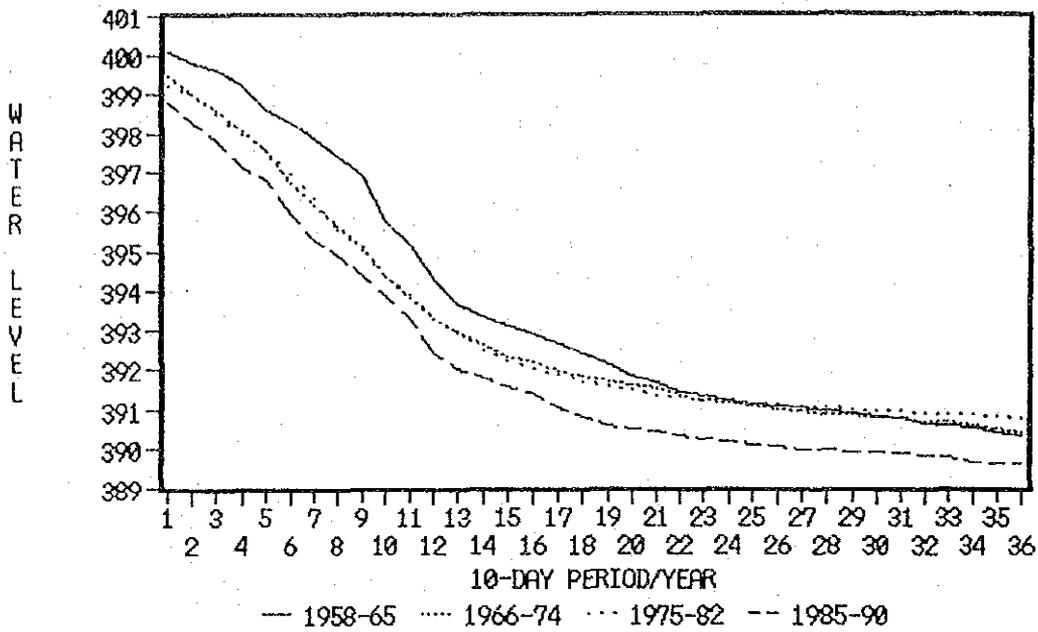


付図3.2 地質図

AVERAGE 10-DAY MEAN WATER LEVEL  
RECESSING ORDER, WAD EL NAU

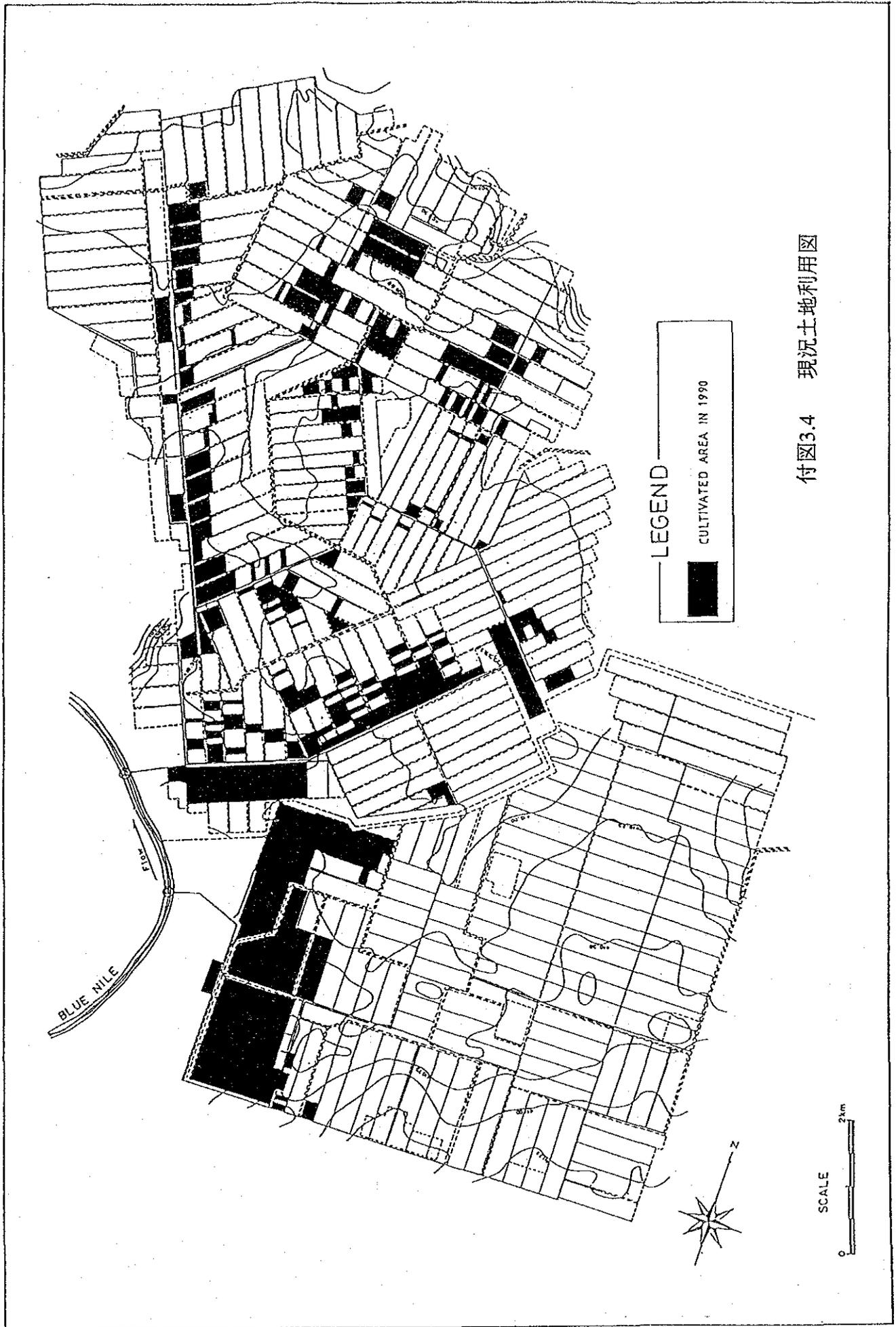


AVERAGE 10-DAY MEAN WATER LEVEL  
RIVER DATUM (RECESSING ORDER)

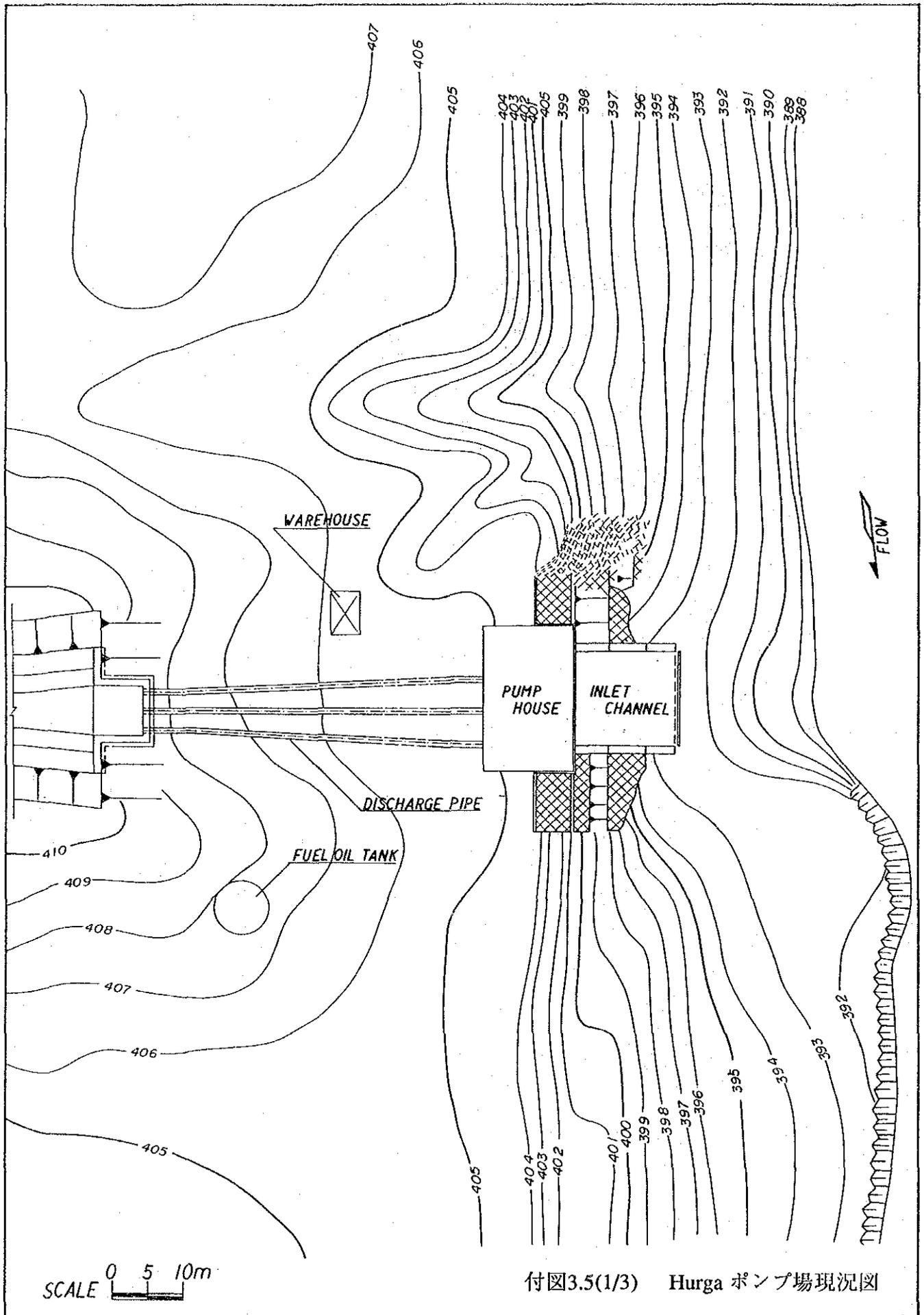
10-DAY	1958-65	66-74	75-82	85-90	10-DAY	1958-65	66-74	75-82	85-90
1	400.06	399.45	399.23	398.77	20	391.83	391.60	391.47	390.51
2	399.82	399.03	399.00	398.30	21	391.64	391.50	391.37	390.45
3	399.64	398.62	398.52	397.80	22	391.45	391.36	391.29	390.35
4	399.22	398.07	398.00	397.14	23	391.34	391.22	391.23	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

