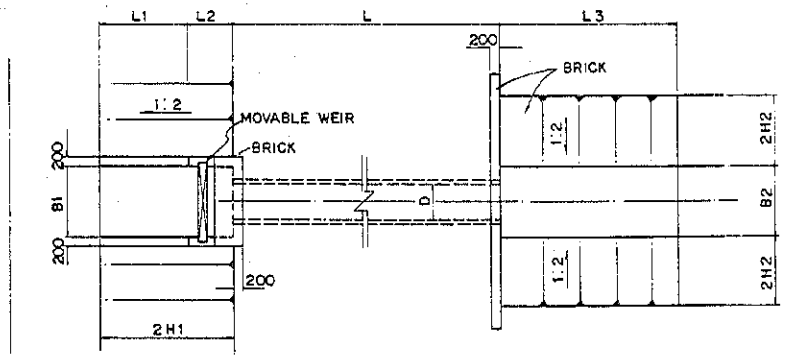
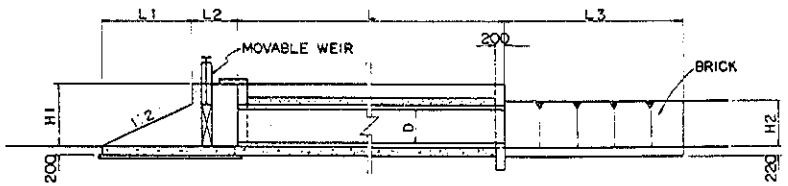


Fig. 5.7 BIFURCATION



PLAN



LONGITUDINAL SECTION

DIMENSION TABLE

Offtake Canal Name	B1 (mm)	H1 (mm)	B2 (mm)	H2 (mm)	D (mm)	L1 (mm)	L2 (mm)	L3 (mm)	L (mm)
(1) Hurga Scheme									
Ga. No.1, No.1	1,000	1,900	500	1,700, 1,900	760	2,300	1,500	5,000	7,500
Ga. No.3	1,000	2,100	500	1,500	500	2,700	1,500	5,000	7,500
No.4	1,000	2,000	500	1,500	760	2,500	1,500	5,000	7,500
No.7,Ga. No.4(p)	1,000	1,900	500	1,300	500	2,300	1,500	5,000	7,500
Ga. No.2	1,500	2,100	1,000	1,600	910	2,700	1,500	5,000	7,500
No.2(p), No.2	1,500	1,800	1,000	1,500, 1,700	760	2,100	1,500	5,000	7,500
No.3	1,500	1,800	1,000	2,000	910	2,100	1,500	5,000	7,500
No.5	1,500	1,800	1,000	1,600	760	2,300	1,500	5,000	7,500
No.6	2,000	1,900	2,000	2,000	1,240	2,300	1,500	5,000	7,500
Major	2,000	2,100	2,000	1,900	1500*1500<1	2,700	1,500	5,000	7,500
(2) Nur El Din Scheme									
No.1	1,000	2,000	500	1,800	760	2,500	1,500	5,000	7,500
No.2	1,500	2,000	1,500	1,700	910	2,500	1,500	5,000	7,500
No.3	1,500	2,000	1,500	1,900	1,010	2,500	1,500	5,000	7,500
No.4	1,500	1,900	1,000	1,700	910	2,300	1,500	5,000	7,500
No.5	1,500	1,800	1,500	1,800	910	2,300	1,500	5,000	7,500

