添付資料　4

協議議事録

協議議事録

基本設計調査

MINUTES OF DISCUSSIONS
BASIC DESIGN STUDY ON THE PROJECT
FOR
THE WATER SUPPLY SYSTEM IN GIALAM AREA IN
HANOI CITY IN THE SOCIALIST REPUBLIC OF VIET NAM

Based on the results of the Preliminary Study, the Japan International Cooperation Agency (JICA) decided to conduct a Basic Design Study on the Project for the Water Supply System in Gialam Area in Hanoi City in the Socialist Republic of Viet Nam (hereinafter referred to as " the Project").

JICA sent a study team, which is headed by Mr. Haruo Iwahori, Development Specialist, JICA to the Socialist Republic of Viet Nam and the team is scheduled to stay in the country from April 25, to June 6, 1993.

The team held discussions with the officials concerned of the Government of the Socialist Republic of Viet Nam and conducted a field survey at the study area.

In the course of the discussions and field survey, both parties have confirmed the main items described on the attached sheets. The team will proceed to further work and prepare the Basic Design Study Report.

Hanoi, May 18, 1993

岩堀春雄

Mr. Haruo Iwahori
Leader
Basic Design Study Team
JICA

Mr. Nguyen Thanh Binh
Director
Transportation
and
Urban Public Works Service

ATTACHMENT

1. Objective

The objective of the Project is to extend the water supply system for the improvement of the water supply situation in Gia Lam Area in Hanoi City.

2. Project Site

The site of the Project is located at Gialam Area which is on the left side of the Red River in Hanoi City. The tentative location map of the site shown in Annex I of the minutes of discussions of the Preliminary Study is finalized as shown in Annex I of this attachment according to the Gia Lam Water Master Plan during the Basic Design Study.

3. Executing Agency

The executing agency of the Project is the Transportation and Urban Public Works Service (TUPWS) supervised by the Hanoi People's Committee, bears over all responsibilities for the administration and execution of the Project.

4. Items Requested by the Viet Nam Side

After discussion with the Basic Design Study Team, the following items were judged necessary for the realization of the Project.

1) Supply of two units of drilling equipment.

2) Supply of materials and equipment for twelve well construction.

3) Installation of pumps and electrical works for twelve wells.

4) Detail design and construction of raw water transmission lines for 7 km.

5) Detail design and construction of treatment plant in design capacity of 30,000m^3/d.

6) Supply of materials for distribution pipelines in a range of diameter from 50mm to 600mm, including necessary installation equipment.

7) Supply of materials and auxiliary equipment for house connections.

However, the final components of the Project may differ from the above items, if it is judged necessary to revise after further studies.

5. Japan's Grant Aid System

1)Viet Nam side had understood the system of Japan's Grant Aid explained by the team.

2)Viet Nam side will take the necessary measures described in Annex II for smooth implementation of the Project, on condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

6. Schedule of the Study

1)The consultants will proceed the field survey in the Socialist Republic of Viet Nam until June 6, 1993.

2)JICA will prepare the draft report in English and dispatch a mission in order to explain its contents around August, 1993.

3)In case that the contents of the report is accepted in principle by the Government of the Socialist Republic of Viet Nam, JICA will complete the final report and send it to the Government of the Socialist Republic of Viet Nam by the end of October, 1993.

7. Scope of Cooperation

The scope of cooperation to be covered by the scheme of Japan's Grant Aid will be studied and clarified by the Basic Design Study which is carried out by JICA, after the feasibility of the Project is confirmed by the Government of Japan.

8. Scope of Work of Basic Design Study

The scope of work of the basic design study will include;

1)Technical survey
2)Management and financial survey
3)Basic design of facilities and equipment for the Project
4)Implementation plan of the Project
5)Evaluation of the Project

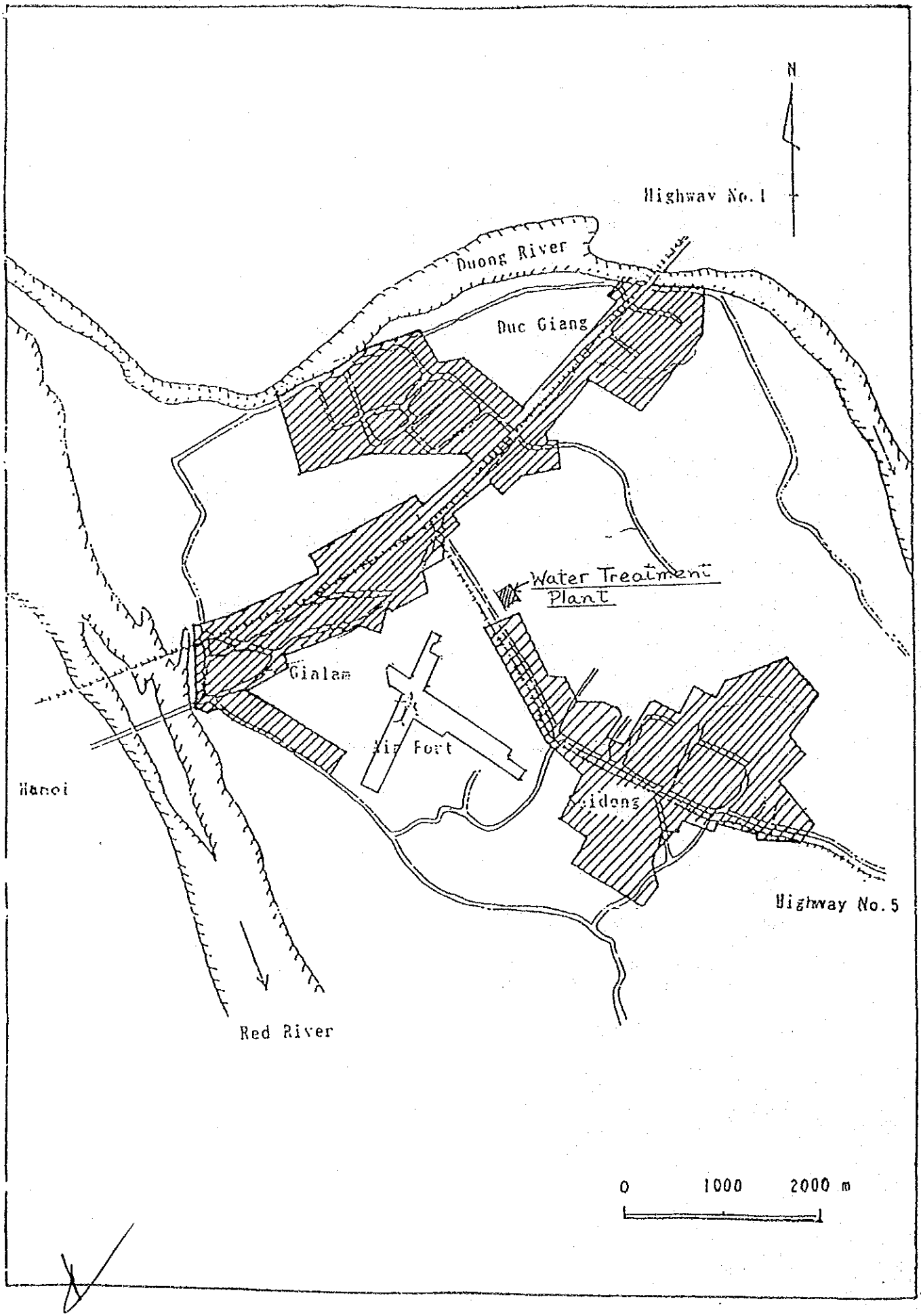
9. Items Discussed by Both Sides

Both sides confirmed items written in Annex III and IV for purpose of smooth and effective implementation of the Project.

10. Title of the Project

The official title of the Project is changed to "Basic Design Study on the Project for the Water Supply System in Gia Lam Area, Hanoi City in the Socialist Republic of Viet Nam".

ANNEX 1.


N
Highway No.1
Duong River
Duc Giang
Water Treatment Plant
Gialam
Fort
Hanoi
Highway No.5
Red River
0
1000
2000 m

ANNEX II

Necessary Measures to be Taken by the Government of the Socialist Republic of Viet Nam on condition that Japan's Grant Aid Assistance is extended.

1. To provide data and information necessary for the Project,

2. To bear the commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement,

3. To exempt taxes and to take necessary measures for customs clearance of the materials and equipment brought for the Project at the port of disembarkation in Viet Nam,

4. To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contracts, such facilities as may be necessary for their entry into Viet Nam and stay therein for such performance of their work,

5. To assign the necessary staff for operation and maintenance of the facilities constructed and equipment purchased under the Grant Aid,

6. To maintain and use properly and effectively the facilities constructed and equipment purchased under the Grant Aid and

7. To bear all the expenses other than those to be born by the Grant Aid necessary for construction of the facilities as well as for the transportation and installation of the equipment.

ANNEX XII

As a result of discussions and field survey, both sides confirmed the following items:

1. The Project corresponds to the contents of the "Water Master Plan of Hanoi City" and the "Gia Lam Water Master Plan", and also the Project contributes to realize the objectives of the above mentioned Master Plans.

2. Working share of the implementation is shown in ANNEX IV.

3. Although the industrial water demand is excluded in the design , the water use for domestic purpose in the industrial area is included in the design capacity of the Project.

4. In order to execute the Project effectively, Viet Nam side strongly requested to the team to provide training for technology and management in the field of water supply in Japan.