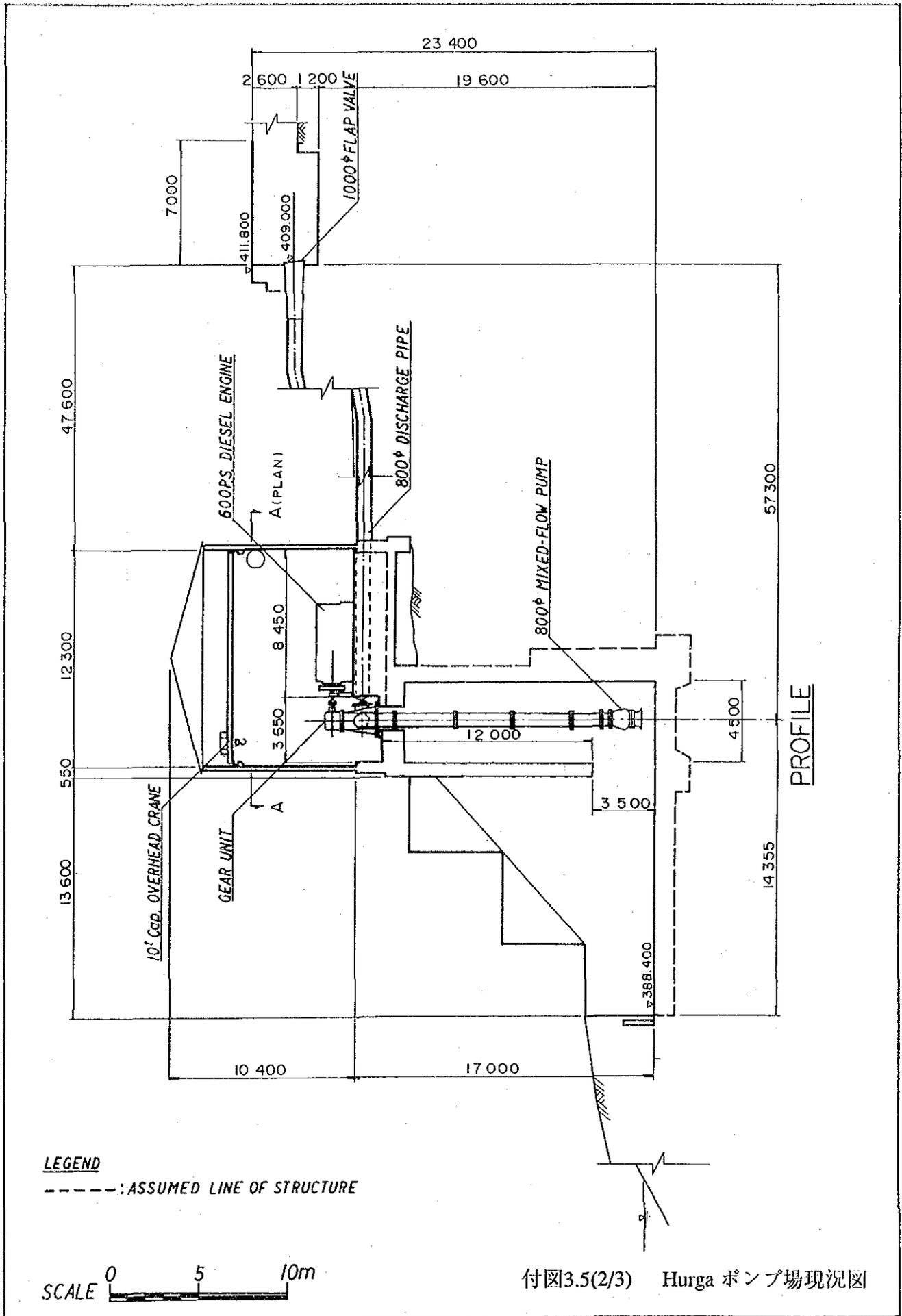
付図3.3 Wad El Nau 測水所10日平均水位

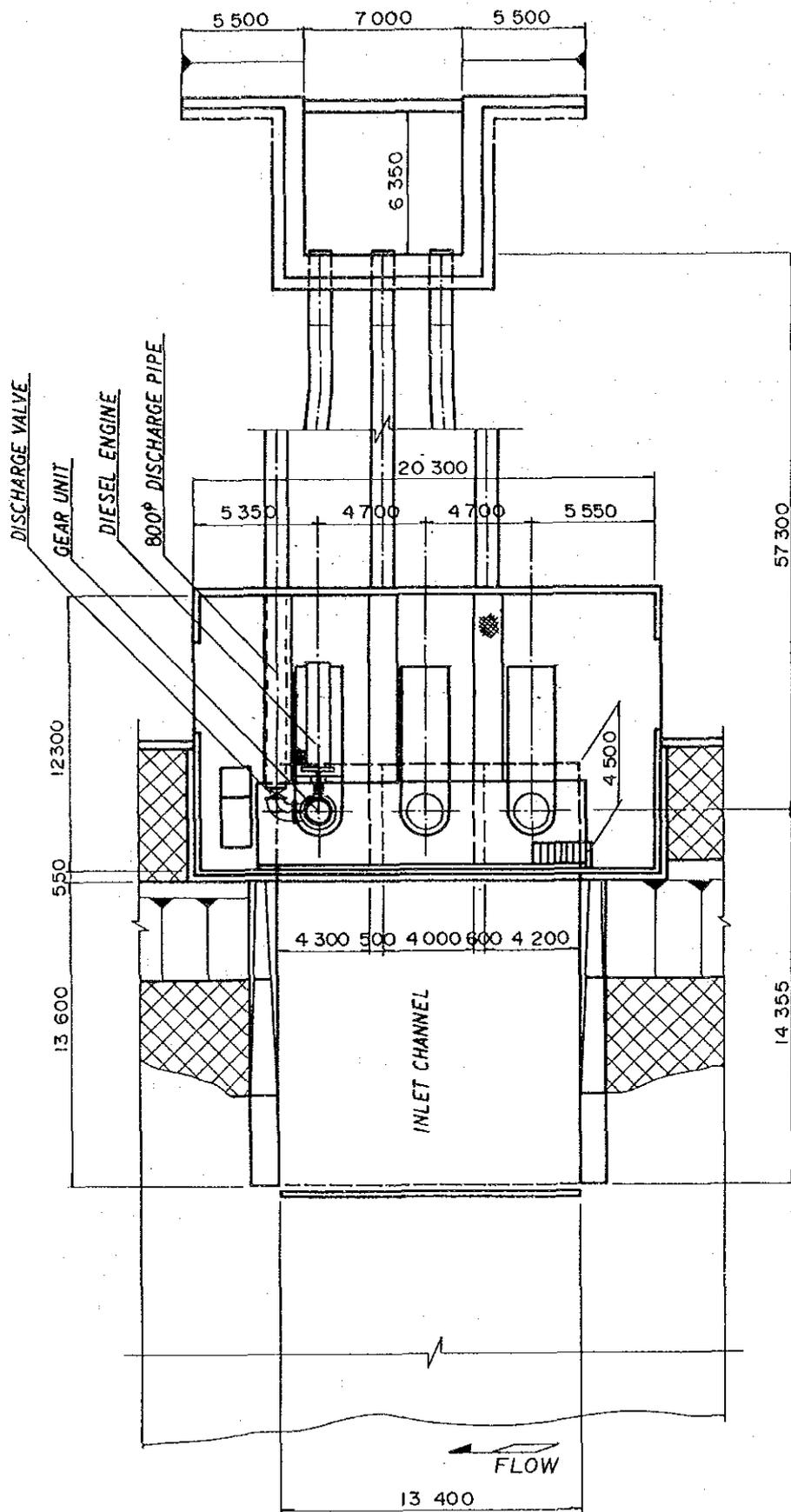


付図3.4 現況土地利用図



付図3.5(1/3) Hurga ポンプ場現況図



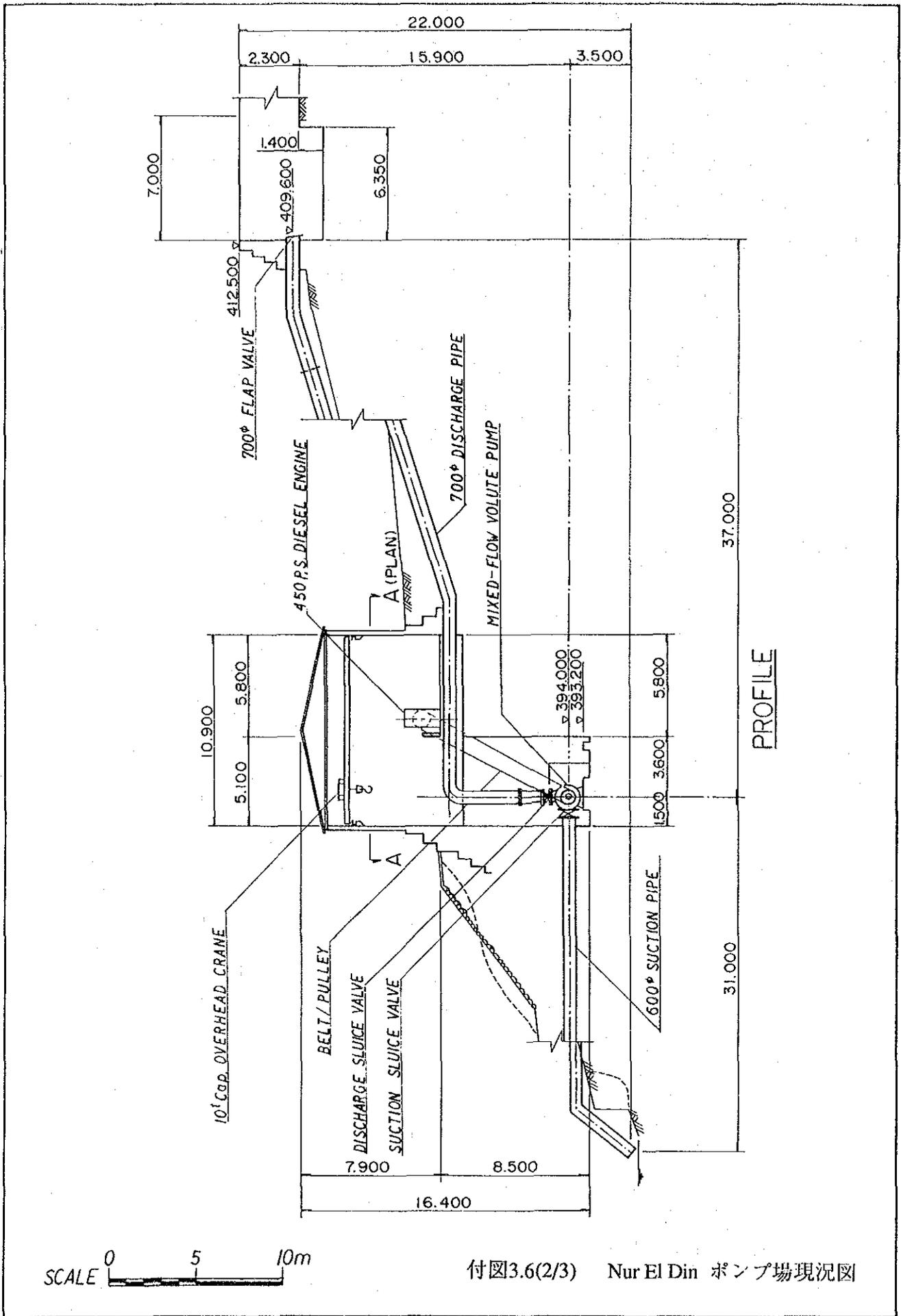


PLAN  
A-A SECTION

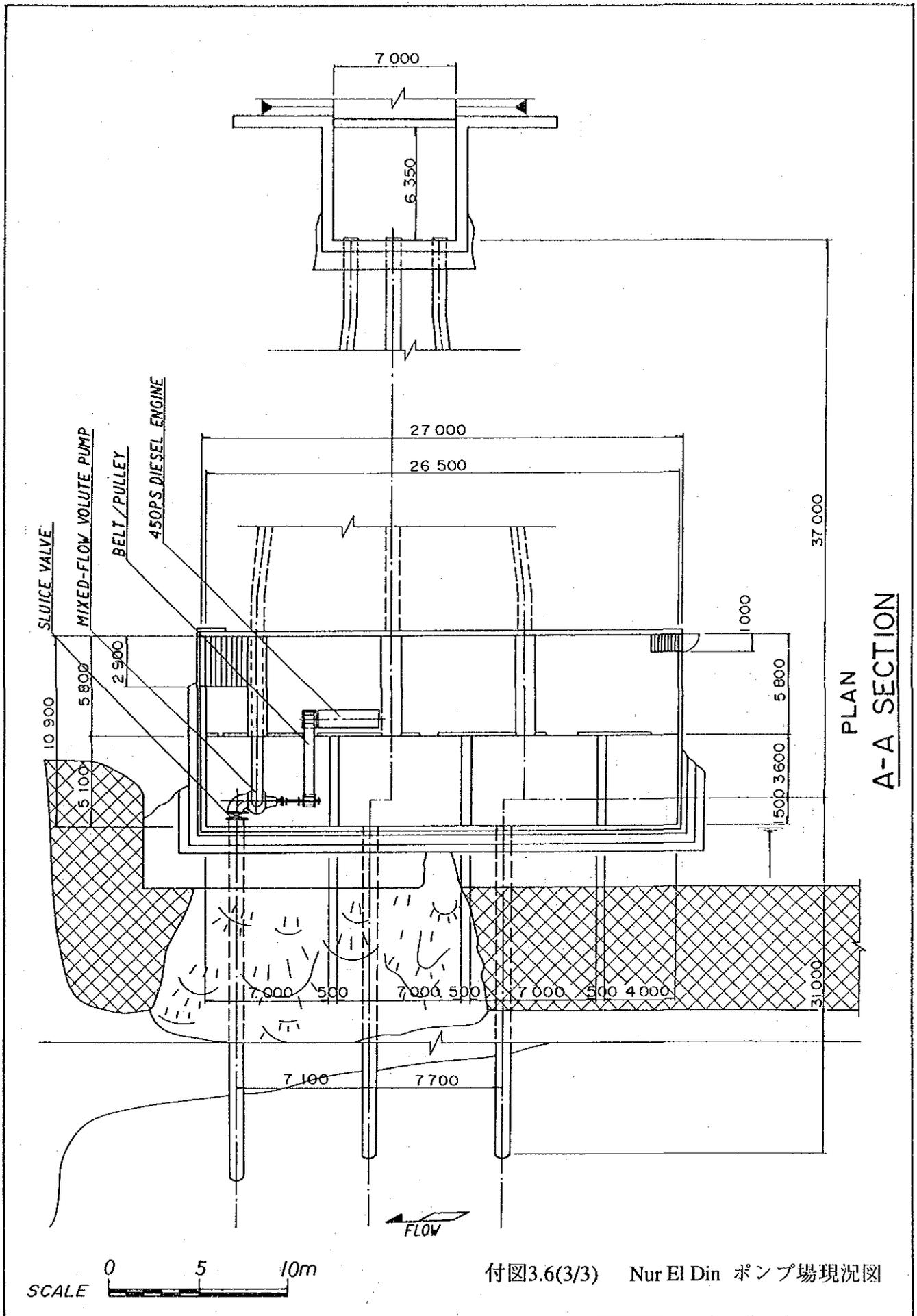
SCALE 0 5 10m

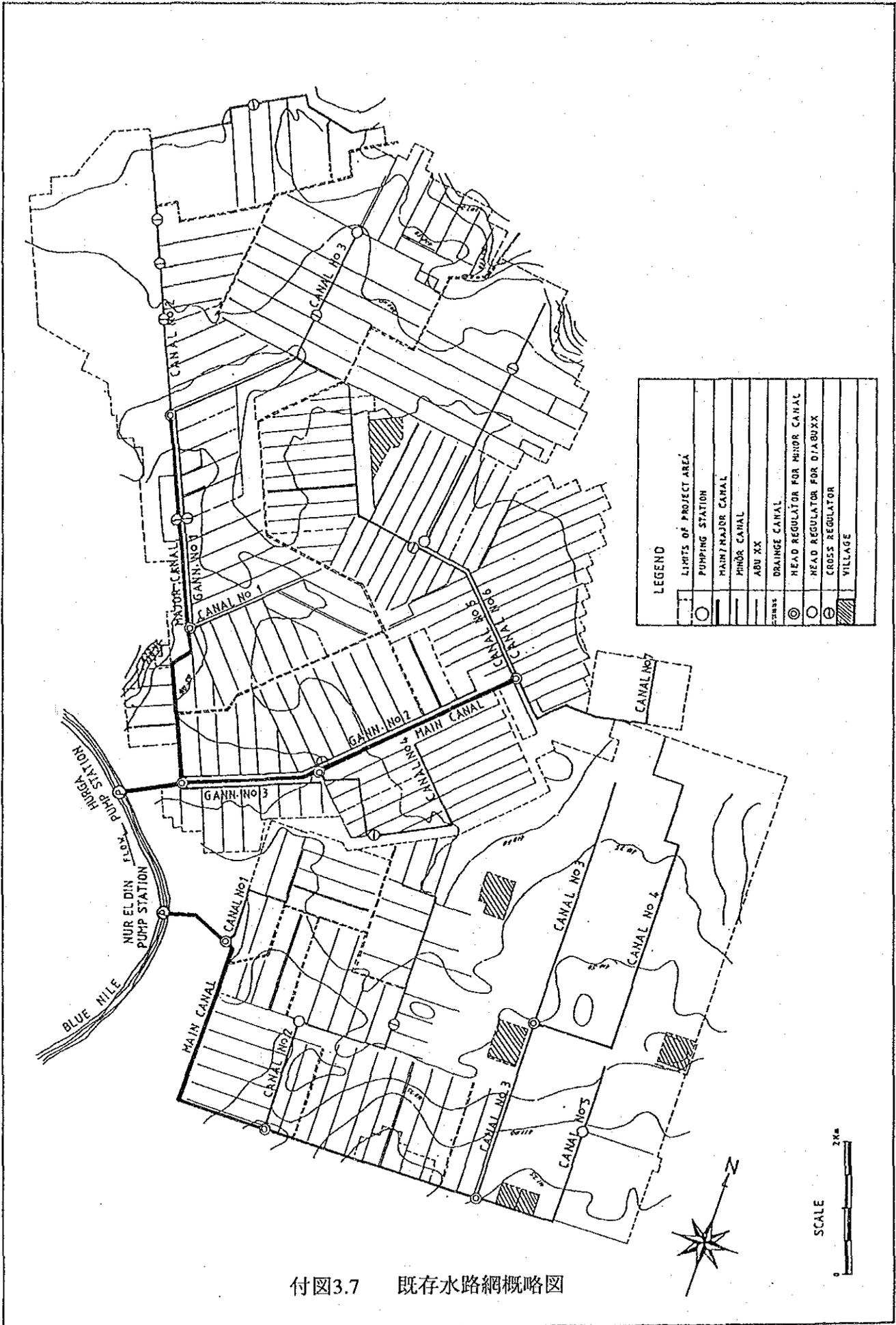
付図3.5(3/3) Hurga ポンプ場現況図



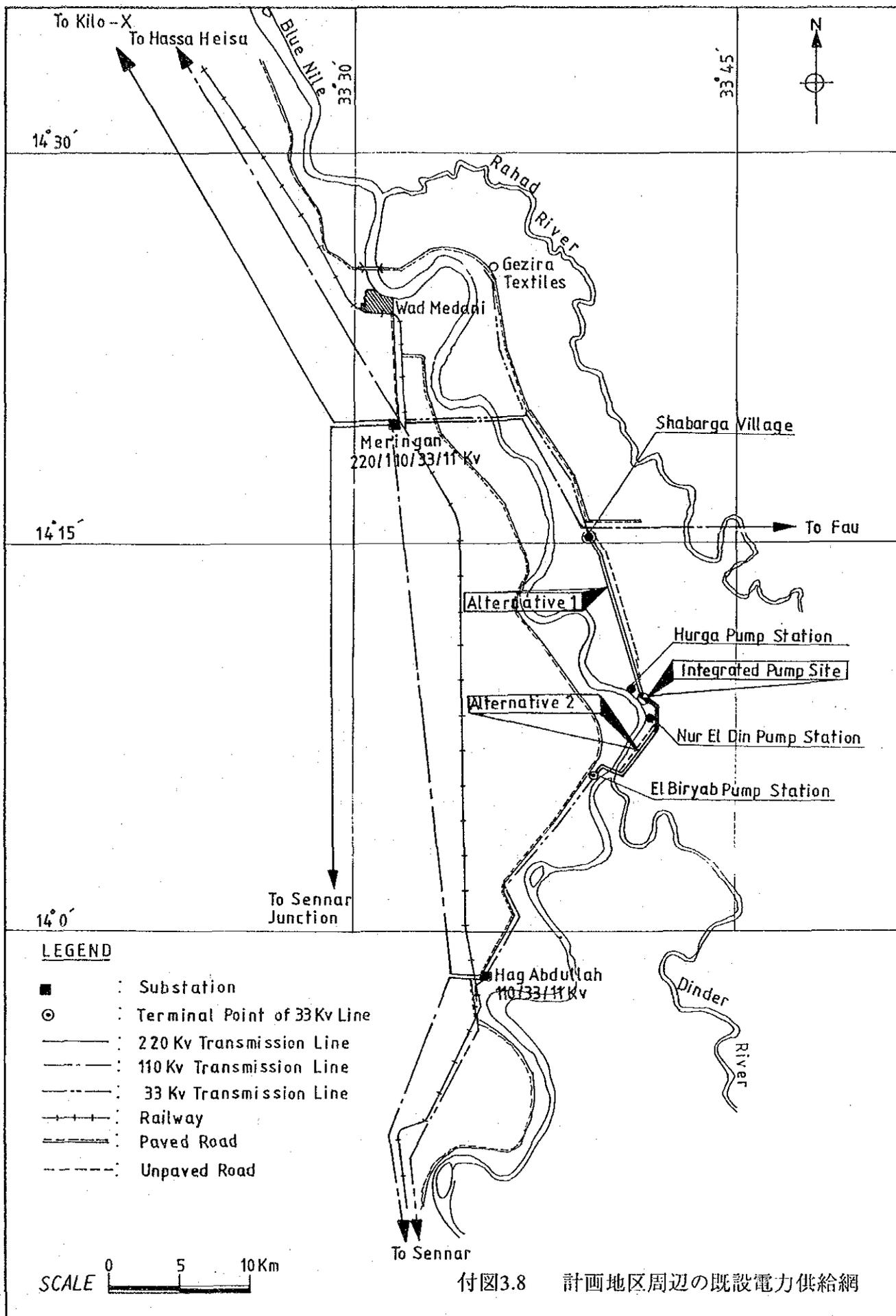


付図3.6(2/3) Nur El Din ポンプ場現況図





付図3.7 既存水路網概略図



(1) Conceivable Plans for Each Component

Prime Mover

- A1; Existing diesel engine
- A2; New diesel engine
- A3; Diesel-electric motor
- A4; Electric motor

Pumps

- B1; Vertical shaft volute pump
- B2; Vertical shaft mixed-flow pump

Pump house

- C1; Existing pump house
- C2; Individual new pump house
- C3; Integrated new pump house

(2) First Screening for Each of Components

Prime Mover

- A2
- A4

Pumps

- B1
- B2

Pump house

- C1
- C3

(3) Formulation of Alternative Plans

- Alt-1d; A2+B1+C1
- Alt-2d; A2+B1+C3
- Alt-3d; A2+B2+C3
- Alt-1e; A4+B1+C1
- Alt-2e; A4+B1+C3
- Alt-3e; A4+B2+C3

The suffixes "d" and "e" mean diesel engine driven and electric motor driven.