Note : <1 : Box Type

MOVABLE WEIR

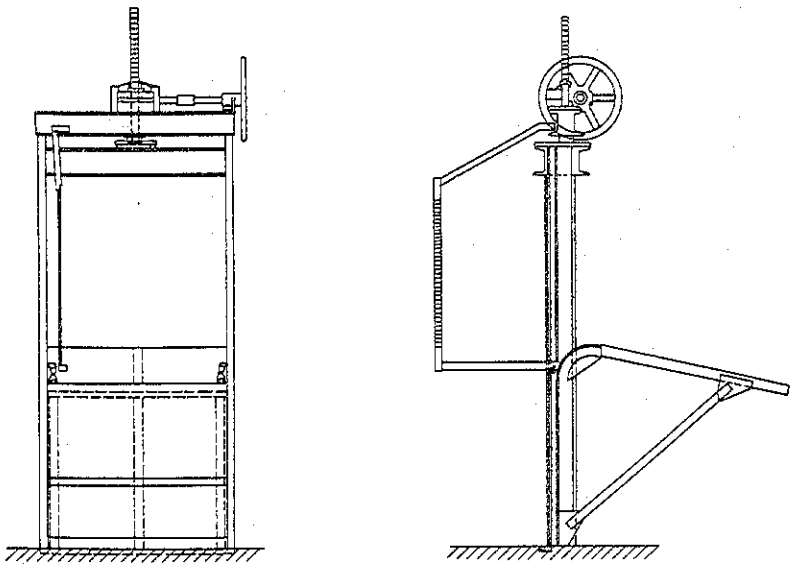
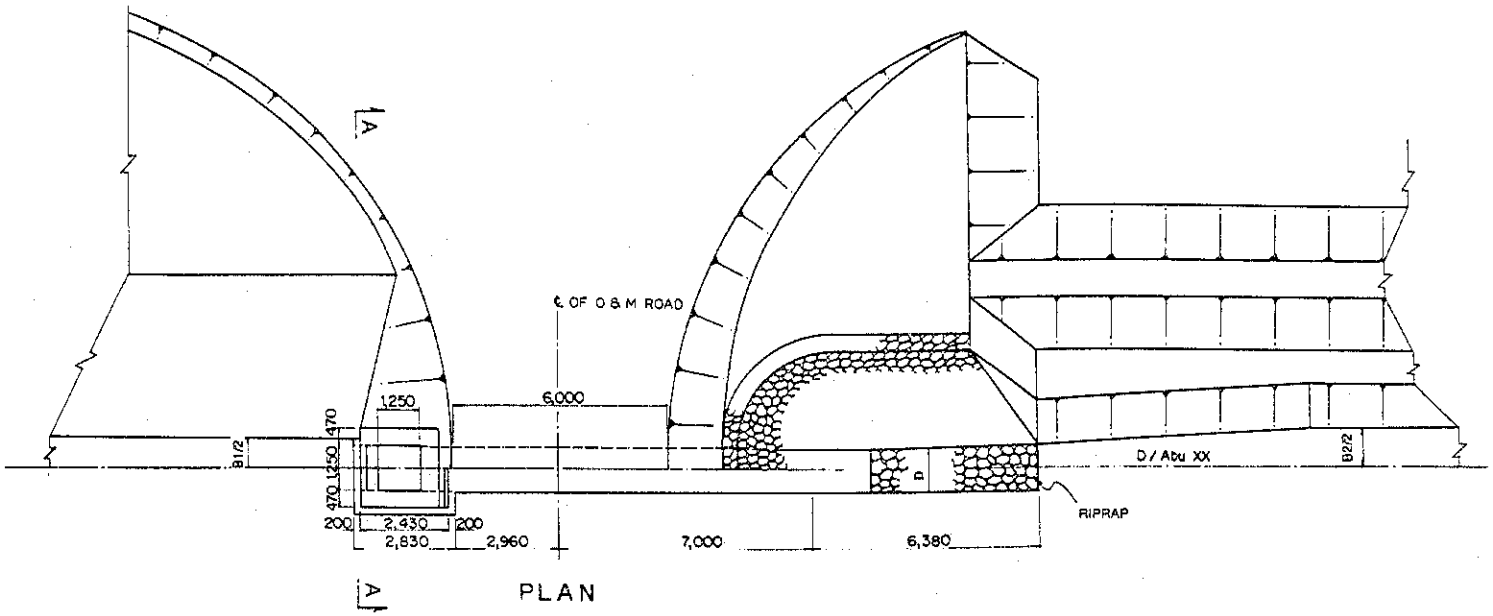
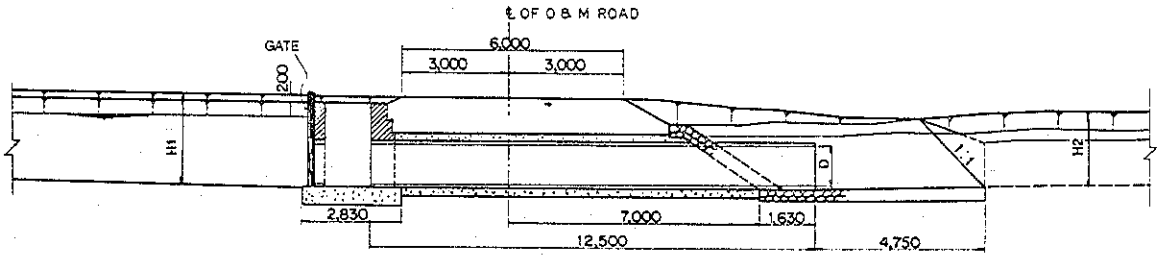
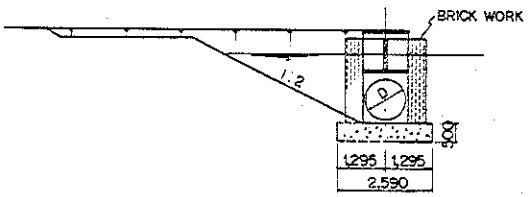