5. Viet Nam side shall take necessary measures to prevent any public nuisance to be caused by the increased water consumption due to the Projcet.

6. Viet Nam side shall obtain all necessary permission and approval of the land use for the treatment plant.The authrized land use will be reported in a written form to the Embassy of Japan by 30 of June, 1993.

The team strongly requested to the Viet Nam side efficiency and sustainability of the project on condition that Japan's Grant Aid Assistance is extended, and Viet Nam side agreed the following items:

7. To secure the necessary budget for Viet Nam's working share shown in the ANNEX IV.

8. To execute Viet Nam's working share in accordance with the implementation schedule of Japan's working share.

   The tentative implementation schedule of Japan's working share will be from December, 1993 to March, 1996.

9. To secure necessary institution and manpower for the purpose of proper implementation of the Project, operation and maintenance for its after completion of the water supply system.

10. To secure financial sustainability for the Project by collecting reasonable water tariff after completion of the water supply system.

11. To secure necessary budget for proper operation and maintenance after completion of the water supply system.

ANNEX IV

Both side confirmed that working share of the implementation is shown in the Table.

Table: Working Share

Item of Works	Viet Nam	Japan
1. Intake Facilities		
1) To acquisit the land for the construction sites.	Yes	
2) To heap up, level and reclaim the sites.	Yes	
3) To construct gate, fence and exterior lights in and around the sites.	Yes	
4) To construct access roads.	Yes	
5) To supply electric power to the sites	Yes	
6) Drilling equipment.		Yes
7) Materials and equipment of well construction.		Yes
8) Construction and supervision of wells.	Yes	
9) Installation and supervision of pumps and electrical works including pump houses.		Yes
10) Detail design of raw water transmission lines.		Yes
11) Construction and supervision of raw water transmission lines .		Yes

Item of Works	Viet Nam	Japan
2. Treatment Facilities		
12) To acquisit the land for construction.	Yes	
13) To heap up, level and reclaim the site.	Yes	
14) To construct gate, fence and exterior lights in and around the site.	Yes	
15) To construct access roads.	Yes	
16) To supply electric power to the site	Yes	
17) Construction of drainage facilities from the treatment plant site.	Yes	
18) Detail design of treatment plant.		Yes
19) Construction and supervision of treatment plant including reservoirs and disribution pumps.		Yes
20) Detail design, construction and supervision of administrative buildings including ware house.	Yes	
3. Distribution Pipeline Network Facilities		
21) To acquisit the land for pipeline networks.	Yes	
22) Stockyard for supplied materials.	Yes	
23) Detail design of pipeline networks including elevated tanks.	Yes	
24) Materials for distribution pipeline networks.		Yes
25) Construction and supervision of pipeline networks including elevated tanks.	Yes	
26) Materials and auxiliary equipment for house connections.		Yes
27) Installation and supervision of house connections.	Yes	

協議議事録

ドラフト・ファイナルレポート説明

Minutes of Discussion
Basic Design Study on The Project for
The Water Supply System in Gia Lam Area
Ha Noi City in The Socialist Republic of Viet Nam

In April 1993, the Japan International Cooperation Agency(JICA) dispatched a Basic Design Study Team on the Project for the Water Supply System in Gia Lam Area, Ha Noi City in The Socialist Republic of Viet Nam (hereinafter referred to as the Project), and through discussions, field survey, and technical examination of the results in Japan, has prepared the draft report of the study.

In order to explain and to consult the Viet Nam side on the components of the draft report, JICA has sent to the Socialist Republic of Viet Nam study team which is headed by Mr.Kiyoto KUROKAWA, First Basic Design Study Division, Grant Aid Study and Design Department,JICA and is scheduled to stay in the country from August 17, 1993 to August 27, 1993.

As a result of discussions, both parties have confirmed the main items described on the attached sheets.

Ha Noi, August 26, 1993

Mr. Kiyoto KUROKAWA
Leader
Basic Design Study Team

Mr. Nguyen THANH BINH
Director
Transportation
and
Urban Public Works Service

ATTACHMENT

1. Components of Draft Report

The Government of Viet Nam has agreed and accepted in principle the components of the Draft Report proposed by the Team.

2. Japan's Grant Aid System

(1) Viet Nam side has understood the system of Japan's Grant Aid explained by the team.

(2) Viet Nam side will take the necessary measures described in Annex-1 for smooth implementation of the Project, on condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

3. The Team will make the Final Report in accordance with the confirmed items, and send it to the Government of Viet Nam by the end of October 1993.

4. Items Discussed by Both Sides

Items discussed by the both sides are shown in Annex-2.

5. Recommendations

Importance of the recommendations given in the Draft Final Report, was confirmed as shown in Annex-3.

6. Viet Nam side will execute Viet Nam's working share in accordance with the implementation schedule of Japan's working schedule. A provisional schedule of Japan's working share will be from December, 1993 to March, 1996.

7. Discussions have been made on the draft final report and comments raised were clarified through discussions. Further comments, if any, shall be transferred to the study team through Embassy of Japan before 10 September, 1993.

ANNEX-I

Necessary measures to be taken by the Government of the Socialist Republic of Viet Nam on condition that Japan's grant Aid Assistance is extended;

1. To provide data and information necessary for the Project,

2. To ensure land for the sites of the project,

3. To clear, level and reclaim the sites prior to commencement of the construction,

4. To construct access roads to the sites prior to commencement of the construction,

5. To provide facilities for distribution of electricity and other incidental facilities such as gate, fence and exterior lighting in and around the sites,

6. To bear the commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement,

7. To exempt taxes and to take necessary measures for custom clearance of the materials and equipment brought for the Project at the port of disembarkment in Viet Nam,

8. To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contracts, such facilities as may be necessary for their entry into Viet Nam and stay therein for such performance of their work,

9. To assign the necessary staff for operation and maintenance of the facilities and equipment purchased under the Grant Aid,

10. To maintain and use properly and effectively the facilities constructed and equipment purchased under the Grant Aid and

11. To bear all the expenses other than to be born by the Grant Aid necessary for construction of facilities as well as for the transportation and installation of the ,

12. To announce the objective of the project to the people of the project area to obtain their full cooperation with the project.

ANNEX II

Both sides confirmed that working share of the implementation is shown in the Table.

Table: Working Share

Item of Works	Viet Nam	Japan
1. Intake Facilities		
1) Land acquisition of construction sites.	Yes	
2) Land preparation of the drilling sites.	Yes	
3) To construct gate, fence and exterior lights in and around the sites.	Yes	
4) To construct access roads.	Yes	
5) To supply electric power to the sites	Yes	
6) Drilling equipment.		Yes
7) Materials and equipment of well construction.		Yes
8) Construction and supervision of wells.	Yes	
9) Installation and supervision of pumps and electrical works including pump houses.		Yes
10) Materials for raw water transmission line.		Yes
11) Detail design of raw water transmission lines.	Yes	
12) Construction and supervision of raw water transmission lines .	Yes	

Item of Works	Viet Nam	Japan
2. Treatment Facilities		
12) Land accquisition of the treatment plant site.	Yes	
13) To heap up, level and reclaim the site..	Yes	
14) To construct gate, fence and exterior lights in and around the site.	Yes	
15) To construct access roads.	Yes	
16) To supply electric power to the site	Yes	
17) Construction of drainage facilities from the treatment plant site.	Yes	
18) Detail design of treatment plant.		Yes
19) Construction and supervision of treatment plant including distribution pumps.		Yes
20) Construction and supervision of reservoirs and drying bed of sludge treatment facility.	Yes	
21) Detail design, construction and supervision of administrative buildings including ware house.	Yes	
3. Distribution Pipeline Network Facilities		
21) Land acquisition for pipeline networks.	Yes	
22) Stockyard for supplied materials.	Yes	
23) Detail design of pipeline networks	Yes	
24) Materials for distribution pipeline networks.		Yes
25) Construction and supervision of pipeline networks.	Yes	
26) Materials and auxiliary equipment for house connections.		Yes
27) Installation and supervision of house connections.	Yes	

ANNEX III

Through discussions, importance of the recommendations for the project implementation given in the draft final report, is confirmed as listed below and with understanding of these recommendations, the project can be regarded as a model of the medium scale urban water supply schemes in Viet Nam:

1. Although it is definitely required to increase the water tariff in near future in accordance with increase in production costs of water and income level of beneficiaries, the water tariff is set to maintain financial self sustenance of the water company.

2. For this purpose, it is strongly recommended to establish a new financially and institutionally independent water supply company under supervision of TUPWS.

3. In order secure water charge collection, house connections shall be completed in an early stage of the project implementation.

   For this purpose, construction of the distribution pipeline shall be completed within the construction period of the project.

4. As special attention shall be paid at construction of distribution pipelines to prevent leakage through joints, a special inspection team shall be organized.

5. In 2006 an extension of the project facilities will be required to meet the future water demand. Prior to the extension of facilities, a new water supply plan shall be formulated incorporating the urban conditions at that time.

6. In order to prevent environmental deterioration ceused by the water pollution, it is strongly recommended to take necessary measures for drainage and sewerage system in the project area.

添付資料　5

メモランダム

MEMORANDUM OF DISCUSSIONS
ON
BASIC DESIGN STUDY ON THE PROJECT
FOR
THE WATER SUPPLY SYSTEM IN GIA LAM AREA
IN
HANOI CITY IN THE SOCIALIST REPUBLIC OF VIET NAM

Based on the minutes of discussions exchanged on 16 May, 1993, officials concerned of the Government of the Socialist Republic of Viet Nam and JICA Study Team further continued the study and exchanged views on the Basic Design on the Project.