(4) Selection of Prime Mover

Electric motor

(5) Selection of Promising Alternative Plan

- Alt-1e; A4+B1+C1
- Alt-2e; A4+B1+C3
- Alt-3e; A4+B2+C3

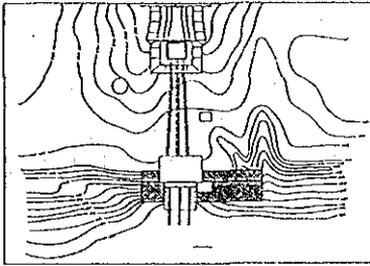
(6) Cost Evaluation

(7) Technical Evaluation

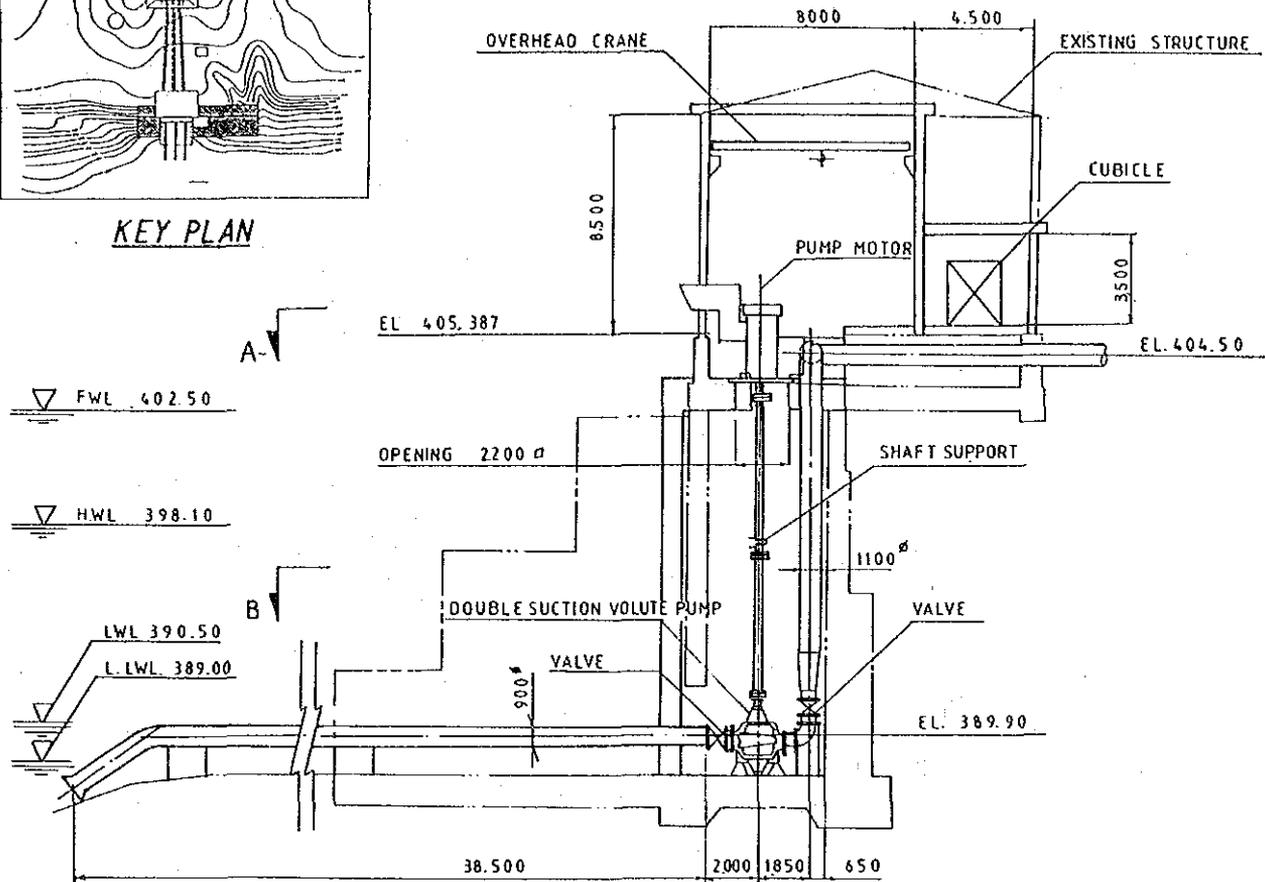
(8) Selection of Most Preferable Plan

Alt-2e; A4+B1+C3

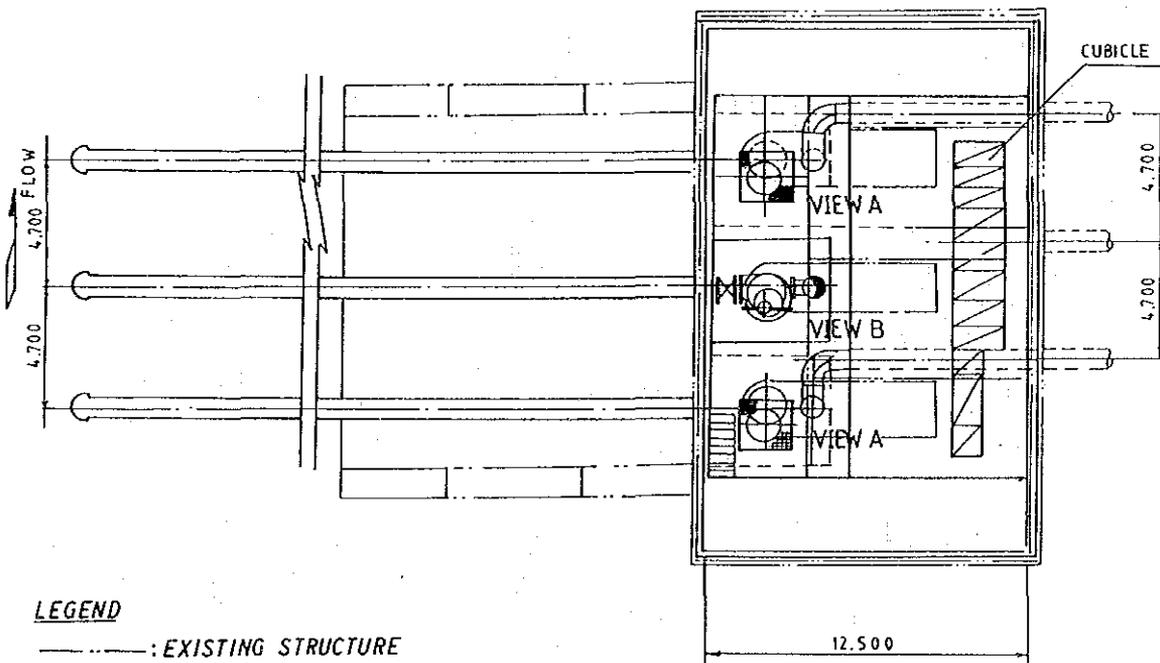
付図4.1 ポンプ場代替案比較検討の流れ図



KEY PLAN



PROFILE



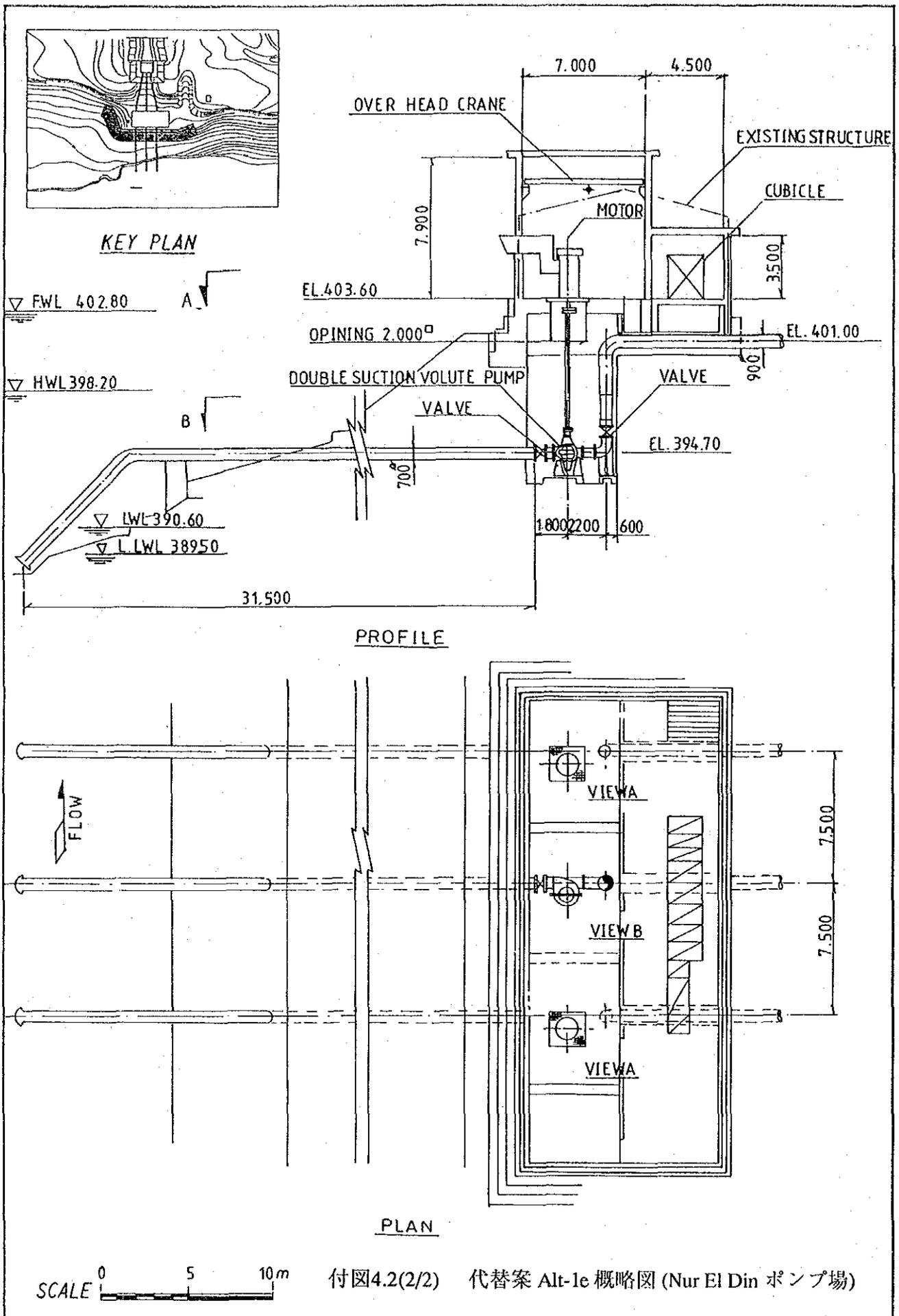
LEGEND

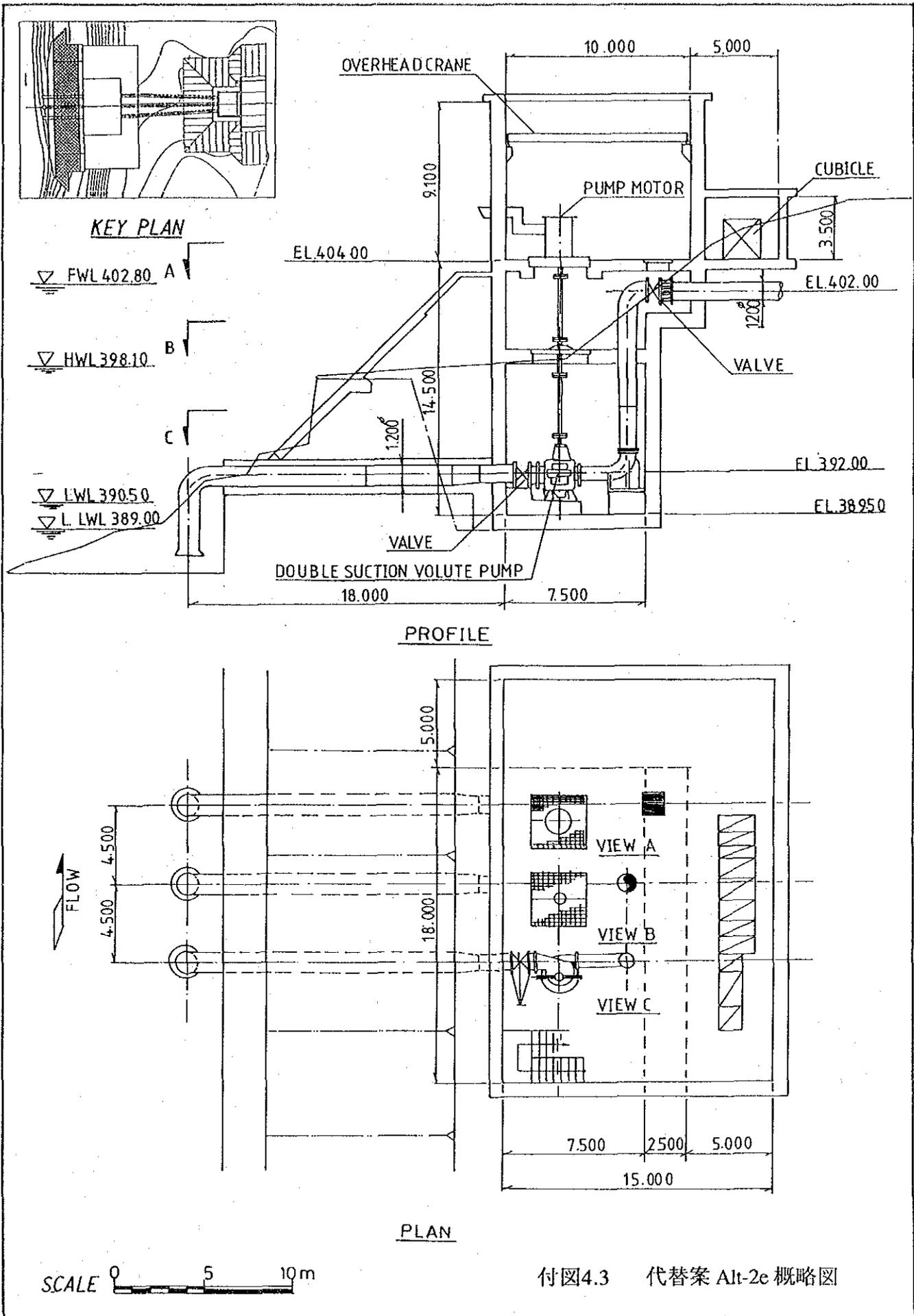
— : EXISTING STRUCTURE

PLAN

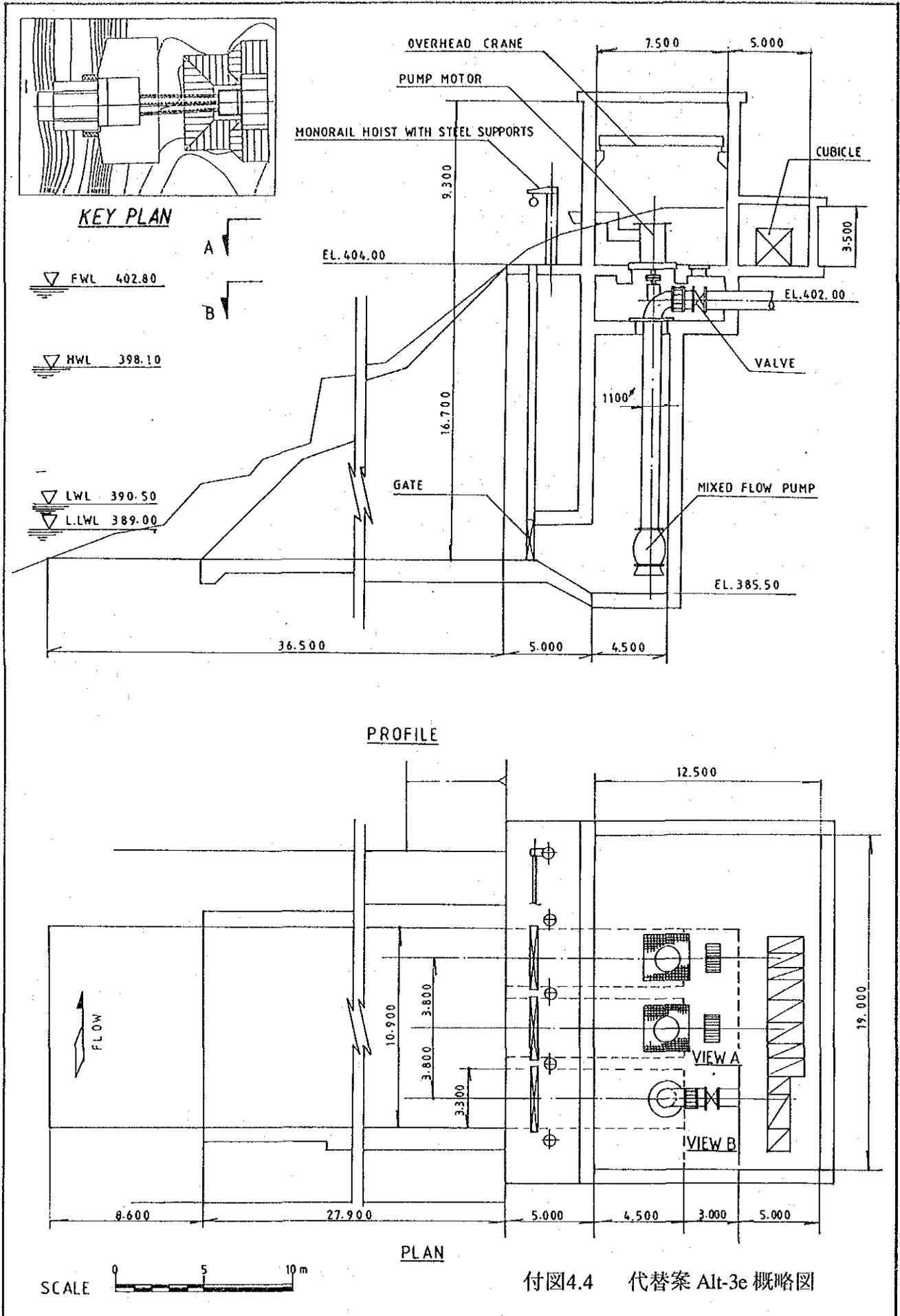


付図4.2(1/2) 代替案 Alt-1e 概略図 (Hurga ポンプ場)