Fig. 5.8 MOVABLE WEIR





LONGITUDINAL SECTION

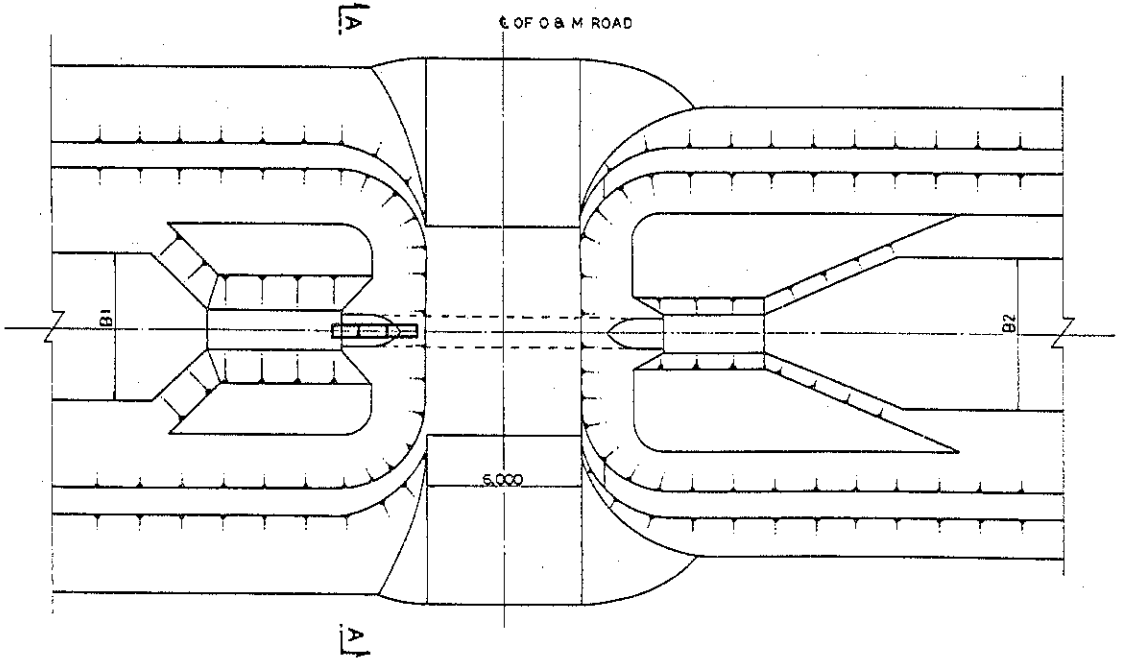


SECTION A-A

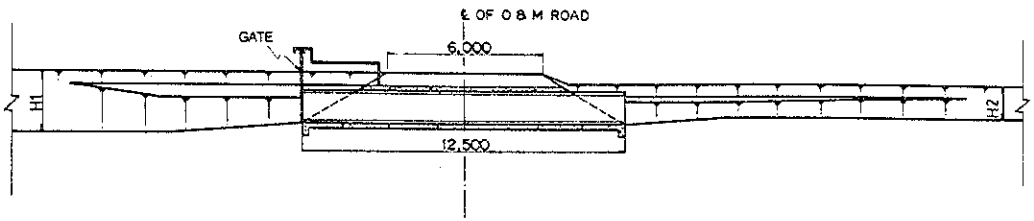
DIMENSION TABLE

Canal Name	B1 (mm)	H1 (mm)	B2 (mm)	H2 (mm)	D (mm)
D/Abu xx-3.1	1,000	2,000	500	700	500
D/Abu xx-3.2	1,000	2,000	300	500	350
D/Abu xx-6.1	2,000	2,000	300	600	350
D/Abu xx-6.2	2,000	2,000	500	700	500
D/Abu xx No.1	1,500	1,800	300	600	350
D/Abu xx No.2	1,500	1,700	500	600	500

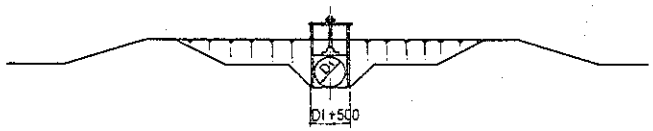
Fig. 5.9 WELL-HEAD REGULATOR



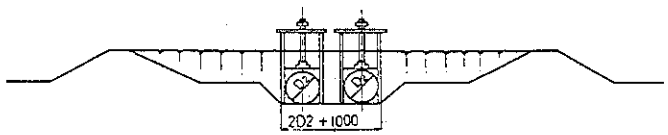
PLAN



LONGITUDINAL SECTION



SECTION A-A
(SINGLE PIPE)