According to the results of the above study, the both parties agreed the proposed concept of the Basic Design of the project as shown in the attachments.

1 June, 1993

Mr. A. Togo
Acting Team Leader
Basic Design Study Team
JICA

Mr. Pham Quoc Truong
Deputy Director
Transportation
and
Urban Public Works Service
Hanoi City

ATTCHMENT

During the field survey, various discussions were made with officers concerned in all aspects of the project in addition to the field inspection. The following part of this attachment summarizes provisional conclusion of the field survey and proposal for the project. Further details will be studied and analyzed at head office in Tokyo to finalize the Basic Design Study.

1. The Project Area

The project area of this Basic Design Study coincide with the project area of the Water Master Plan for Gia Lam Precinct.

2. Service Area

The service areas of the project are determined based on the land use plan proposed by the Planning Institute of Hanoi on 25 May, 1993.

These proposed service areas coincide with the service areas for urban areas proposed in the above master plan, however there are a small difference between the two due to the revision of the land use plan.

In addition to the proposed service areas in the urban area, the sub-urban areas are included in the proposed service areas. These sub-urban areas are the areas where densely populated rural communities are observed adjacent to the urban area.

Land Use Plan (ha)

Urban Area	Total	Residential	Offices	Pub. Util	Industry	Storing	Parks	
Ngoc Thuy	51.0	19.0	14.0	2.0	13.0	3.0	0	
Gia Lam	137.0	76.4	11.0	12.0	21.0	2.0	14.0	
Duc Giang	238.0	75.0	17.0	11.0	69.0	43.0	23.0	
Sai Dong	250.8	80.0	18.0	12.0	117.0	3.0	20.0	1.0
Total	676.8	250.4	60.0	37.0	220.0	51.0	57.0	1.0

* Excluding the area of roads.

Sub-urban areas of 313 ha are included as shown in the water demand calculation sheets (Table 1). An average population density in the sub-urban area is estimated at 160/ha in 2000.

3. Design Period

The Water Master Plan for Gia Lam Princinct intends to plan the water supply facilities until the year 2010. However, the project area has just commenced its rapid growth of urbanization and there are a lot of uncertainties in the future projection of urban development in the area so that the design period of this study is proposed to be the year of 2000 to minimize contradictions between the actual urban development and the utility plan in future.

The water demand of the proposed service areas is estimated to be 28,845 m3/day of which daily maximum demand is almost 30,000 m3/day corresponding to the requested design capacity of Hanoi authority.

4. Water Demand

Since there is much of uncertainty in the future urban development in the project area, the over all avreage unit water consumption rate each categories is taken after the Hanoi Water Master Plan. However, since the water supply facilities in Hanoi City are partly very old and recorded a large amount of the water unaccounted for, the losses and other water use corresponding to 35% of the total demand is proposed to be defined in the study as all facilities of the project are to be constructed and no heavy losses are expected.

Accordingly, the proposed unit water consumption rate for the project is determined as shown below:

	W/M.Plan	Gia Lam Water Supply
Domestic water	150 l/c/day	150 l/c/day
Sub-urban area	60 l/c/day	60 l/c/day
Small scale industry	12 l/c/day	--
Public service	16 l/c/day	16 l/c/day
Washing	10 l/c/day	10 l/c/day
Industry 30m3/ha/day	50% of 30m3/ha/day	50% of
Losses and other use	35% of Design Capacity	-
Consumption at plant		7% of Day Max
Irrigation		40% of 20m3/ha/day
Losses		11.25% of Day Max.

The water demand of the project is estimated at 28,845 m3/day as the daily maximum demand (20,603 m3/day daily average) according to the above assumption.

5. Design Criteria and Conditions

1) Design Capacity

The design capacity of the project is determined to be 30,000m3/day at the daily maximum demand corresponding to the design capacity requested by the Hanoi authority.

Taking the standard peak factor of the design criteria of Viet Nam (1.4) the average daily demand (ADD) is calculated as 21,430 m3/day.

As the required amount of water in the treatment process is estimated at 7% of the max. daily demand (MDD), the design capacity of the water treatment facilities is 32,100 m3/day.

The peak hour factor for distribution networks design is 1.35.

2) Water Quality

Based on the result of interpretation of the existing water quality of the ground water, the design raw water quality is determined as shown in Table 2,while the standards for drinking water quality is shown in Table3.

Necessary treatment facilities shall be provided to purify the design raw water quality to the water quality to satisfy the standards of the drinking water.

3) Water Source

Based on the result of interpretation of hydrogeological conditions in the well fields, the safe yield of one well is determined at 50 l/sec (180 m3/hr).

Assuming 20hrs operation of pump, 3,600 m3/hr of water is available from a single well. The required number of wells to meet the design capacity of the project is 9 (32,100/3,600=8.9). Considering 30% of the number of standby pumps (3 units) out of number of operating pumps, total number of pumps required for the project is 12.

Type of the pump is proposed to be submersible pump.

Based on hydrogeological analysis, the minimum distance to avoid influence of draw down of wells is estimated to be 250 m in the well field of the project. Taking this condition into consideration, the size of the proposed well field along the Red River is a little insufficient to accommodate 12 wells. For this reason, it is proposed to provided 8 wells at the well field along the Red River and another 4 wells at the treatment plant site.(Fig. 1)

The proposed well design is shown in Fig.2.

4) Raw Water Transmission Pipeline

The rout of the raw water transmission line is proposed to be along the highway No.1 and the No.5 for about 7 km.(Fig 1)

Proposed pipe material is ductile cast iron pipe (DIP) wit mortar lining. The diameter of the raw water transmission pipeline is in a range between 250 mm and 600 mm and majority of the pipes is 600 mm in diameter.

5) Water Treatment Plant

Major concern of the water treatment is removal of iron, manganese and ammonia.

i). Treatment Process

In order for determination of the treatment process, three alternatives will be compared including non-chemical system as shown in Fig.3.

Major considerations of the above comparison are:

-Economical aspects
-Technical aspects
-Easiness of operation and maintenance

Provisionally the alternative 2 is proposed for the project.

ii).Layout Plan

Proposed site of the treatment plant was the area adjucent to the junction of the highway No.1 with the highway No.5. Howver, this area is subject to accident under the approach area of airplanes to the Gia Lam air port. Inaddition the proposed area would be utilized more efficiently for commercial area.Therefore, the plant site isproposed to transfer further south for about one kilometer along the highway No. 5.(Fig. 1)

A preliminary layout plan is shown in Fig.4. The required land size is estimated at about 7 ha (260 m x 260 m). All buildings shown in the Fig.4 will be provided by JICA except item No. 13, 14 and 15 which will be supposed to be constructed by Viet Nam authority.

iii). Operation and Instrumentation System

The pumps of wells shall be operated at the central control panel in the water treatment plant.(Fig 5)

Filter washing system will be designed to be either the one man control or timer control.

The treatment plan will be equipped with analytical appartus necessary for chemical water quality analysis of temperature,pH, iron,manganese and residual chlorine.

iv). Supply Reservoir

The storage capacity of the supply reservoir is 20% of the maximum daily demand (4.80 hrs);The design capacity of the supply reservoir is 6,000 m3 (30,000 X 0.2 = 6,000 m3).

6).Distribution System

Although the land use plan is determined by the Planning Institue of Hanoi, implementation schedule of the utility plan especially road consrruction plan is stil to be determined. For this reason a part of distribution of the water demand estimated in each part of service areas can not be completed until the consrtuction of road will be completed.

Therefore, distribution is planned to supply water through pipelines installed along the existing roads which may sufficiently be able to meet the water demand even in near future.(Fig.6)

i).Distribution system and Power Supply.

A direct pumping system is proposed for the project. In order to distribute 30,000 m3/day(daily maximum demand) six (6) pump units will be installed including two (2) units for standby. Operation hours is 24 hours in normal conditions.

For emergency case of failure in public electric supply, generator sets will be provided in capacity of 25% of total power requirement. The generator sets will be provided in the treatment plant site.

ii). Minimum Pressure in Pipe Line Networks

The minimum pressure of the distribution networks will be maintained at 20 m water pressure at the peak hour time.

iii). Fire Hydrant

The fire hydrants will be installed at 300m intervals along the main roads where fire-fighting car can go through. The fire hydrants will be connected with the distribution lines with a diameter 150 mm or more. Type of the fire hydrant is under ground type in diameter of 65 mm.

iv). Pipe Materials

Ductile iron pipes (DIP)with mortar lining will be installed in the pipelines with diameter of 200mm and more.

PVC or PE pipes will be utilized for the pipelines with diameter of 150 mm and less.

DIP will be installed in the pipeline even less than 150 mm or less where vehicle traffic is expected.

7). Electrical Works

i). Design Condtions

Rated voltage 380 V, 50 HZ shall be used for the power supply and single phase 220 V shall be used for control curcuit.

Although the single phase 220 V shall be used in general, the sigle phase 100 V may be used the control circuit of equipment for measurement. However, such usage of the 100 v must be minimized.

Final sub-circuit for the lighting and receptacle shall be single phase 220 V.