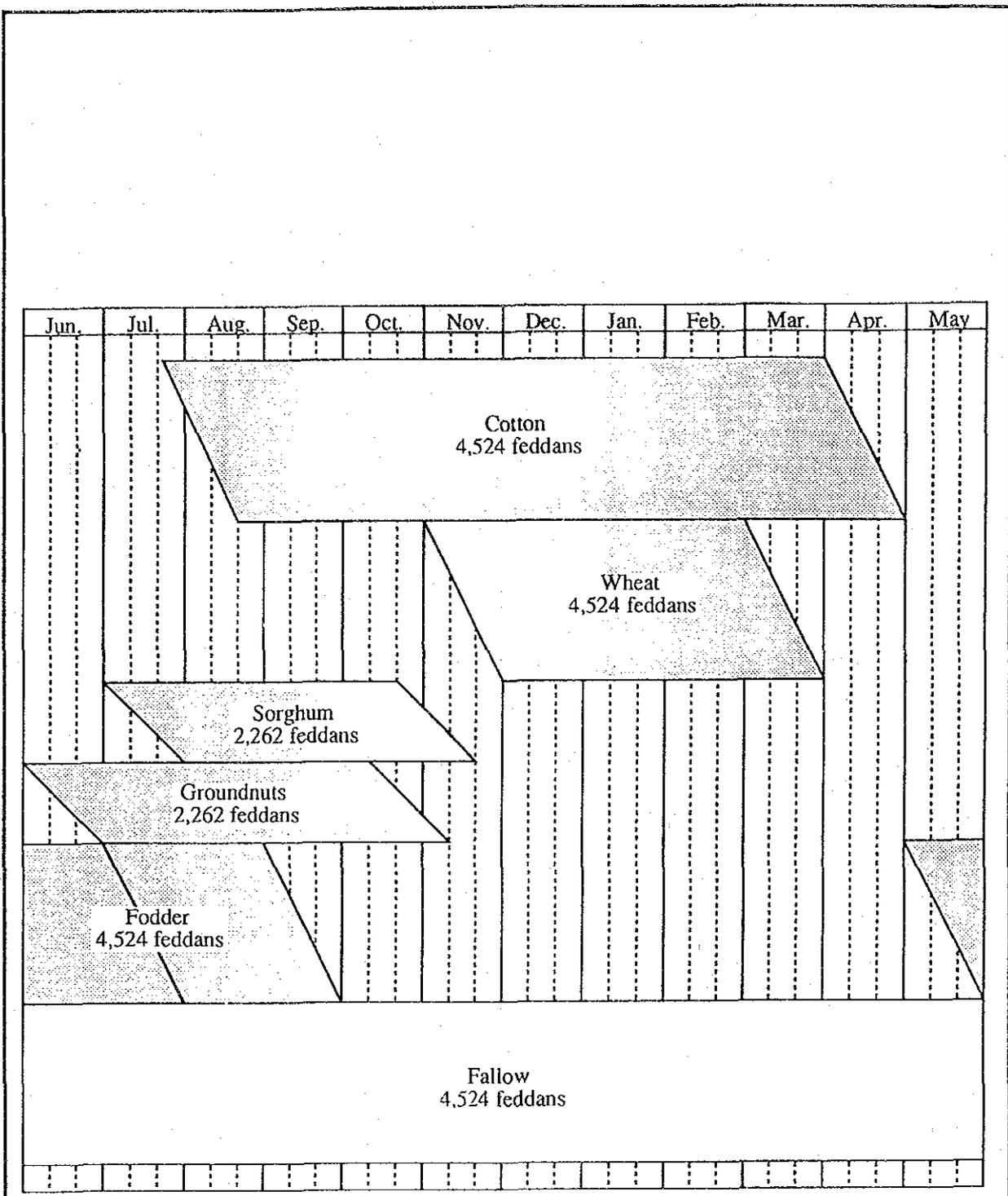




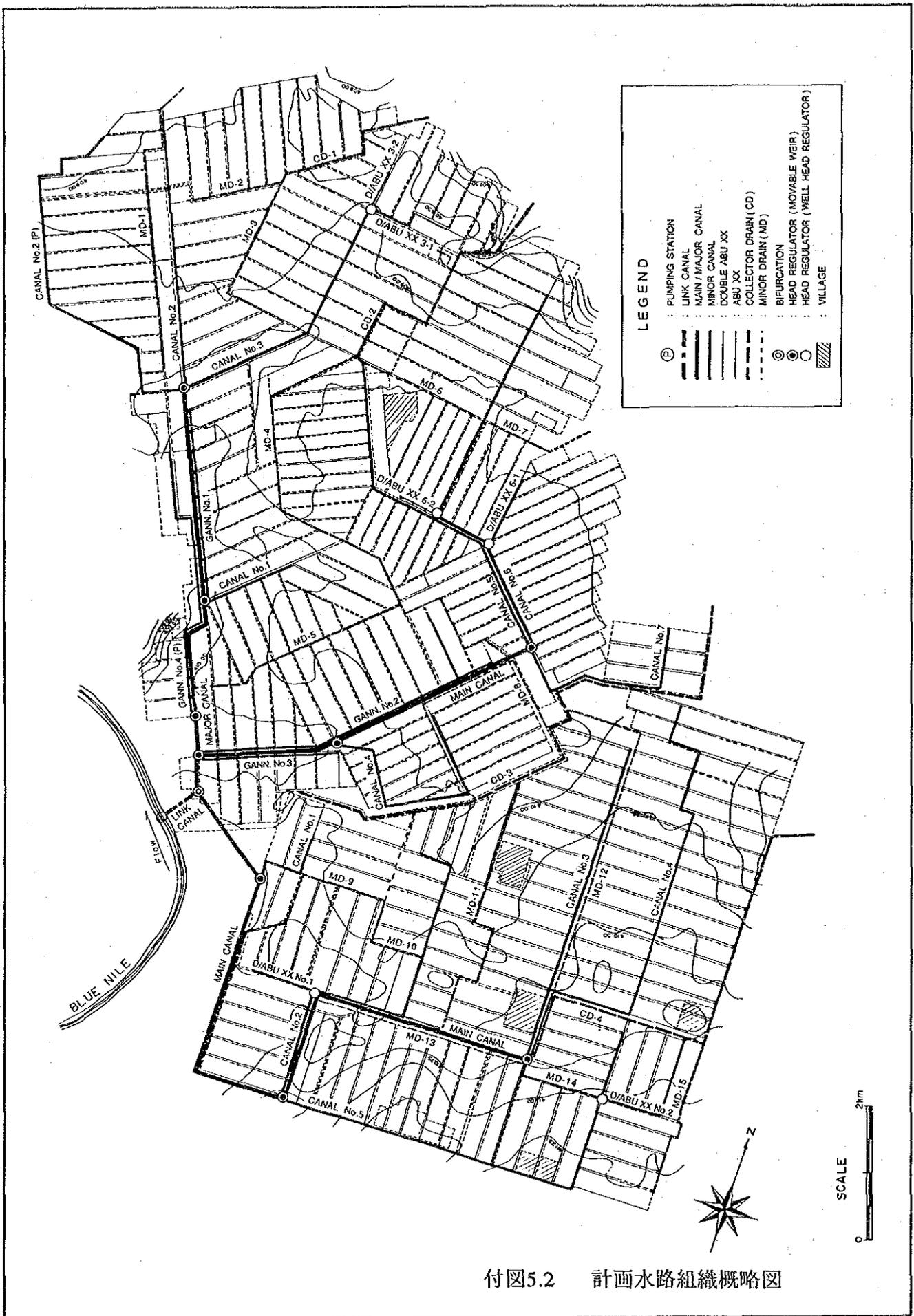
付図4.3 代替案 Alt-2e 概略図



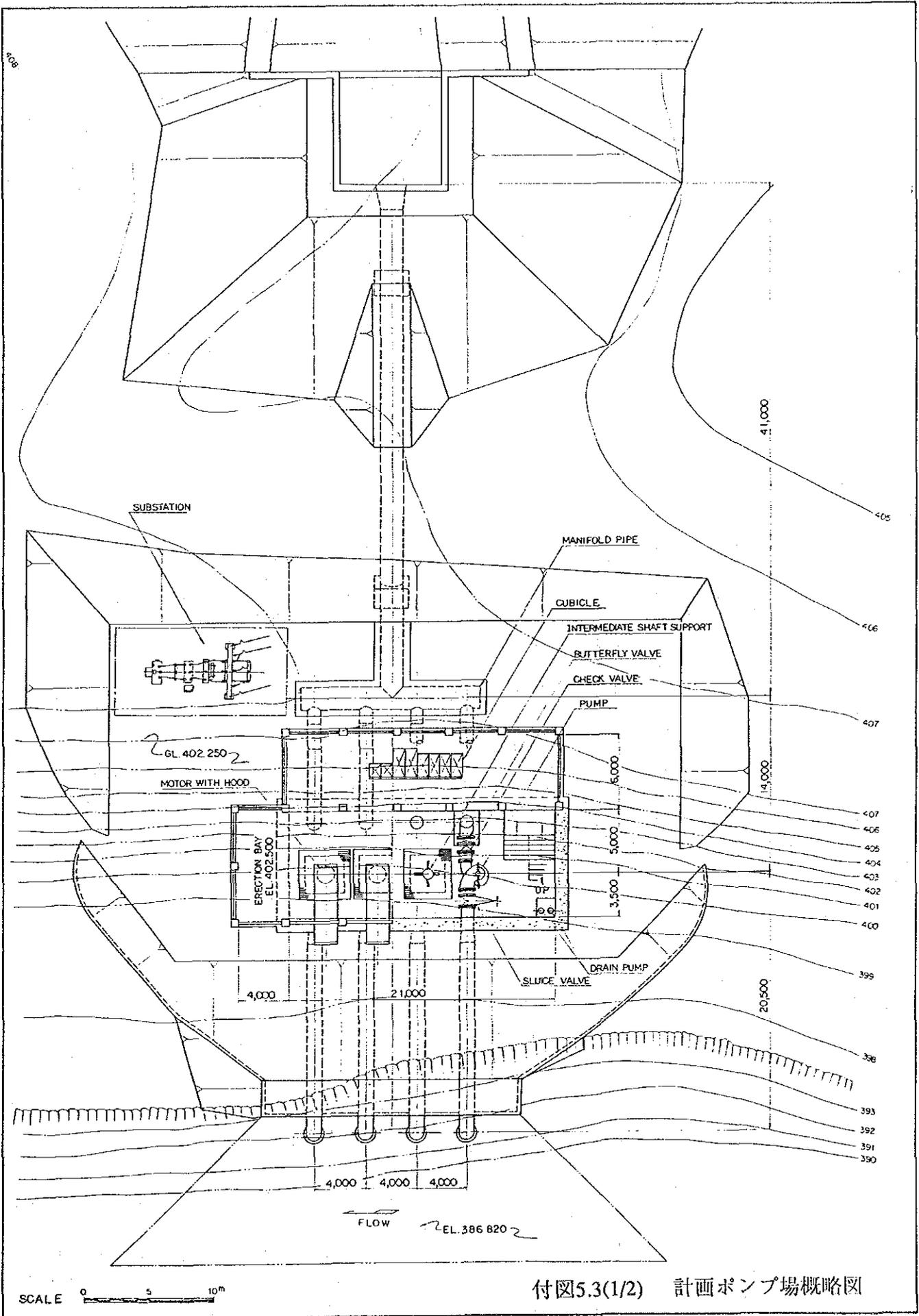
付图4.4 代替案 Alt-3e 概略图



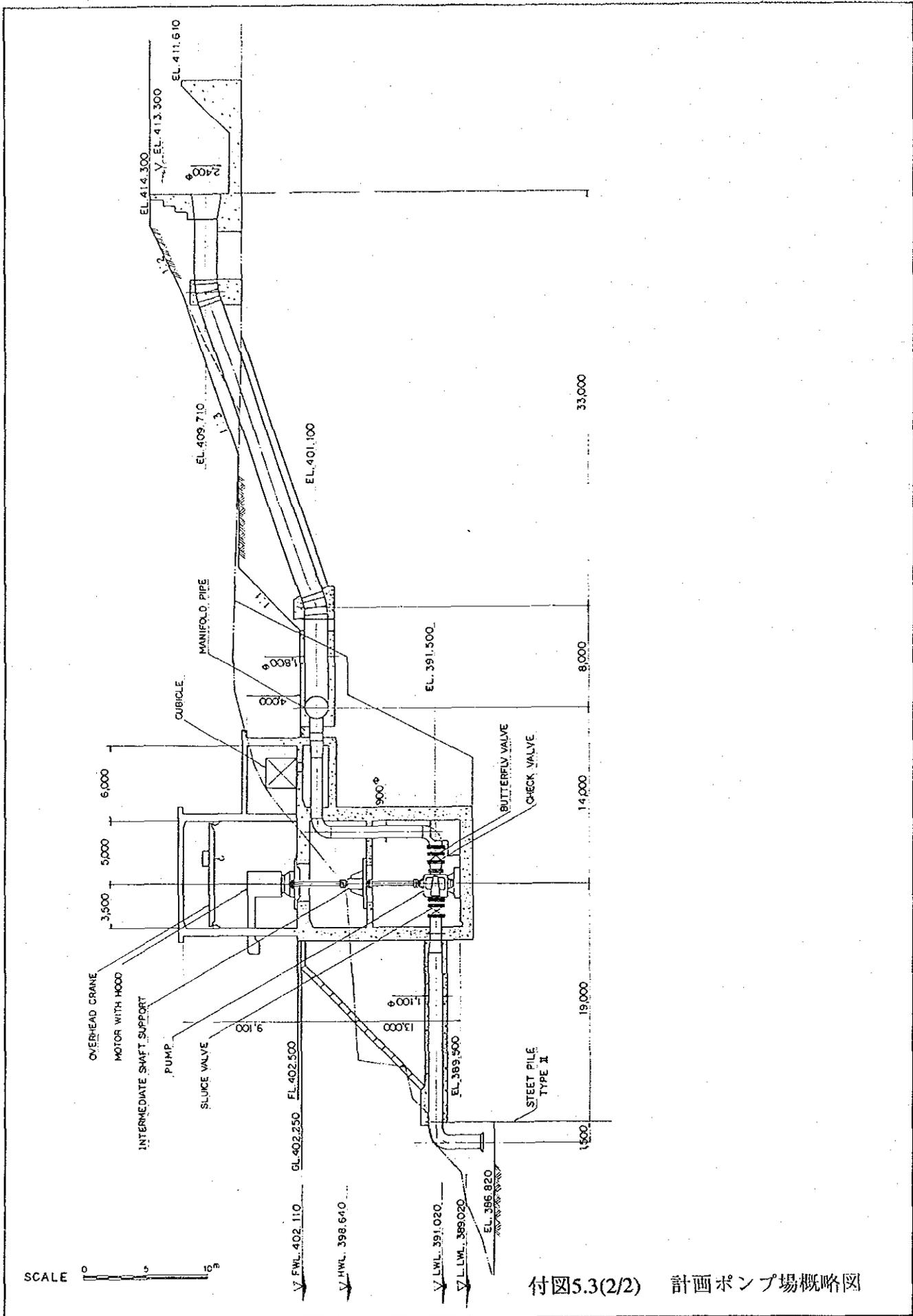
付図5.1 計画作付体系



付図5.2 計画水路組織概略図

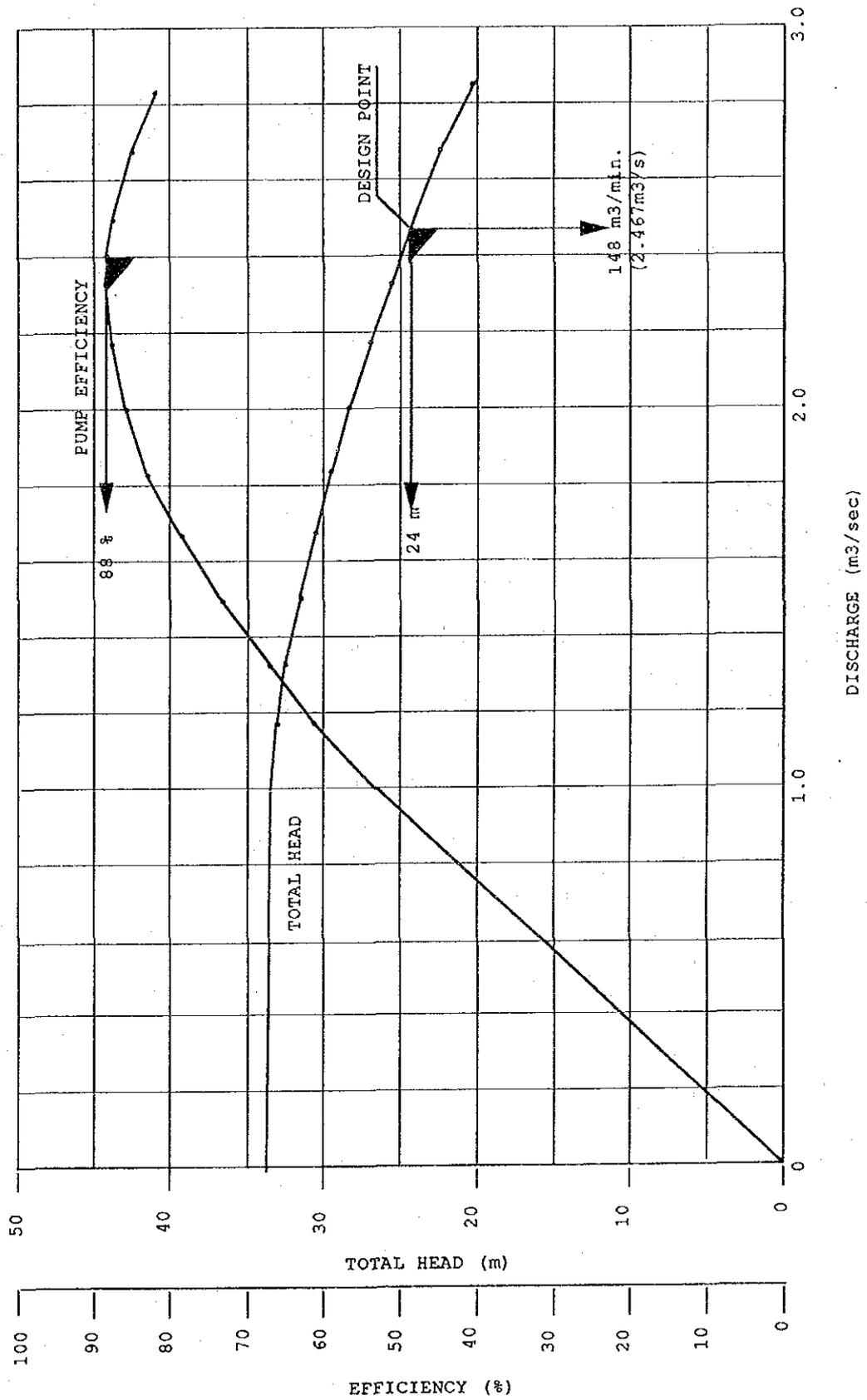