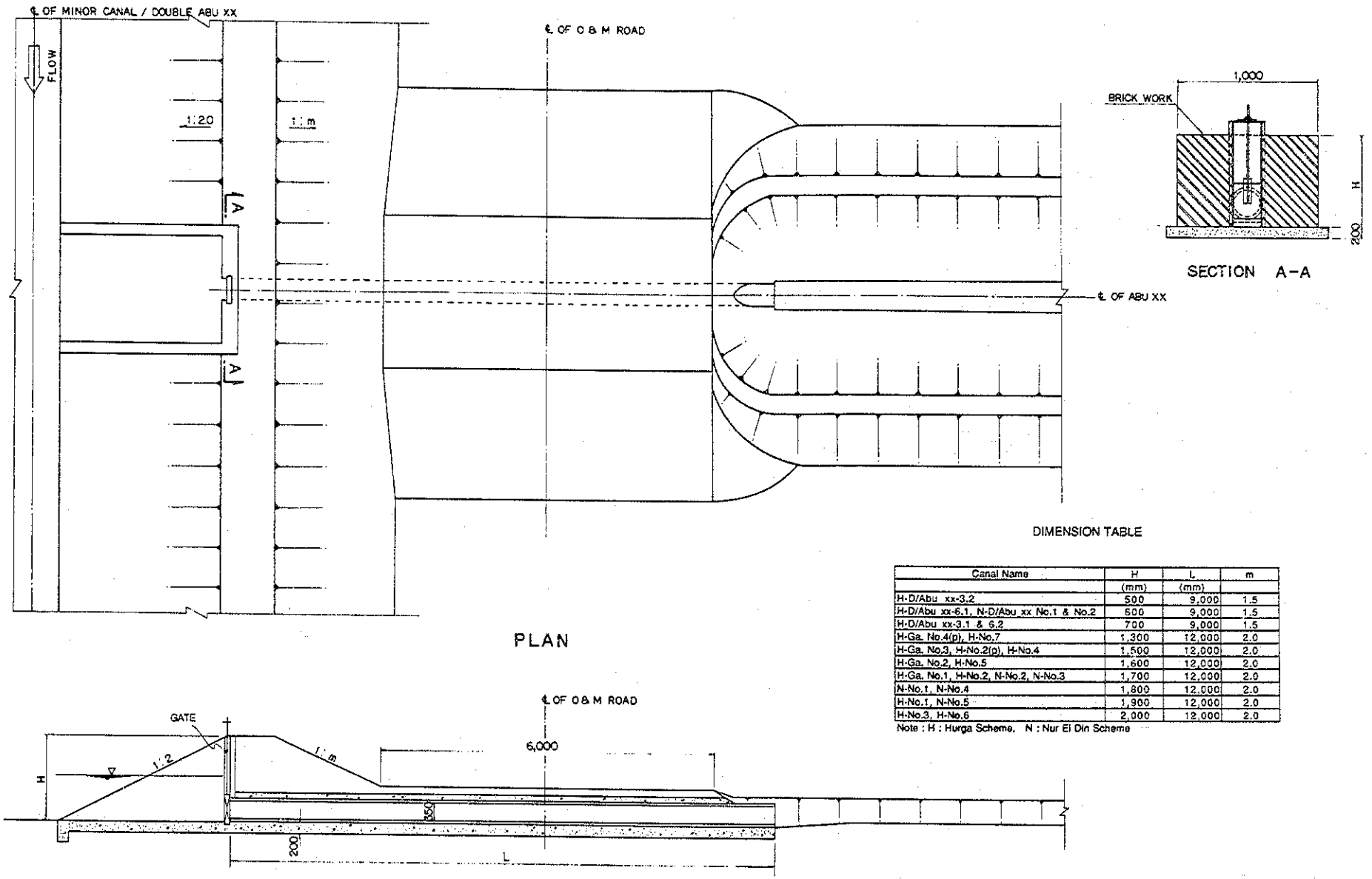


SECTION A-A
(DOUBLE PIPE)

DIMENSION TABLE

TYPE	Q (m3/s)	B1 (mm)	H1 (mm)	B2 (mm)	H2 (mm)	D1 (mm)	D2 (mm)
A	0.0 - 0.2	500	1,300 - 1,500	500	1,300 - 1,500	500	-
B	0.2 - 0.5	500, 1,000	1,500 - 1,900	500, 1,000	1,500 - 1,900	760	-
C	0.5 - 1.0	1,000, 1,500	1,700 - 2,000	1,000, 1,500	1,700 - 2,000	910	-
D	1.0 - 1.5	2,000	2,000	2,000	2,000	1,010	-
E	1.5 - 2.0	2,000	2,000	2,000	1,900	-	1,240
F	2.0 -	4,000	2,000	1,500	1,900	-	1,240

Fig. 5.10 CROSS REGULATOR (PIPE REGULATOR)



DIMENSION TABLE

Canal Name	H (mm)	L (mm)	m
H-D/Abu xx-3.2	500	9,000	1.5
H-D/Abu xx-6.1, N-D/Abu xx No.1 & No.2	600	9,000	1.5
H-D/Abu xx-3.1 & 6.2	700	9,000	1.5
H-Ga. No.4(p), H-No.7	1,300	12,000	2.0
H-Ga. No.3, H-No.2(p), H-No.4	1,500	12,000	2.0
H-Ga. No.2, H-No.5	1,600	12,000	2.0
H-Ga. No.1, H-No.2, N-No.2, N-No.3	1,700	12,000	2.0
N-No.1, N-No.4	1,800	12,000	2.0
H-No.1, N-No.5	1,900	12,000	2.0
H-No.3, H-No.6	2,000	12,000	2.0