Cable and Wire

Following cables and wires shal be utilised for the each circuit:

-H.T. cable

35 KV XLPE

-Low voltage cable for motor

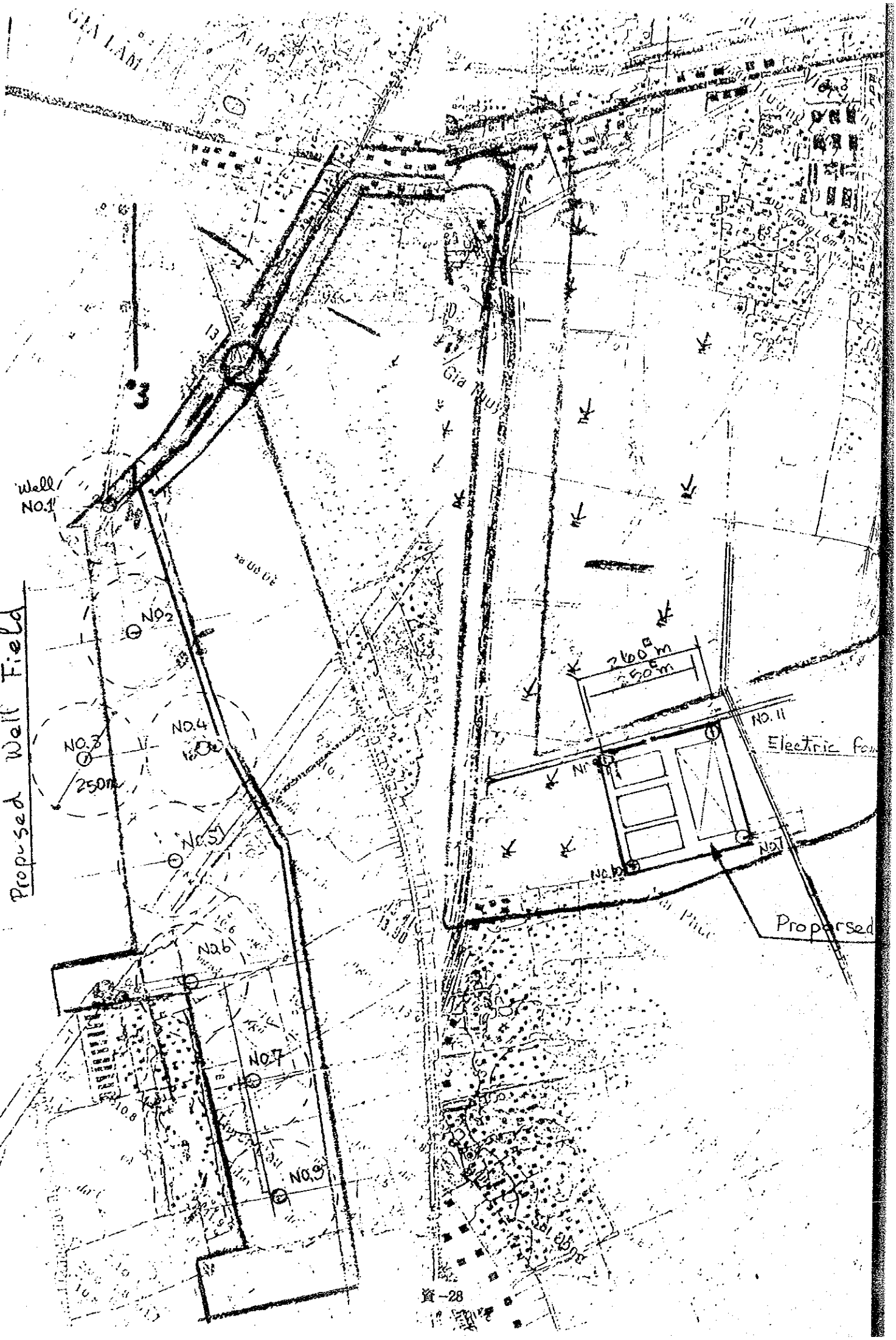
600 V PVC or XLPE cable

Standby Power Supply System

Diesel generator to be installed in the water treatment plant shall be provided for emergency standby power supply for lighting and a distribution pump.

ii). Electric Power Supply System

There are three power supply systems as shown in Fig. 7.


Propused Well Field
Well NO.1
NO.2
NO.3
NO.4
NO.5
NO.6
NO.7
NO.8
NO.9
250m
260m
50m
NO. 11
Electric fo
Propersed

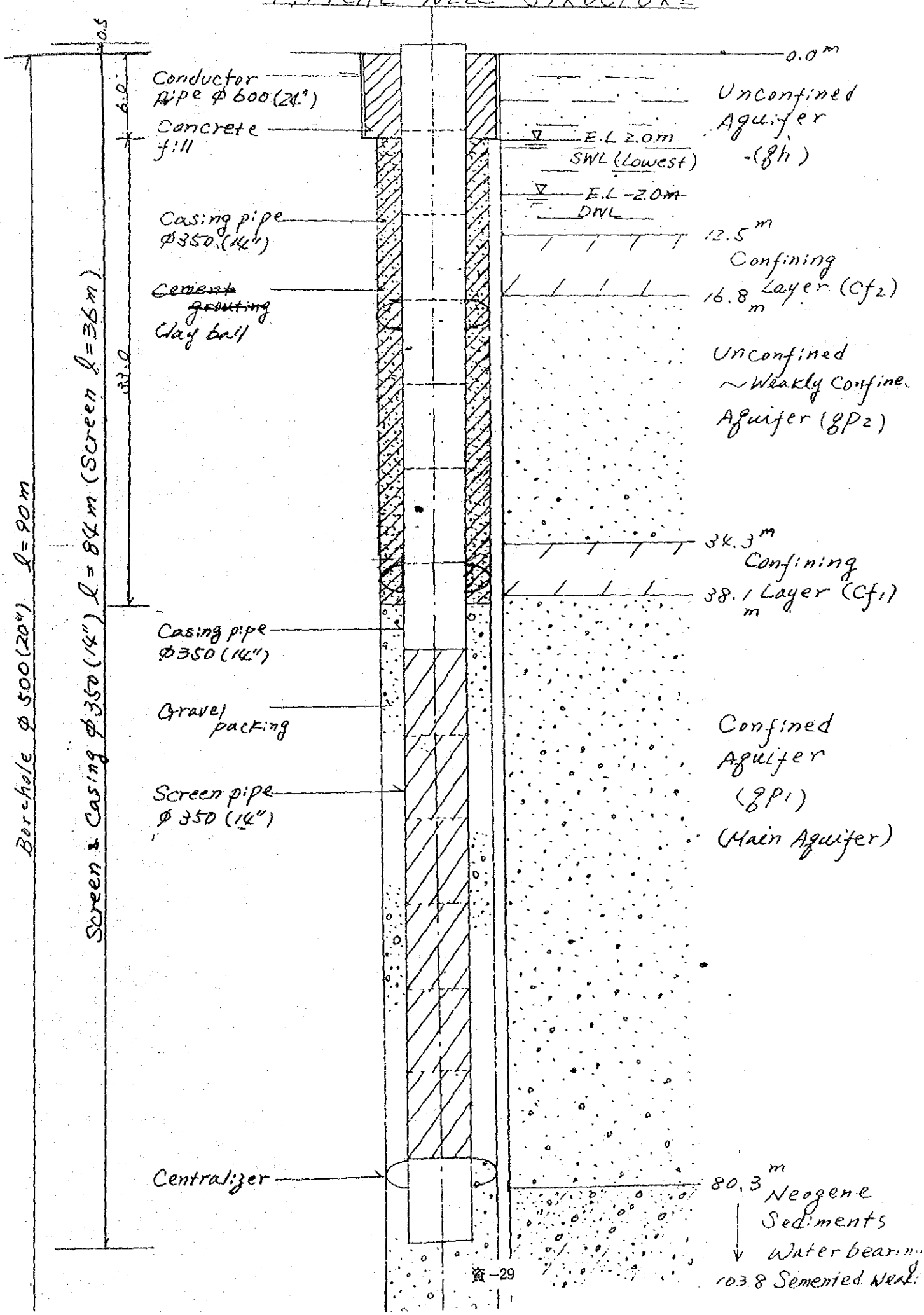
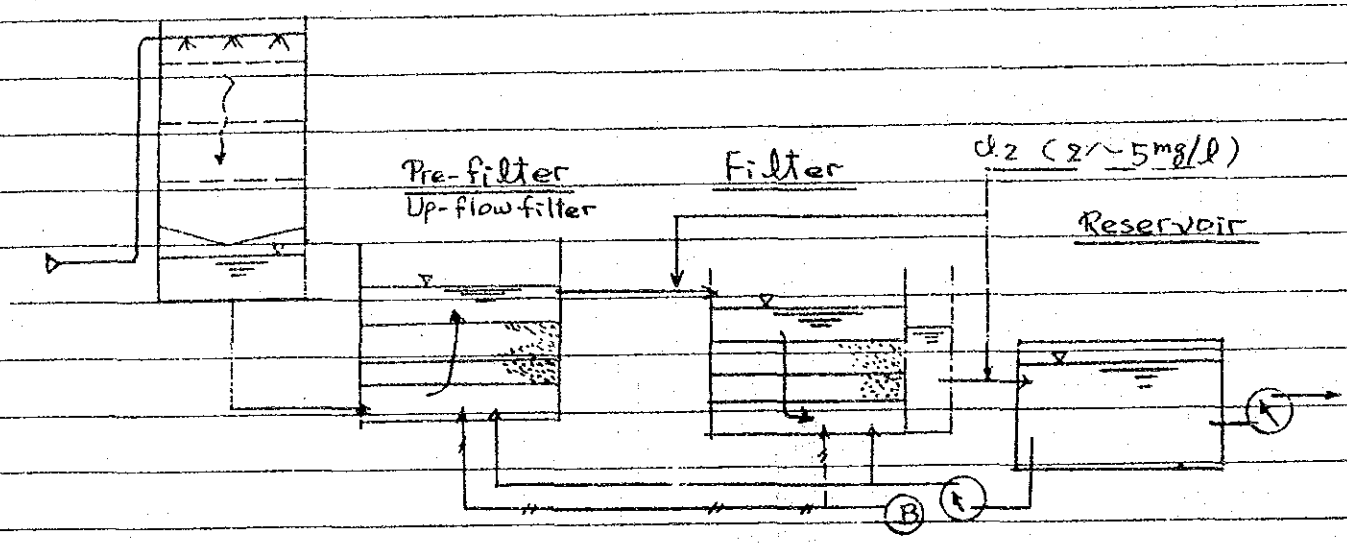