付図5.3(1/2) 計画ポンプ場概略図



付図5.3(2/2) 計画ポンプ場概略図

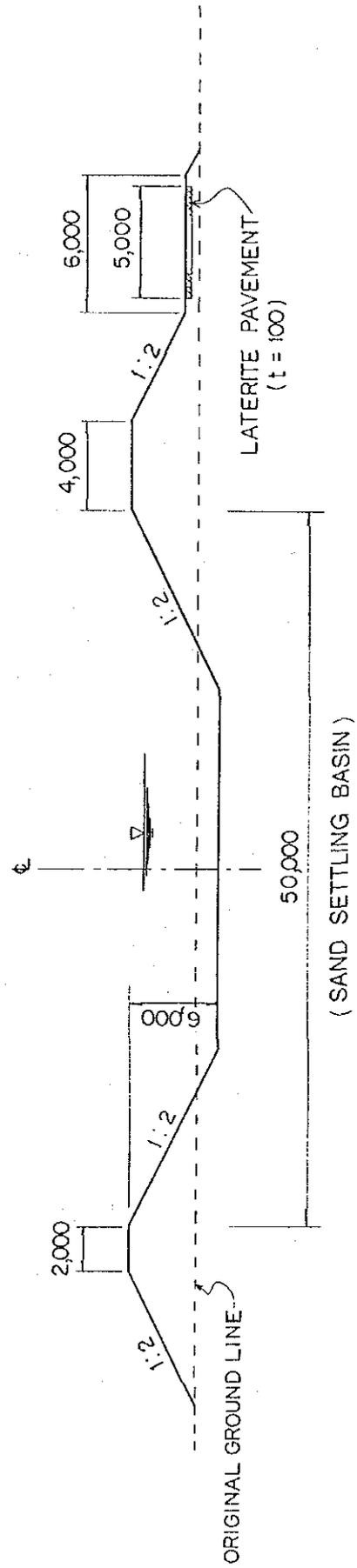
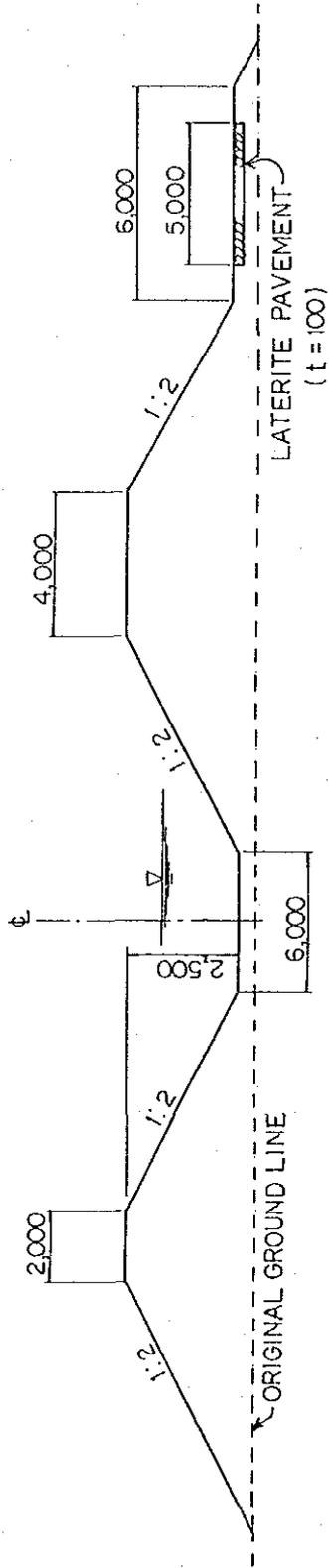
SPECIFICATION OF PUMP  
 TYPE : DOUBLE SUCTION VOLUTE PUMP  
 MOTOR : 750 kW , 10-P  
 RATED DESIGN HEAD : 24 m  
 RATED DISCHARGE : 2.4 m<sup>3</sup>/sec  
 SPECIFIC SPEED : 454 rpm-m