Note : H : Hurga Scheme, N : Nur El Din Scheme

Fig. 5.11 FIELD OUTLET PIPE

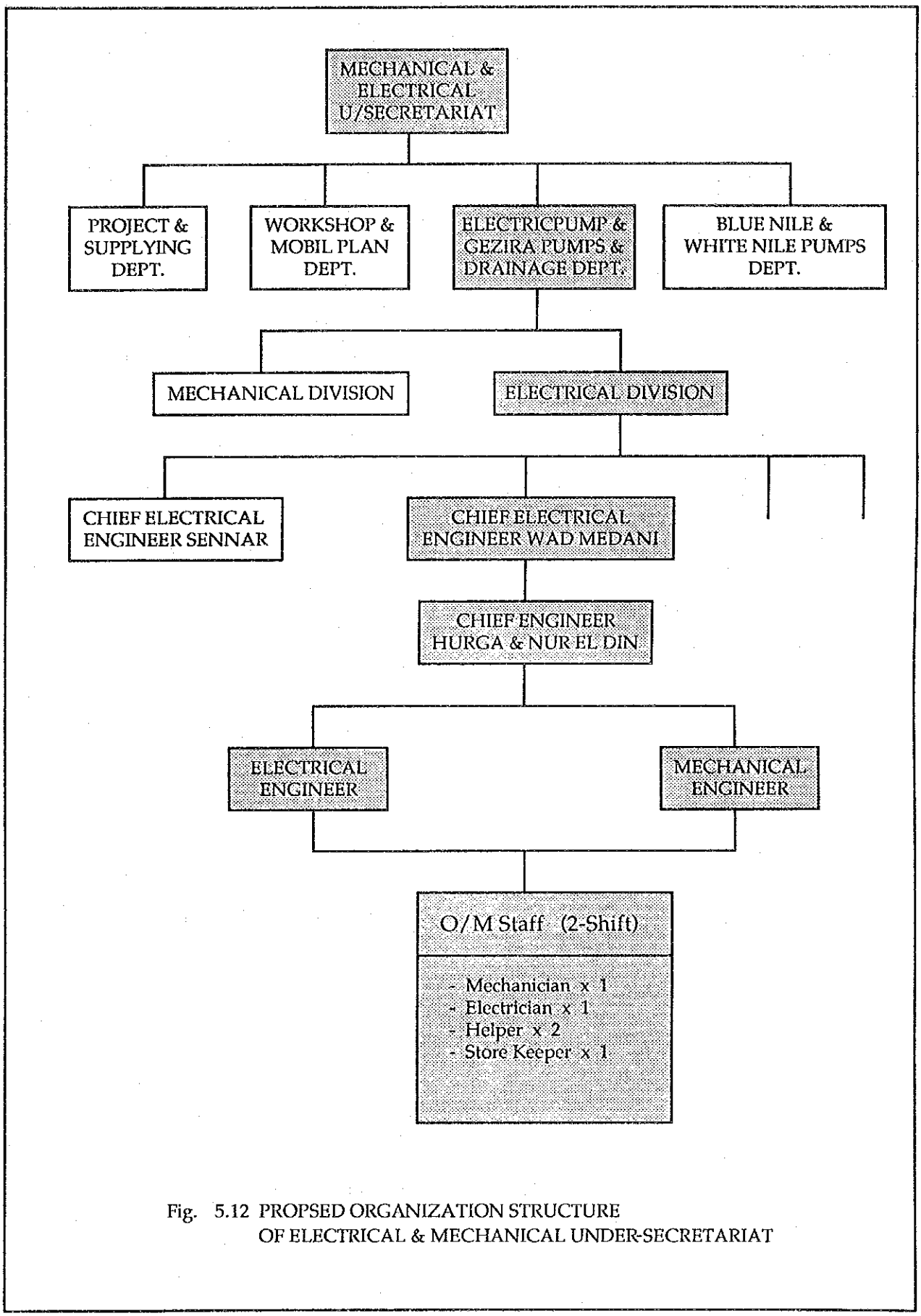


Fig. 5.12 PROPSED ORGANIZATION STRUCTURE
OF ELECTRICAL & MECHANICAL UNDER-SECRETARIAT

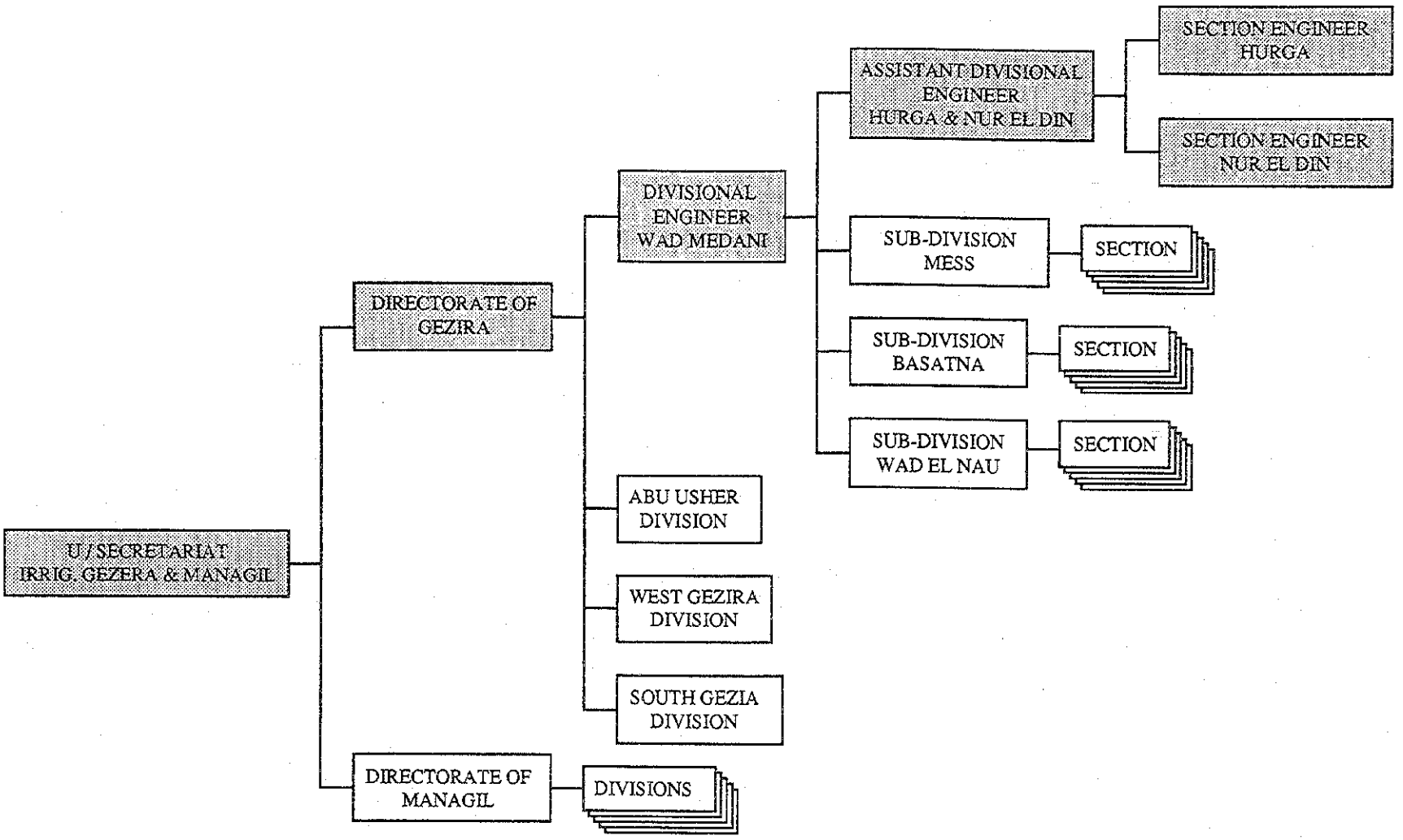
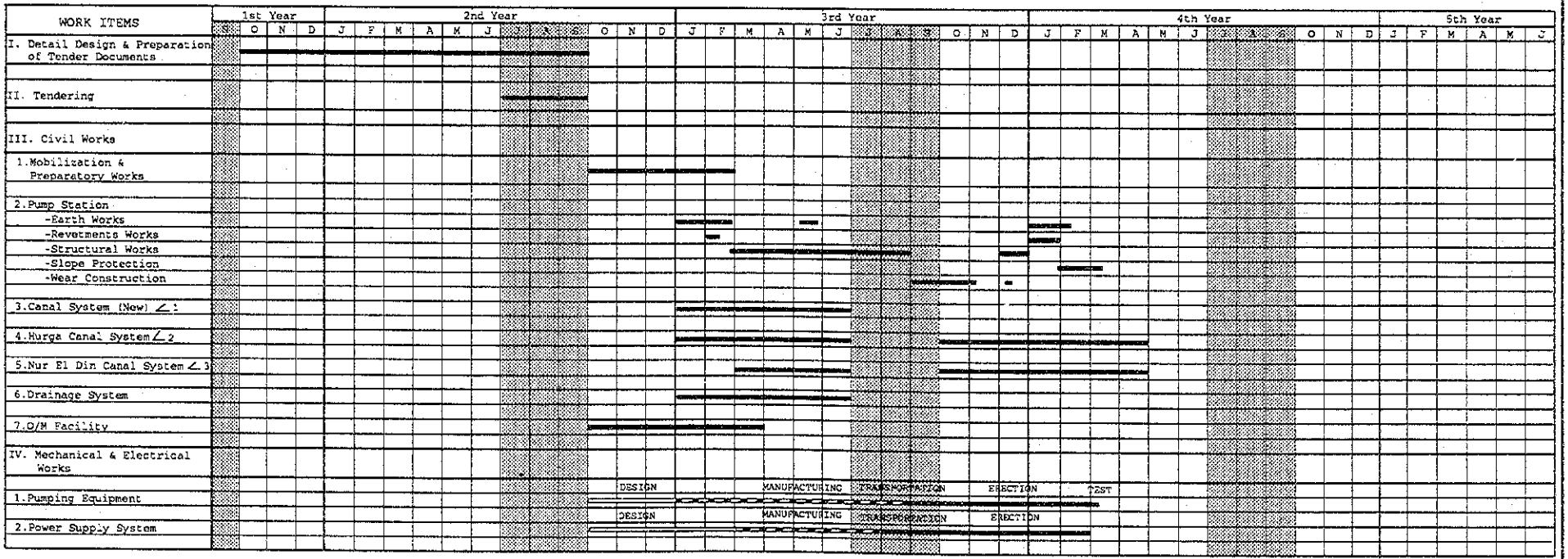


Fig. 5.13 PROPOSED ORGANIZATION STRUCTURE IRRIGATION, GEZIRA & MANAGIL



NOTES:

1 :Link canal and new construction portion of main canal
2 :Rehabilitation of existing irrigation canal system in Hurga scheme
3 :Rehabilitation of existing irrigation canal system in Nur El Din scheme