TYPICAL WELL STRUCTURE
0.5
6.0
32.0
Borehole ϕ 500 (20") ℓ = 90 m
Screen & Casing ϕ 350 (14") ℓ = 84 m (Screen ℓ = 36 m)
Conductor pipe ϕ 600 (24")
Concrete fill
Casing pipe ϕ 350 (14")
Cement grouting
Clay ball
Casing pipe ϕ 350 (14")
Gravel packing
Screen pipe ϕ 350 (14")
Centralizer
0.0 m
Unconfined Aquifer (gh)
E.L 2.0m SWL (Lowest)
E.L -2.0m DWL
12.5 m
Confining Layer (Cf2)
16.8 m
Unconfined ~ Weakly Confined Aquifer (gP2)
34.3 m
Confining Layer (Cf1)
38.1 m
Confined Aquifer (gP1) (Main Aquifer)
80.3 m
Neogene Sediments
Water bearing
Cemented Wea

Fig 3-a

1. Process Flow

Alternative 1 2 steps filtralation system



Alternative 2 2 steps filtration system

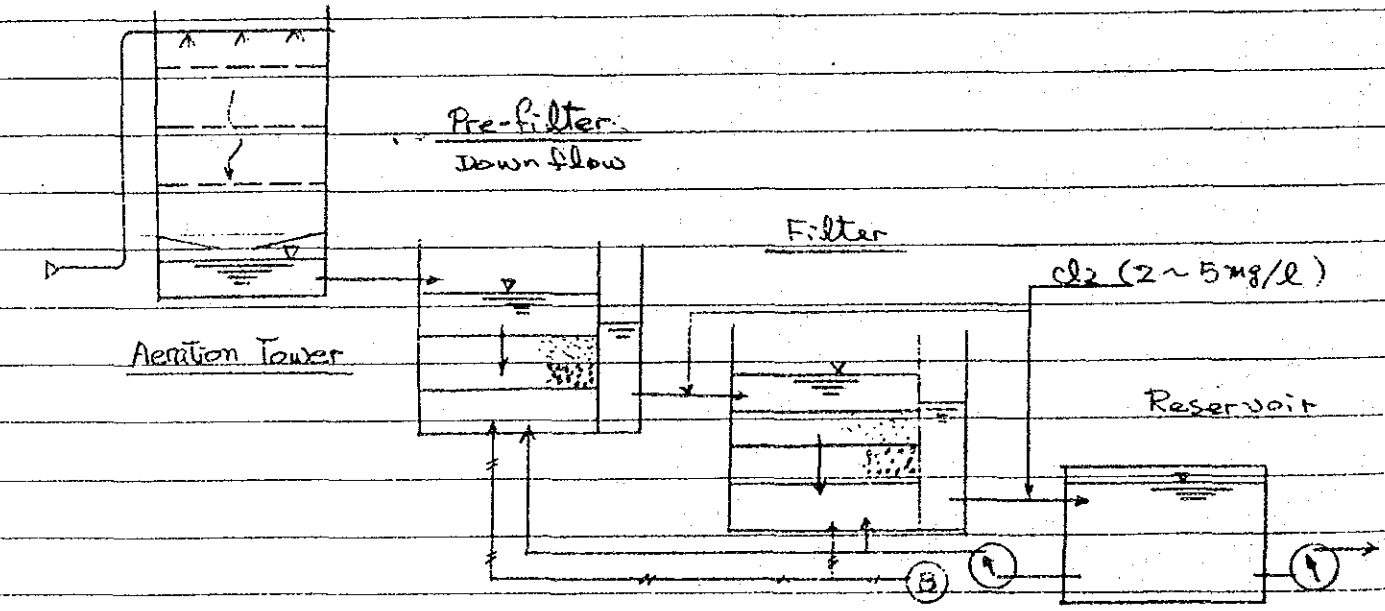


Fig 3 b

Alternative 3 sedimentation and filter.

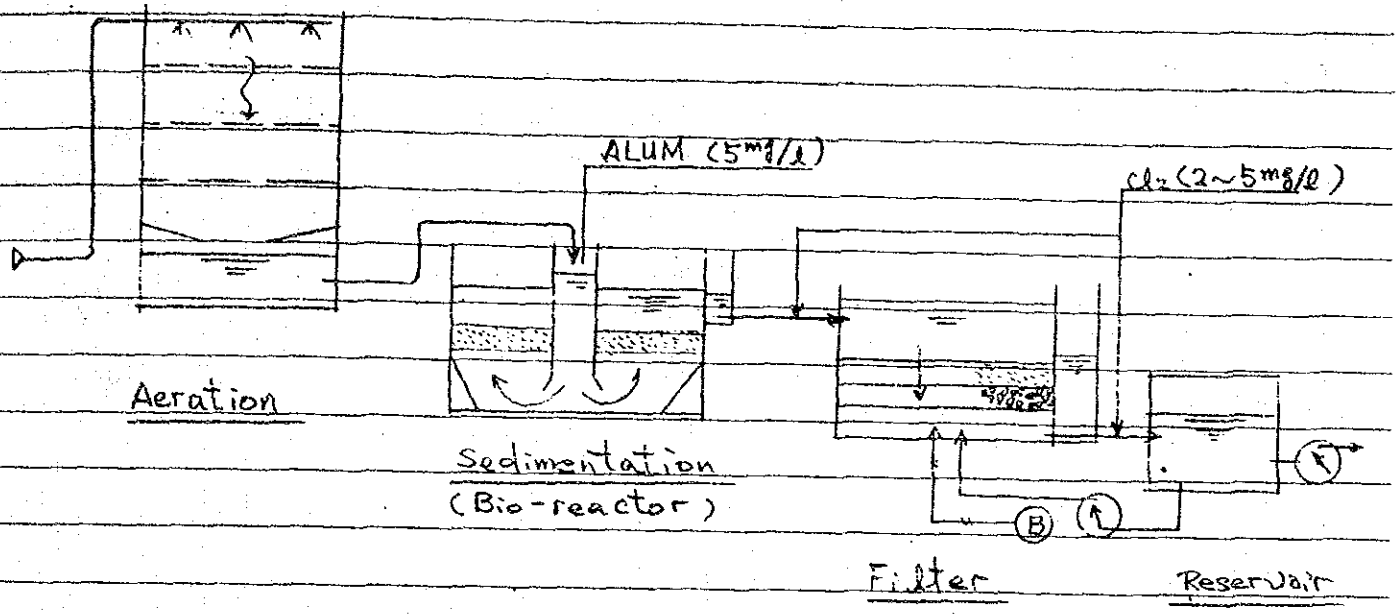
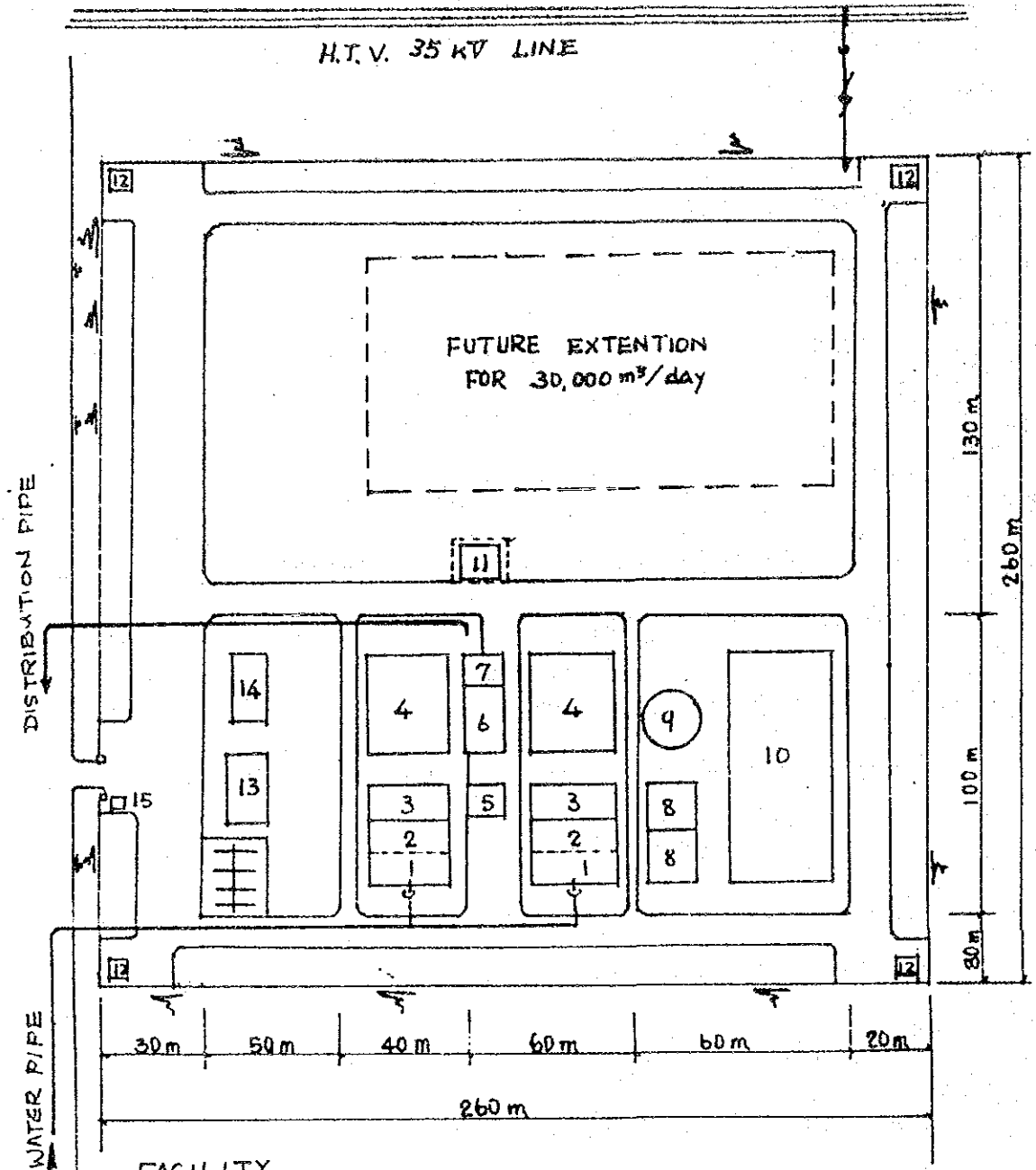