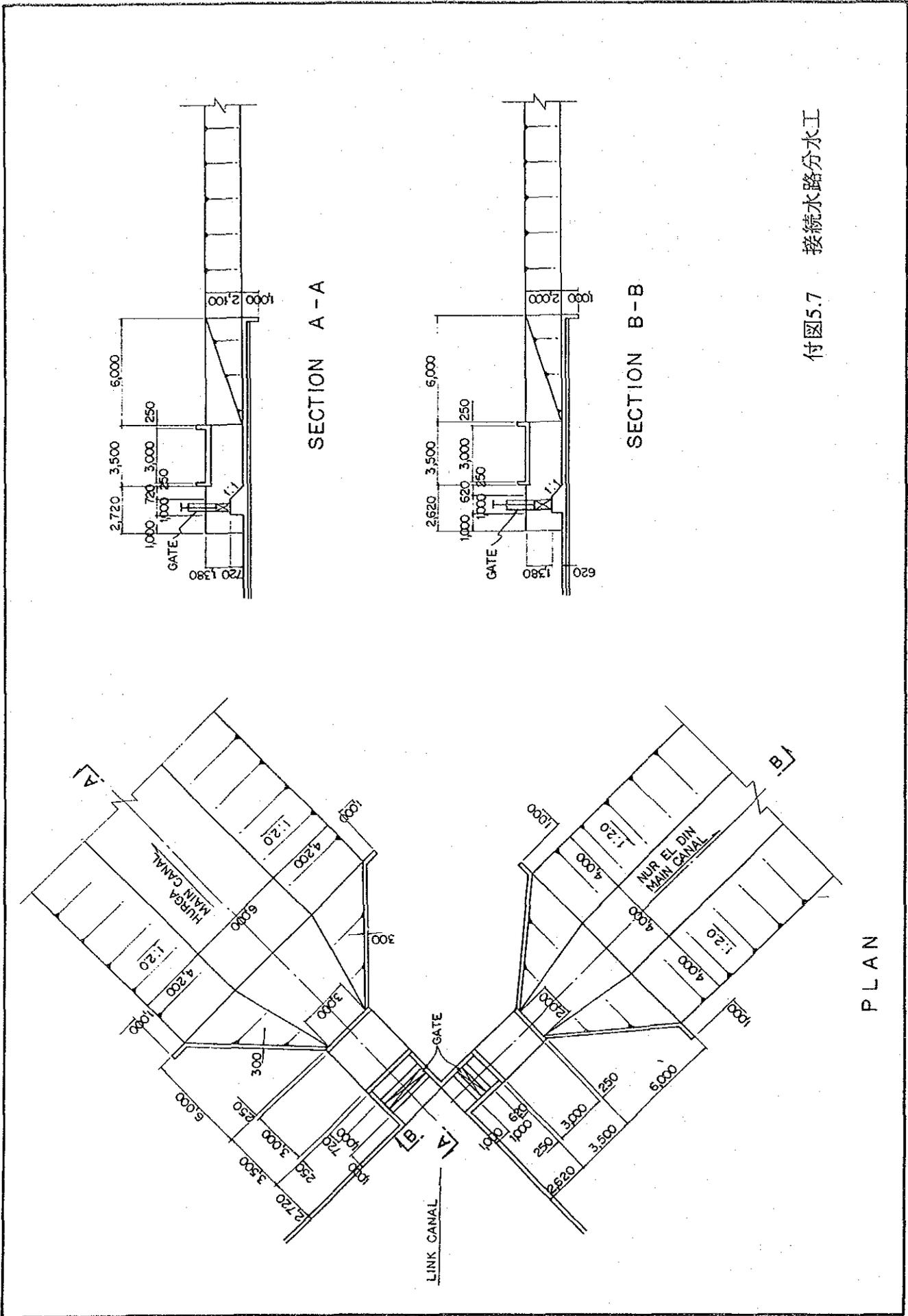
付図5.4 ポンプ特性曲線



LINK CANAL



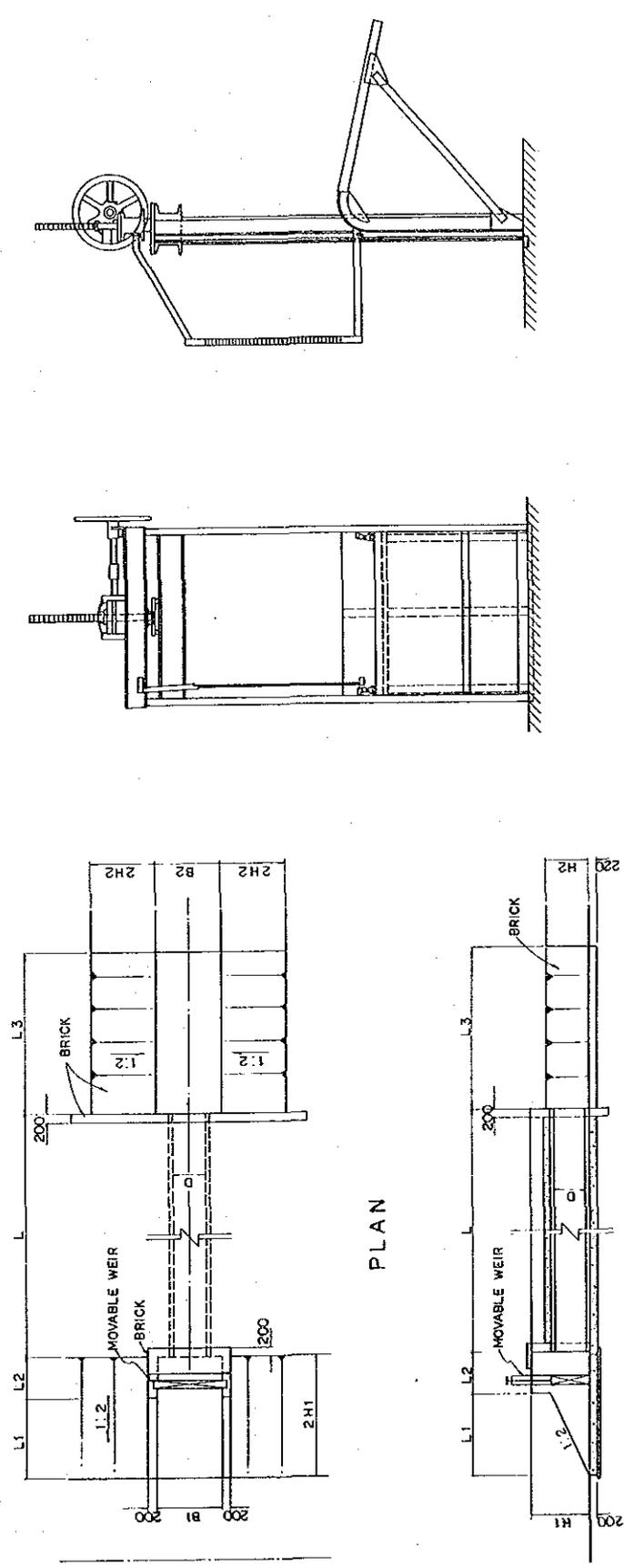
付図5.6 接続水路の標準断面図



付図5.7 接続水路分水工

PLAN

MOVABLE WEIR



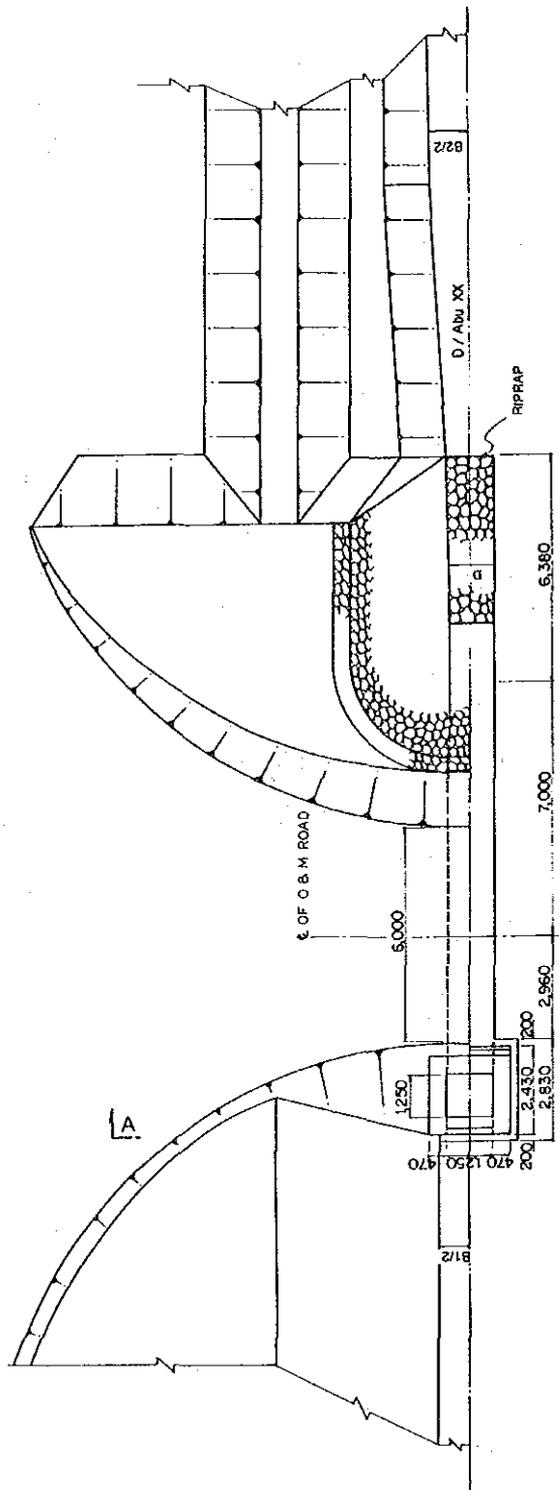
PLAN

LONGITUDINAL SECTION

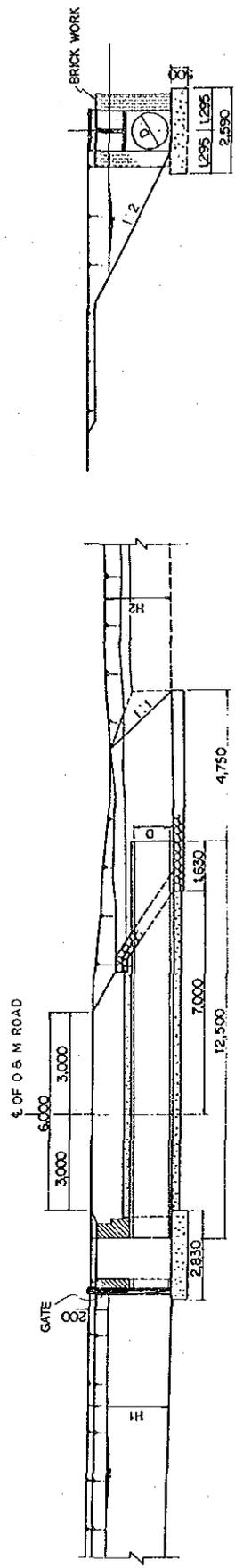
DIMENSION TABLE

Outline Canal Name	B1	H1	B2	H2	D	L1	L2	L3	L
(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
(1) Puuga Scheme									
Can. No. 1 No. 1	1,000	1,900	500	1,700	1,900	760	2,300	1,500	5,000
Can. 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 Can. No. 4 (I)	1,000	1,900	500	1,300	500	2,300	1,500	5,000	7,500
Can. No. 2	1,500	2,100	1,000	1,600	910	2,700	1,500	5,000	7,500
No. 2 (I) No. 2	1,500	1,800	1,000	1,500	1,700	760	2,100	1,500	7,500
No. 3	1,500	1,800	1,000	1,600	760	2,100	1,500	5,000	7,500
No. 5	1,500	1,900	1,000	1,600	760	2,100	1,500	5,000	7,500
No. 6	1,500	1,900	1,000	1,600	760	2,100	1,500	5,000	7,500
No. 8	2,000	2,300	2,000	2,000	1,240	2,300	1,500	5,000	7,500
(2) New El Din Scheme	2,000	2,100	2,000	1,800	1,500	2,100	1,500	3,000	7,500
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	2,600	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	1,900	1,500	1,600	910	2,300	1,500	5,000	7,500

付図5.8 分水工(可動ゲート型)



PLAN



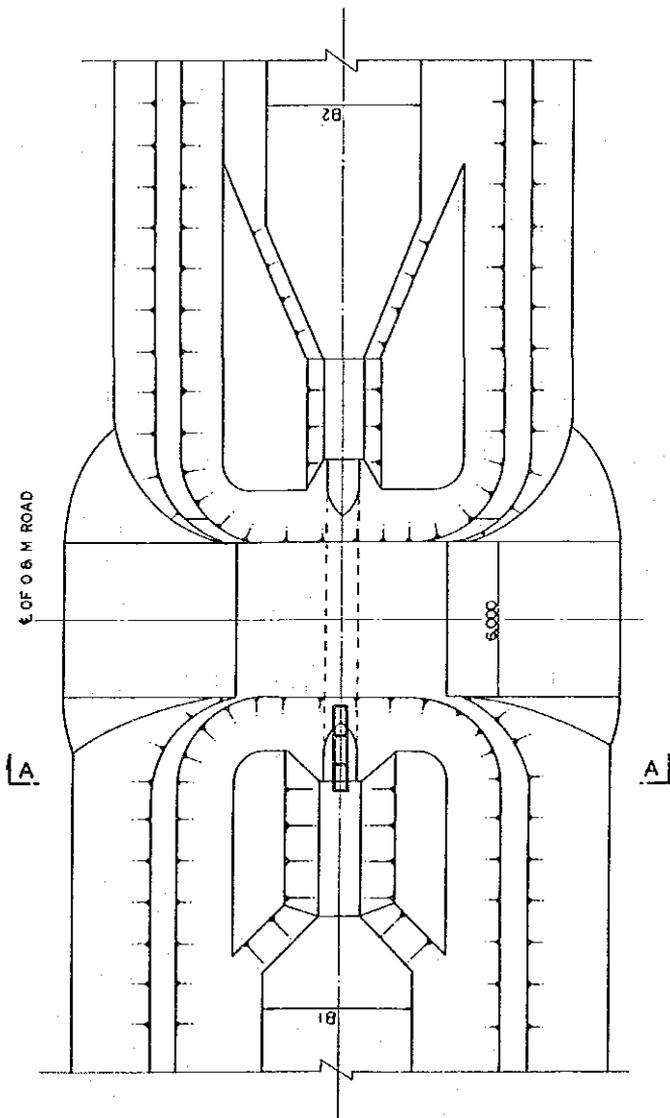
SECTION A-A

LONGITUDINAL SECTION

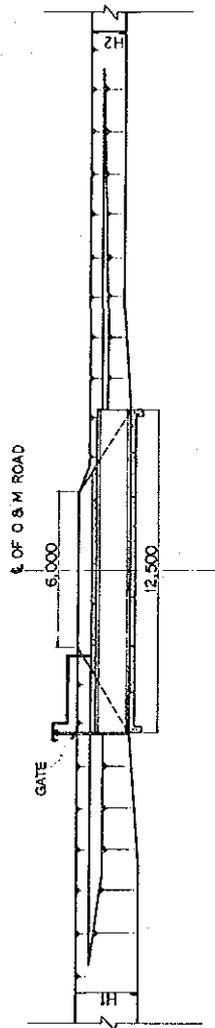
DIMENSION TABLE

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

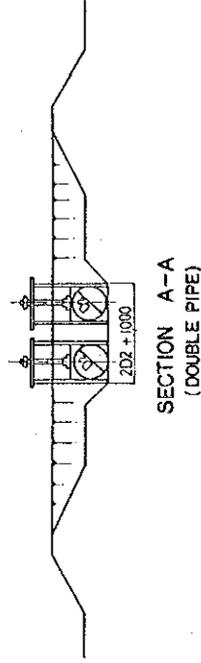
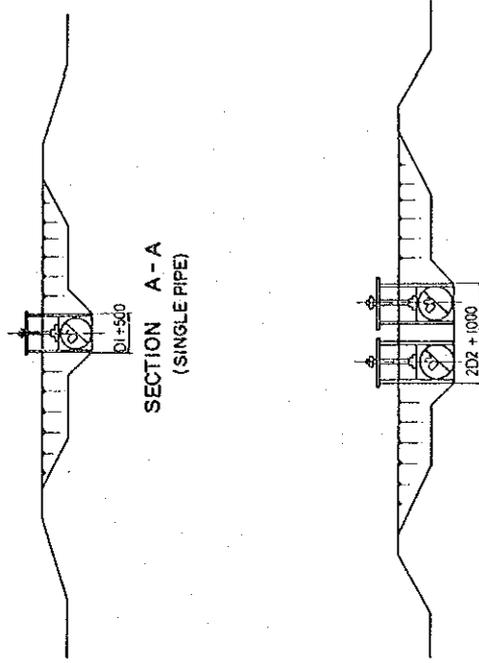
付図5.9 分水工(井筒型)