Fig. 6.1 IMPLEMENTATION SCHEDULE

ATTACHMENT

SCOPE OF WORK
FOR
THE FEASIBILITY STUDY
ON
HURGA AND NUR EL DIN PUMP SCHEME REHABILITATION PROJECT
IN
THE REPUBLIC OF THE SUDAN

AGREED UPON BETWEEN

MINISTRY OF IRRIGATION

AND

THE JAPAN INTERNATIONAL COOPERATION AGENCY

KHARTOUM , SUDAN 18th, DECEMBER, 1989

MR. ISSAM MUSTAFA ACTING FIRST UNDERSECRETARY MINISTRY OF IRRIGATION	DR. MOHAMED KHEIR EL-ZUBEAR FIRST UNDERSECRETARY FOR PLANNIG MINISTRY OF FINANCE AND ECONOMIC PLANNING	MR. YUJI SAKAMOTO LEADER OF THE PRERIMINARY SURVEY TEAM THE JAPAN INTERNATIONAL COOPERATION AGENCY

I . INTRODUCTION

In response to the request of the Government of the Republic of the Sudan (hereinafter referred to as "the Government of Sudan "), the Government of Japan decided to conduct the feasibility study on Hurga and Nur El Din Pump Scheme Rehabilitation Project (hereinafter referred to as"the Study") in accordance with the relevant laws and regulations in force in Japan. Accordingly, the Japan International Cooperation Agency (hereinafter referred to as"JICA"), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, will undertake the Study in close cooperation with the authorities concerned of the Government of Sudan .

The present document sets forth the scope of work with regard to the Study.

II . OBJECTIVE OF THE STUDY

The objective of the study is to conduct the feasibility study on Hurga and Nur El Din Pump Scheme Rehabilitation Project.

III . OUTLINE OF THE STUDY

1. Study Area

The study area shall cover the Hurga and Nur El Din Pump Scheme Rehabilitation Project area of about 9400ha which is located to the right bank of the Blue Nile about 30 km Southeast of Wad Medani in Central Province.

2. Scope of the Study

The Study will be divided into the following two works.

Work- I : Data collection, survey, investigation and formulation of basic concept of the project

Work- II : Formulation of a rehabilitation plan

Major work items of each works are;

1. Work- I (Work in Sudan)

(1). Data collection and field survey

To collect and review data and information relevant to the Study and to carry out field survey on the followipg items;

A) Natural condition

a. Topography

b. Meteorology

C. Hydrology

d. Geology

e. Soil

f. Vegetation

g. Water quality

B) Irrigation and drainage system

a. Existing pump facilities

b. Irrigation and drainage system

c. Operation and maintenance system

d. Water requirement

e. Power supply

C) Agriculture

a. Land use

b. Land holding

c. Farming

d. Cropping pattern

e. Yield

f. Agricultural support system

D) Agro-economy

a. Farmers' income and productivity

b. Marketing

c. Regional economy

d. Social and institutional aspect

E) Programes

a. Regional and national development plans relevant to the project

F) Others

a. Construction cost

b. Operation and maintenance cost

(2) Formulate basic concept of the project

a) Rehabilitation plan

b) Irrigation and drainage plan

c) Basic layout of major facilities

d) Power supply

2. Work- II (Work in Japan)

(1) Formulate the rehabilitation plan of the project on the basis of the results of the study on data and information collected through field survey and investigation, as follows;

A) Formulation of the following plans

a) Land use and classification

b) Selection of crops, cropping pattern and farming

c) Pump facilities

d) Power supply

e) Agricultural infrastructure

-Irrigation and drainage facilities

-Farm road

f) Water management

g) Others

B) Preliminary design of the major structure

C) Implementation schedule of the project

D) Organization and institutional plan for operation and maintenance

E) Estimation of the project cost and benefit

F) Project evaluation

IV. STUDY SCHEDULE

The Study shall be executed in accordance with the attached tentative work schedule.

V. REPORTS

JICA will prepare and submit the following reports in English to the Government of Sudan.

(1) Inception Report

Twenty (20) copies at the commencement of the field work in the Work- I

(2) Interim Report

Twenty (20) copies at the end of the Work-I

(3) Draft Final Report

Twenty (20) copies at the end of the Work-II

The Government of Sudan provides JICA with its comments on the

Draft Final Report through the Embassy of Japan within one (1)month after the receipt of the Draft Final Report

(4) Final Report

Fifty (50) copies within two (2) months after receiving the comments on the Draft Final Report.

VI. UNDERTAKING OF THE GOVERNMENT OF SUDAN

1. To facilitate smooth conduct of the Study, the Government of Sudan will take necessary measures;

(1) to secure the safety of the Study team,

(2) to permit the members of the Japanese study team to enter, leave and sojourn in Sudan for the duration of their assignment therein, and assist them in alien registration requirements during the period of the study and consular fees,

(3) to exempt the members of the Japanese study team from taxes, duties, fees and other charges on equipment, machinery and other materials brought into Sudan for the conduct of the Study, in this case those equipment and etc. will be re-exported to Japan,

(4) to exempt the members of the Japanese study team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Japanese study team for their services in connection with the implementation of the Study,

(5) to provide necessary facilities to the Japanese study team for remittances as well as utilization of the funds introduced into Sudan from Japan in connection with the implementation of the Study,

(6) to secure permission for entry into private properties or restricted areas for the conduct of the Study,

(7) to secure permission for the Japanese study team to take all data documents related to the Study including photographs out of Sudan to Japan, and

(8) to provide medical services as needed. Its expenses will be chargeable to members of the Japanese study team.