Fig 4

PAGE 11



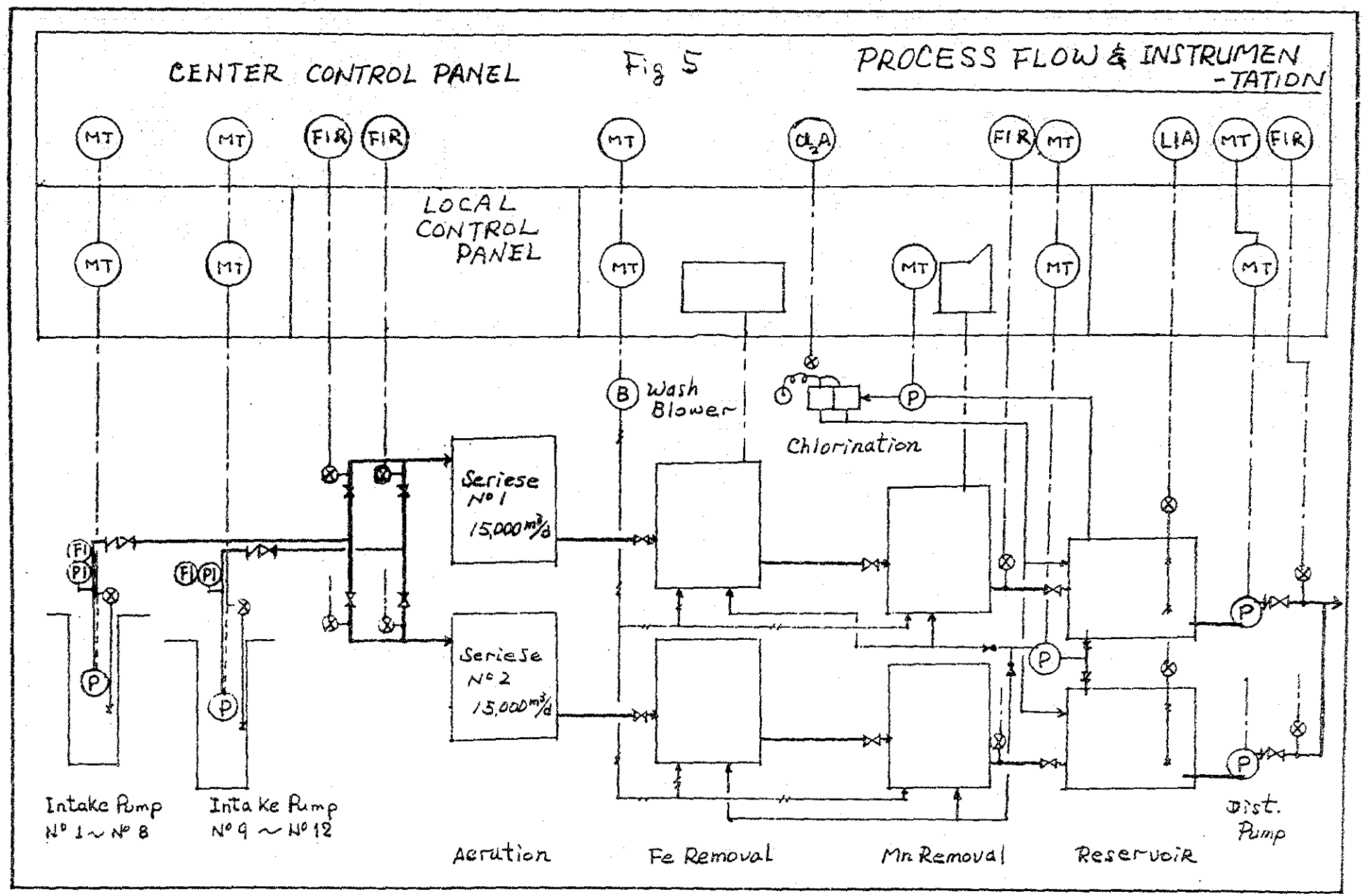
FACILITY

1. AERATION TOWER
2. IRON REMOVE
3. MANGANESE REMOVE
4. RESERVOIR TANK
5. CHLORINATION HOUSE
6. PUMP HOUSE
7. ELECTRIC CONTROL HOUSE
8. SLUDGE RESERVOIR
9. THIKNER
10. DRAYING BED
11. ELECTRICAL SUB STATION
12. INTAKE WELL
13. ADMINISTRATION BLD.
14. WORK-SHOP & STORE
15. GUARD HOUSE