PLAN



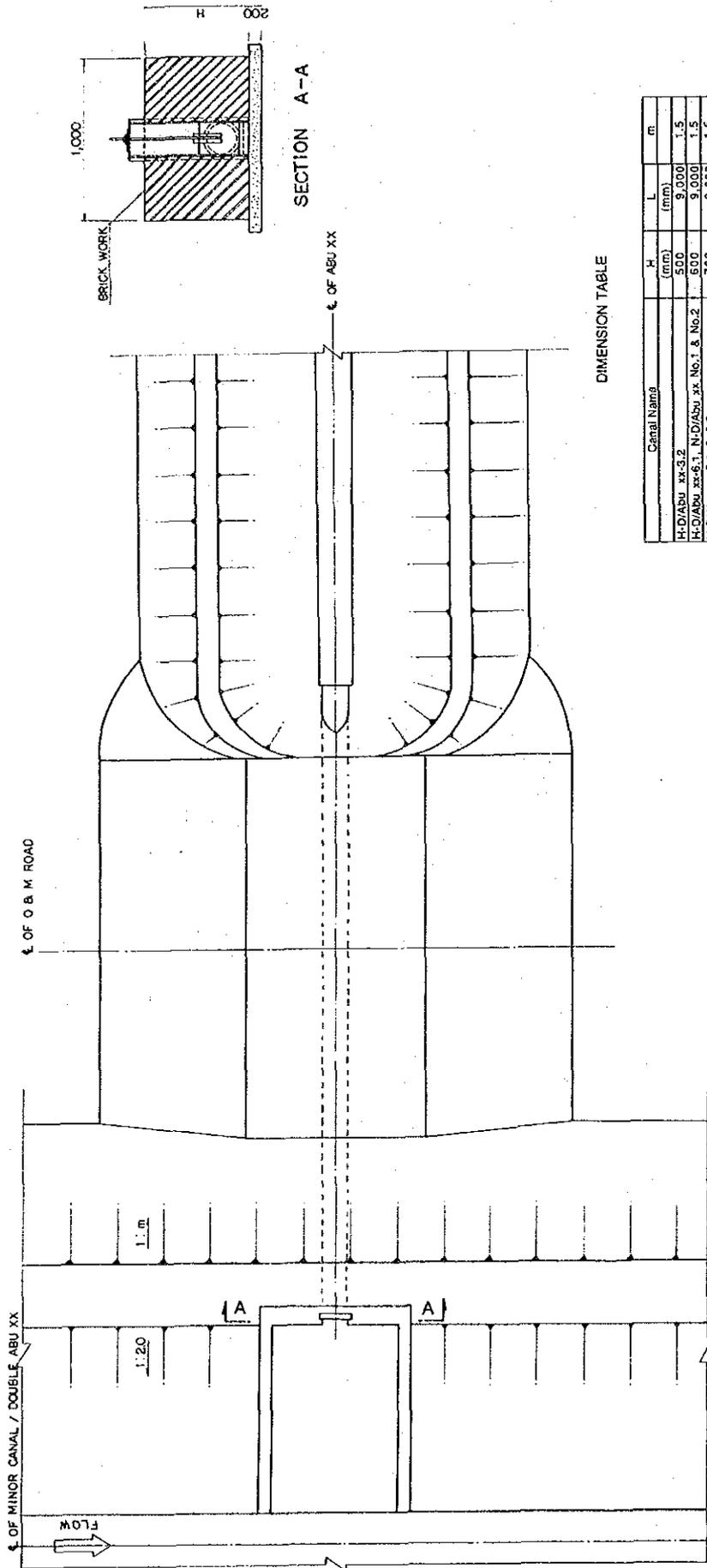
LONGITUDINAL SECTION



DIMENSION TABLE

TYPE	O (m <sup>3</sup> /s)	B <sub>1</sub> (mm)	H <sub>1</sub> (mm)	B <sub>2</sub> (mm)	H <sub>2</sub> (mm)	D <sub>1</sub> (mm)	B <sub>2</sub> (mm)
A	0.0 - 0.2	500	1,300 - 1,500	500	1,300 - 1,500	500	500
B	0.2 - 0.5	500	1,500 - 1,900	500	1,500 - 1,900	760	500
C	0.5 - 1.0	1,000	1,500 - 2,000	1,000	1,500 - 2,000	910	1,010
D	1.0 - 1.5	2,000	2,000	2,000	2,000	1,900	1,240
E	1.5 - 2.0	2,000	2,000	2,000	1,900	1,900	1,240
F	2.0 -	4,000	2,000	1,500	1,900	1,900	1,240

付図5.10 チエック (パイプ型)

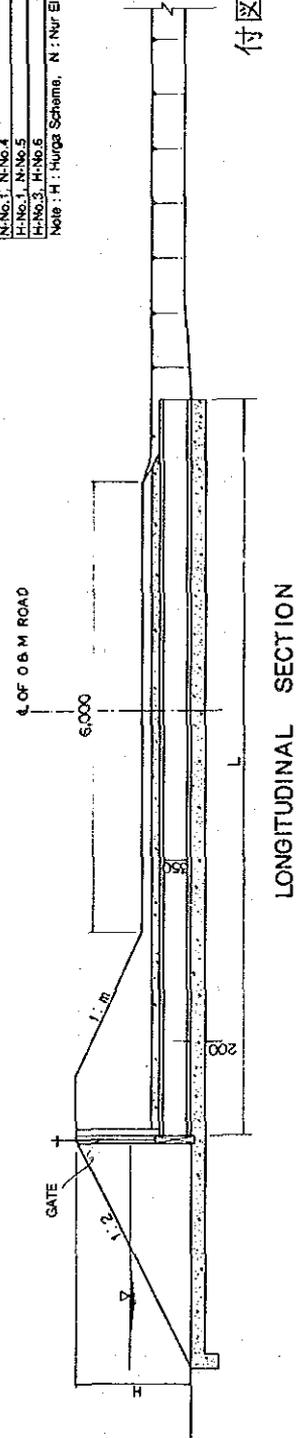


DIMENSION TABLE

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(D), H.No.7	1,300	12,000	2.0
H/Ga. No.3, H.No.2(D), 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, H.No.2, H.No.3	1,700	12,000	2.0
H.No.7, H.No.4	1,800	12,000	2.0
H.No.1, H.No.5	1,900	12,000	2.0
H.No.3, H.No.5	2,000	12,000	2.0

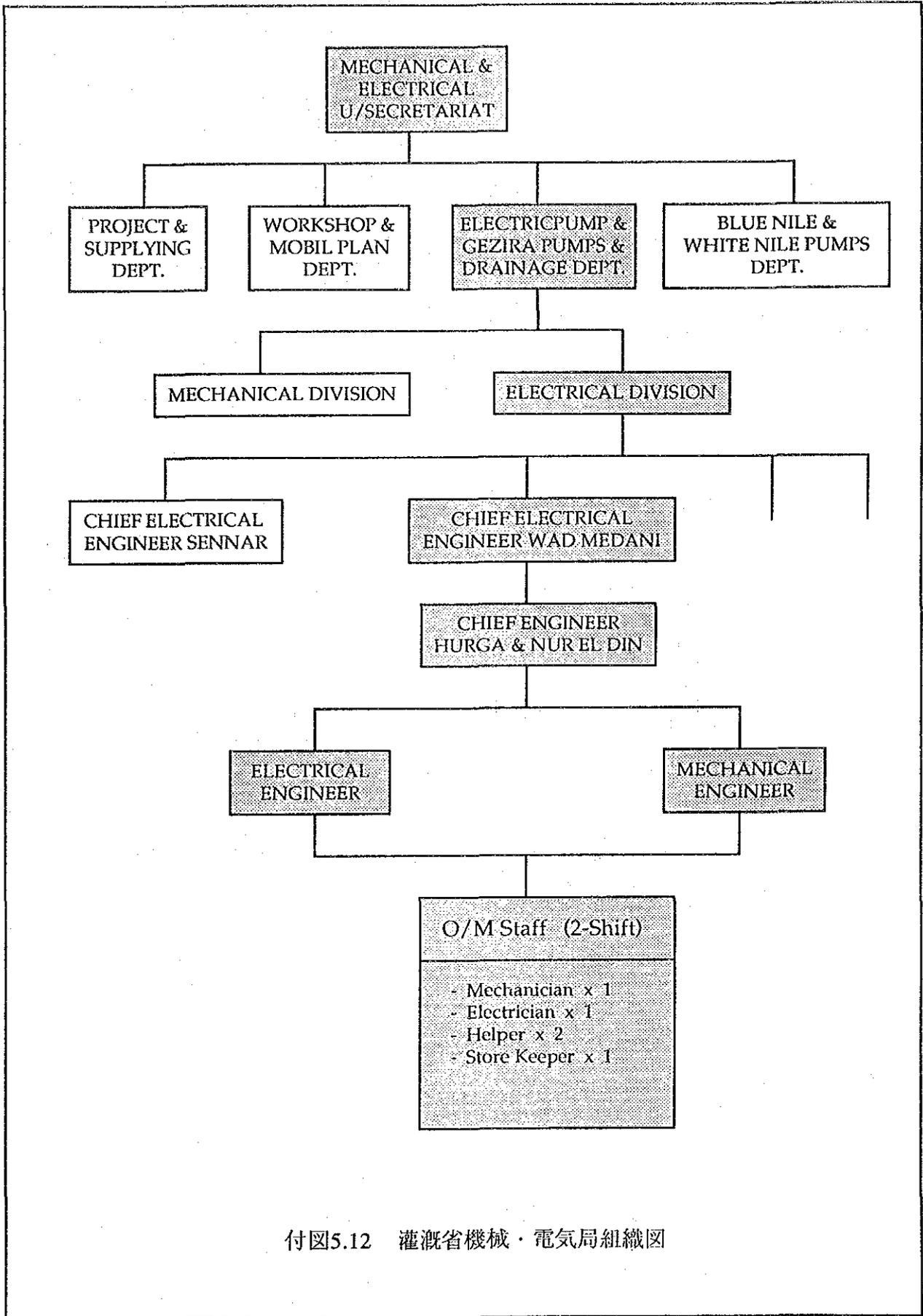
Note: H : Hurga Scheme, N : Nur' El Din Scheme

PLAN

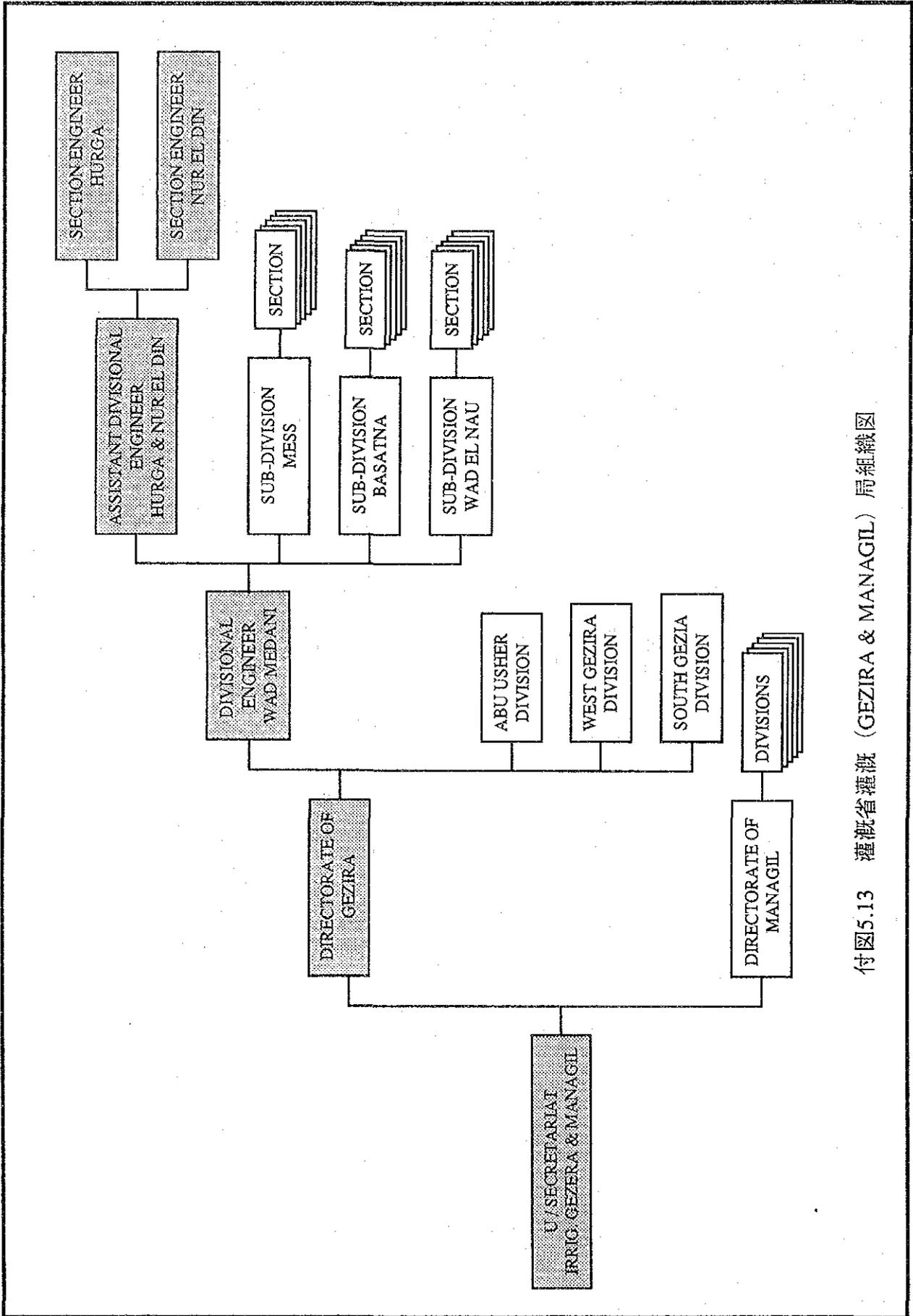


LONGITUDINAL SECTION

付図5.11 分水工 (FOP型)



付図5.12 灌漑省機械・電気局組織図



付图5.13 灌溉省灌溉 (GEZIRA & MANAGIL) 局組織图





## 添付資料

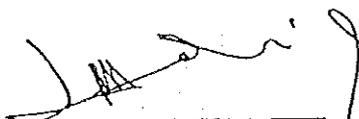


SCOPE OF WORK  
FOR  
THE FEASIBILITY STUDY  
ON  
HURGA AND NUR EL DIN PUMP SCHEME REHABILITATION PROJECT  
IN  
THE REPUBLIC OF THE SUDAN

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 PLANNING  
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

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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 following 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
- ~~78~~

- YV
- 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) Programmes
    - 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

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- 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

YS

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,



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- (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, occurring 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 irrigation (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.

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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.

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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

P/R : Progress Report

DF/R : Draft Final Report

IT/R : Interim Report

F/R : Final Report

▨ Work in Sudan

▨ Work in Japan

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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

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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 limited 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.

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
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JICA