2. The Government of Sudan shall bear claims, if any arises against the members of the Japanese study team resulting from, occuring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or wilful misconduct on the part of the members of the Japanese study team.

3. Ministry of irrigationion (hereinafter referred to as"MOI") shall act as counterpart agency to the Japanese study team and also as coordination body in relation with other governmental and non-governmental organization concerned for smooth implementation of the Study.

4. MOI shall, at its own expense, provide the Japanese study team with the following in cooperation with other agencies concerned;

(1) available data and information related to the Study,

(2) additional survey related to the Study, if necessary,

(3) counterpart personnel to participate in the various activities for the Study,

(4) suitable office space with necessary equipment and furniture in Khartoum and the Project site,

(5) appropriate number of vehicles with drivers and fuel, and

(6) credentials or identification cards to the members of the study team.

VII. UNDERTAKING OF JICA

For the implementation of the Study, JICA shall take the following measures;

1. to dispatch, at its own expense, study team to Sudan, and
2. to pursue technology transfer to the Sudanese counterpart personnel in the course of the Study.

VIII. OTHERS

JICA and MOI will consult with each other in respect of any matter that may arise from or in connection with the Study.

APPENDIX

TENTATIVE WORK SCHEDULE

DESCRIPTION	MONTH												
	1	2	3	4	5	6	7	8	9	10	11	12	13
I. Work – I	▬	▬	▬										
II. Work – II				▭	▭	▭	▭						
III. Explanation of Draft Final Report							▬						
IV. Reports	△ IC/R			△ IT/R			△ DF/R			△ F/R			

IC/R: Inception Report

DF/R : Draft Final Report

P/R : Progress Report

IT/R : Interim Report

F/R : Final Report

▬ Work in Sudan

▭ Work in Japan

MINUTES OF MEETING
ON
SCOPE OF WORK
FOR
THE FEASIBILITY STUDY
ON
HURGA AND NUR EL DIN PUMP SCHEME REHABILITATION PROJECT
IN
THE REPUBLIC OF THE SUDAN

KHARTOUM, SUDAN, 18th DECEMBER, 1989

MR. ISSAM MUSTAFA
ACTING FIRST UNDERSECRETARY
MINISTRY OF IRRIGATION

MR. YUJI SAKAMOTO
LEADER OF THE PRELIMINARY SURVEY
TEAM
JAPAN INTERNATIONAL COOPERATION
AGENCY

MINUTES OF MEETING

The Japanese Preliminary Study Team (hereinafter referred to as "The Team") sent by the Japan International Cooperation Agency (hereinafter referred to as "JICA") headed by Y. SAKAMOTO visited the Republic of The Sudan from December 10 to 18, 1989 for the purpose of discussion on the scope of work for the Feasibility Study on the Hurga and Nur El Din Pump Scheme Rehabilitation Project (hereinafter referred to as "The study").

The Team had a series of discussions with representatives from Ministry of Irrigation (hereinafter referred to as "the MOI") and the Ministries concerned, and carried out field survey of the study area.
The list of attendants of the meeting is shown in Appendix.
The main items of mutual understanding are as follows:

1. The study area shall cover the existing Hurga and Nur El Din Pump Irrigation area of about 9400ha.

2. The team was requested and promised to convey the following to JICA headquarters for consideration;
   1) to provide necessary equipment for the study,
   2) to provide additional vehicles, as MOI is limitted in providing two vehicles only to the study team,
      It is requested that these vehicles and equipment will be handed over to MOI at the completion of the study, and
   3) to accept a few counterpart personnel for training in Japan.

-APPENDIX-

LIST OF ATTENDANTS

SUDANESE SIDE

MINISTRY OF FINANCE & ECONOMIC PLANNING (MOFEP)

Dr. Mohamed Kheir El-Zubear	First Undersecretary for Planning
Mr. Hashim Mohamed Zain	Assistant Undersecretary
Mr. Mohamed Saeid Abdalla	Inspector
Mr. Babikir Abi Abdalla	Agricultural Section

MINISTRY OF IRRIGATION(MOI)

Mr. Tagel Sir Ahmed	First Undersecretary
Mr. Issam Mustafa	Acting First Undersecretary
Mr. Osman Mohamed Kheir	Undersecretary for Projects
Mr. Gafar Mahgoub	Undersecretary for Irrigation Services
Mr. Ahamed Mohamed Bashir	Undersecretary for Mechanic & Electric
Dr. Siddig Hussein Abbo	Deputy Director of Planning

JAPANESE SIDE

JICA Preliminary Survey Team

Mr. Yuji Sakamoto	Team Leader
Mr. Shirou Hirabayashi	Member of Team
Mr. Yoshinobu Matsuo	〃
Mr. Yasuhiro Fujita	〃
Mr. Shigemitsu Tsukamoto	〃

Embassy of Japan

Mr. Keiji Tomoi	Third Secretary