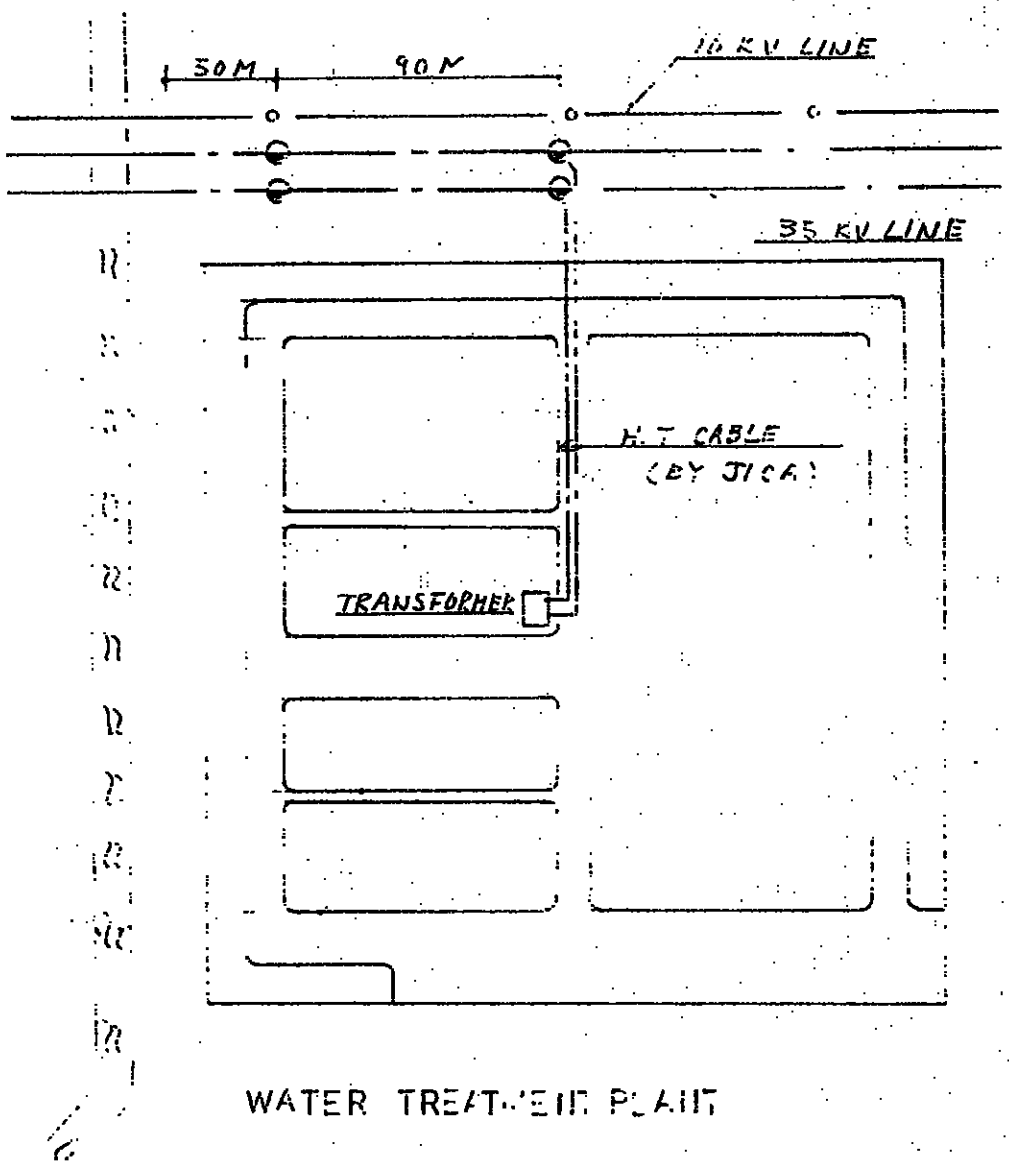
LAYOUT PLAN FOR WATER TREATMENT PLANT

ROUTE N° 5 ⟹ HÀI Phòng

PRELIMINARY

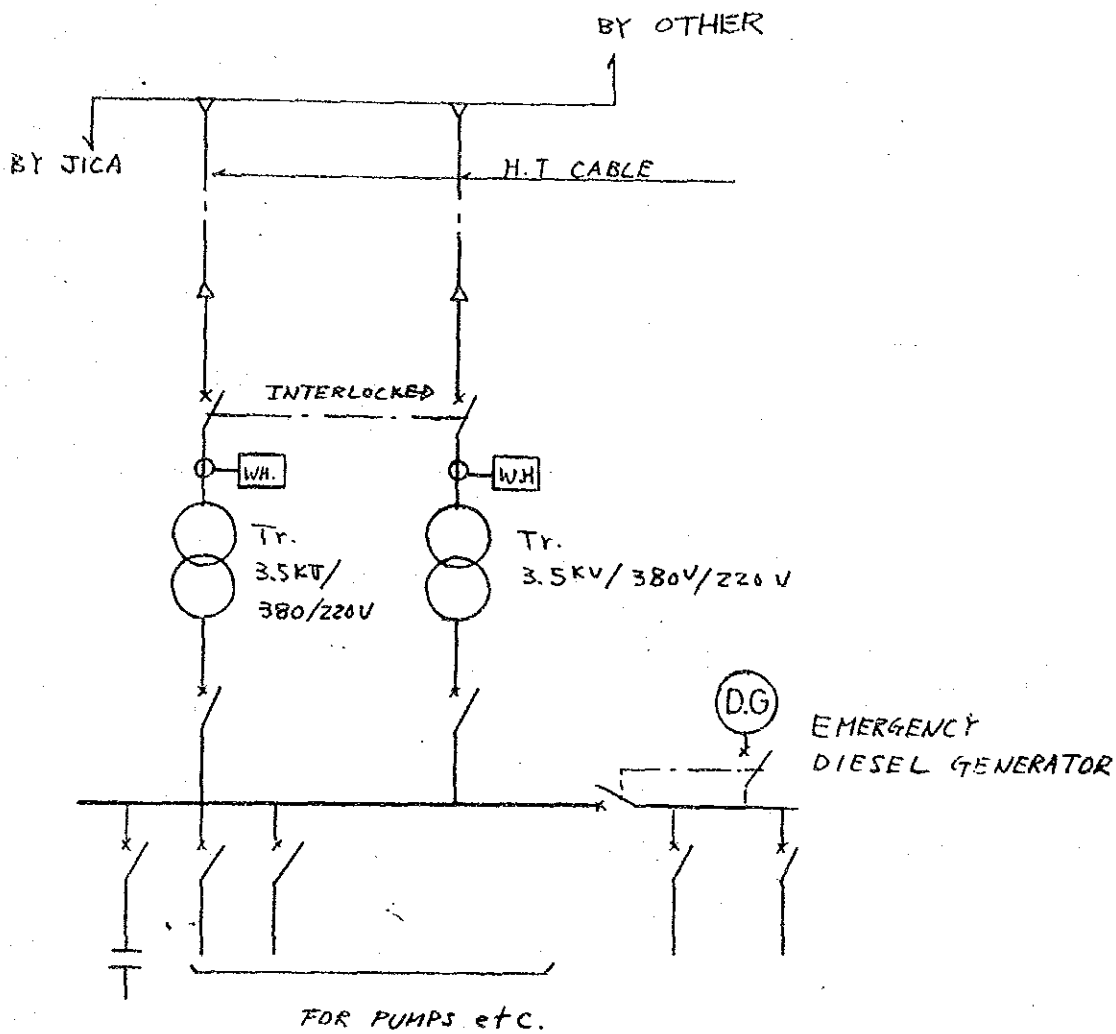

CENTER CONTROL PANEL
Fig 5
PROCESS FLOW & INSTRUMEN-TATION
MT
FIR
LIA
Cl_2A
LOCAL CONTROL PANEL
B Wash Blower
Chlorination
Seriese N°1 15,000m³/d
Seriese N°2 15,000m³/d
FI
PI
P
Intake Pump N° 1 ~ N° 8
Intake Pump N° 9 ~ N° 12
Dist. Pump
Aeration
Fe Removal
Mn Removal
Reservoir

POWER CONNECTION FOR WATER PLANT



SINGLE LINE DIAGRAM

(in case of two (2) Transformer will be installed)



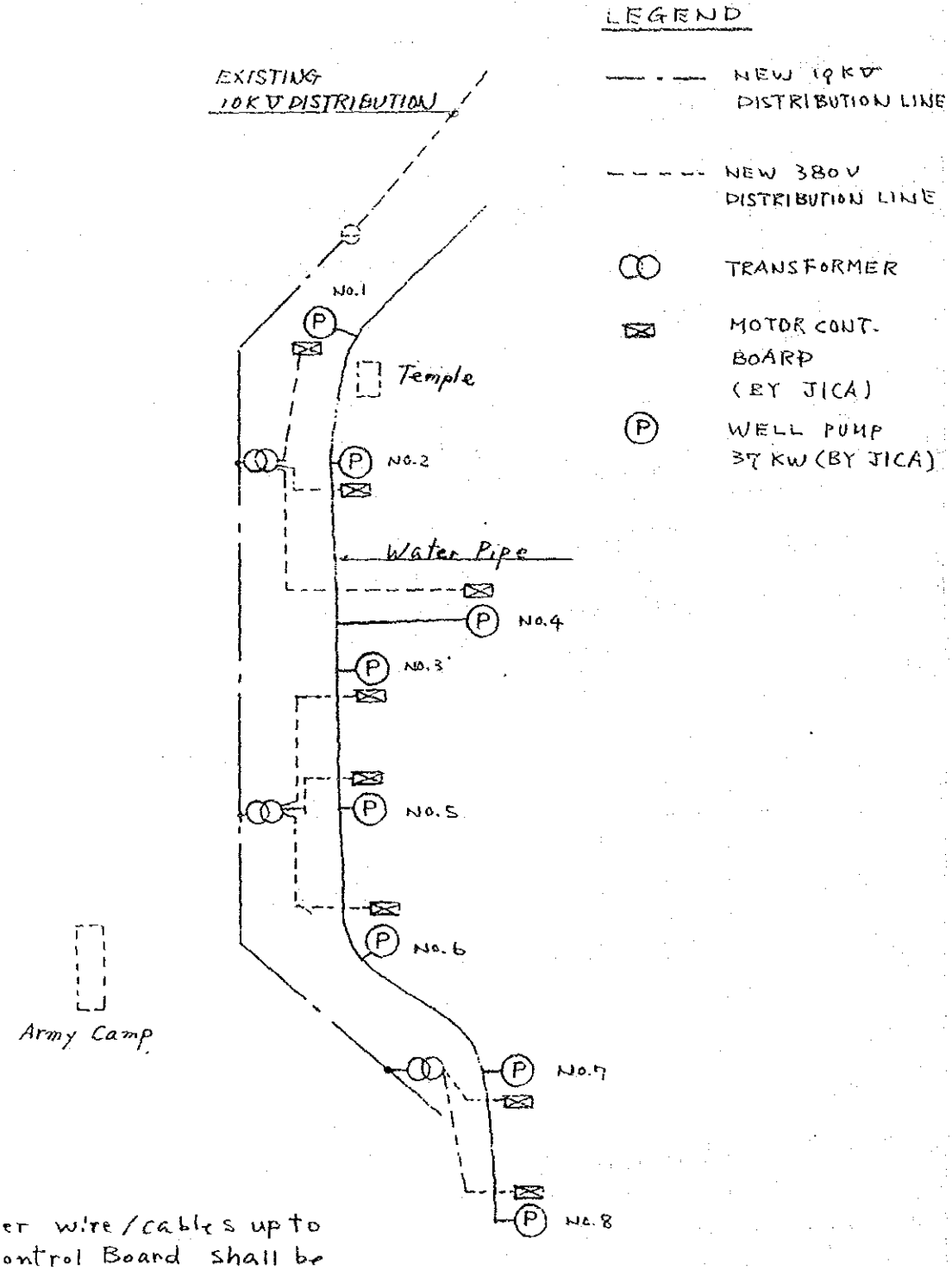
Note

All standard meters such as Amp. Meter Volt. Meter var Meter, Power Factor etc. shall be provided.

W.H.M shall be provided at both H.T and L.V side.

H.T side W.H.M. shall be used for calculating the tariff.

WELL FIELD POWER DISTRIBUTION



NOTE

All power wire/cables up to Motor Control Board shall be supplied and installed by other.

LNDUSE2.XLS

LAND USE PLAN OF GIA LAM WATER SUPPLY SERVICE AREA

Table 1-a

KHU NGOC THUY

Block No	1992	2000	2010	Domestic		Public Use	Cleaning	Irrigation	Total	Loss	Daily Ave.	Daily Max.	Plant Ope.	Intake Caps.	
				Residential	Industrial									D Ave	D Max
				150 l/c/d	30*50%	16 l/c/d	10 l/c/d	20 m3/ha	m3/d	1.25% of 10	10+11	12*1.4	12 * 7%	12+14	13+14
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A1	125	156	195	23	195	2	2	0	222	25	248	347	17	265	364
A2	155	1,026	2,120	154	0	18	10	0	181	20	201	282	14	215	296
A3	370	832	1,635	140	0	15	9	0	164	18	183	256	13	196	269
Total	650	2,117	3,950	318	195	34	21	0	568	64	631	884	44	676	928

LNDUSE2.XLS

Table 1-b

Block No	1992	2000	2010	Domestic		Public Use	Cleaning	GIA LAM Irrigation	Total	Loss	Daily Ave.	Daily Max.	Plant Ope.	Intake Caps.	
				Residential	Industrial									D Ave	D Max
				150 l/c/d	30*50%	16 l/c/d	10 l/c/d	20 m3/ha *40%	m3/d	11.25% of 10	10+11	12*1.4	12 * 7%	12+14	13+14
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
B1	1,360	1,360	1,360	204	0	22	14	0	239	27	266	373	19	285	391
B2	1,500	1,627	1,786	244	0	26	16	9	295	33	328	460	23	351	483
B3	3,000	2,731	2,394	410	0	44	27	16	497	56	552	773	39	591	812
B4	600	604	608	91	300	10	6	0	406	46	452	633	32	484	664
B5	1,500	1,935	2,478	290	0	31	19	0	341	38	379	530	27	405	557
B6	1,630	1,746	1,881	262	0	28	17	0	307	35	342	479	24	366	503
B7	2,260	2,229	2,166	334	11	36	22	0	403	45	448	628	31	480	660
B8	2,200	1,966	1,448	280	0	30	19	0	328	37	365	511	26	391	537
B9	1,500	1,440	1,366	216	0	23	14	0	254	28	282	395	20	302	415
B10	2,100	1,868	1,127	250	0	27	17	0	293	33	327	457	23	349	480
B11	1,200	1,118	1,016	168	0	18	11	0	197	22	219	307	15	234	322
B12	1,100	780	380	117	0	12	8	28	165	19	184	257	13	197	270
B13	0	171	384	26	0	3	2	10	40	4	44	62	3	47	65
B14	40	71	110	11	5	1	1	29	47	5	52	73	4	56	76
B15	500	616	760	92	0	10	6	0	108	12	121	169	8	129	177
B16	350	502	691	75	0	8	5	0	88	10	98	137	7	105	144
B17	380	422	475	63	0	7	4	0	74	8	83	116	6	88	122
B18	150	363	630	55	0	6	4	0	64	7	71	100	5	76	105
B19	0	299	672	45	0	5	3	0	53	6	58	82	4	63	86
B20	1,800	1,825	1,407	244	0	26	16	0	286	32	318	446	22	341	468
B21	2,000	1,788	1,478	265	0	28	18	0	311	35	346	485	24	370	509
B22	0	227	510	34	0	4	2	9	49	6	55	76	4	58	80
B23	400	853	1,419	128	0	14	9	6	157	18	174	244	12	186	256
B24	200	127	35	19	0	2	1	2	25	3	27	38	2	29	40
Prk &Grn				0	0	0	0	2	2	0	3	4	0	3	4
Total	25,790	26,146	26,591	3,922	316	418	261	112	5,030	566	5,596	7,834	392	5,987	8,225

LNDUSE2.XLS

Table 1-c

				DUC GIANG											
Block No	1982	2000	2010	Domestic		Public Use	Cleaning	Irrigation	Total	Loss	Daily Ave	Daily Max	Plant Ope.	Intake Cape.	
				Residential	Industrial									D Ave	D Max
				150 l/c/d	30*50%	16 l/c/d	10 l/c/d	20 m3/ha *40%	m3/d	11.25% of 10	10+11	12*1.4	12 * 7%	12+14	13+14
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
C1	0	0	0	0	114	0	0	0	114	13	127	178	9	136	186
C2	220	744	1,400	112	148	12	7	10	288	33	322	450	23	344	473
C3	1,875	2,321	2,879	348	0	37	23	36	445	50	495	892	35	529	727
C4	0	0	0	0	88	0	0	0	88	8	75	105	5	80	110
C5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C6	2,225	2,417	2,656	382	50	39	24	4	478	54	533	746	37	570	783
C7	320	178	0	27	240	3	2	0	271	31	302	423	21	323	444
C8	0		0	0	0	0	0	0	0	0	0	0	0	0	0
C9	480	1,013	1,680	152	0	16	10	0	178	20	198	278	14	212	292
C10	600	511	400	77	0	8	5	3	83	10	104	145	7	111	152
C11	800	780	960	114	0	12	8	8	142	16	158	221	11	169	232
C12	200	287	418	45	0	5	3	3	55	6	62	86	4	66	91
C13	900	1,040	1,216	156	0	17	10	10	193	22	215	301	15	230	316
C14	900	1,007	1,140	151	0	16	10	14	182	22	213	298	15	228	313
C15	50	72	100	11	0	1	1	0	13	1	14	20	1	15	21
C16	50	418	878	63	21	7	4	0	95	11	105	147	7	113	155
C17	2,272	2,272	2,272	341	0	36	23	2	402	45	448	627	31	479	658
C18	800	722	624	108	0	12	7	0	127	14	141	198	10	151	208
C19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C20	0	320	720	48	0	5	3	0	58	6	63	88	4	67	92
C21	0	785	1,788	119	0	13	8	10	150	17	167	233	12	178	245
C22	0	0	0	0	0	0	0	25	25	3	28	40	2	30	42
C23	2,084	1,892	1,852	284	35	30	19	0	368	41	409	573	29	438	602
C24	2,518	2,828	3,217	424	21	45	28	57	575	65	640	896	45	685	941
C25	858	477	0	72	339	8	5	0	423	48	471	659	33	504	692
Total	16,850	20,063	24,000	3,013	1,035	321	201	184	4,754	535	5,288	7,404	370	5,659	7,774

LNDUSE2.XLS

Table 1-d

SAI DONG

Block No	1992	2000	2010	Domestic		Public Use	Cleaning	Irrigation	Total	Loss	Daily Ave.	Daily Max.	Plant Ope.	Intake Capa.	
				Residential	Industrial									D Ave	D Max
				150 l/c/d	30*50%	16 l/c/d	10 l/c/d	20 m3/ha *40%	m3/d	11.25% of 14	10+11	12*1.4	12 * 7%	12+14	13+14
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
D1	120	644	1,300	97	0	10	6	0	113	13	125	177	9	135	186
D2	100	500	1,000	75	0	8	5	0	88	10	98	137	7	105	144
D3	70	650	1,375	98	0	10	7	0	114	13	127	178	9	136	187
D4	0	422	950	63	0	7	4	0	75	8	83	116	6	89	122
D5	200	273	364	41	0	4	3	0	48	5	53	75	4	57	79
D6	1,280	1,778	2,400	267	0	26	18	0	313	35	348	487	24	372	512
D7	180	722	1,400	108	0	12	7	0	127	14	141	198	10	151	208
D8	100	56	0	8	345	1	1	0	354	40	394	552	28	422	580
D9	616	342	0	51	65	5	3	16	141	16	157	219	11	168	230
D10	760	422	0	63	107	7	4	0	181	20	201	282	14	215	295
D11	1,960	2,042	2,144	306	0	33	20	0	359	40	400	560	28	428	588
D12	1,515	1,714	1,982	257	0	27	17	0	302	34	336	470	23	359	493
D13	0	0	0	0	51	0	0	16	67	8	75	105	5	80	110
D14	2,177	2,134	2,080	320	15	34	21	11	402	45	447	626	31	478	657
D15	900	789	650	118	184	13	8	0	323	36	359	503	25	385	528
D16	842	857	875	129	0	14	9	10	160	18	178	250	12	191	262
D17	300	187	0	25	224	3	2	22	275	31	306	429	21	328	450
D18	0	0	0	0	190	0	0	16	206	23	229	320	16	245	335
D19	0	0	0	0	216	0	0	15	231	26	257	360	18	275	378
D20	0	0	0	0	360	0	0	0	360	41	401	561	28	429	589
D21	0	802	2,030	135	0	14	9	0	159	18	177	247	12	189	260
D22	500	1,878	3,600	282	0	30	19	2	333	37	370	518	26	396	544
D23	380	1,931	3,870	290	0	31	19	0	340	38	378	529	26	405	556
Frk&Grn				0	0	0	0	45	45	5	50	70	3	53	73
Total	12,000	18,223	28,000	2,733	1,755	292	182	154	5,116	576	5,692	7,968	398	6,090	8,367

Table 1-a

SUMMARY

Block No	1992	2000	2010	Domestic		Public Use	Cleaning	Irrigation	Total	Loss	Daily Ave.	Daily Max.	Plant Ope.	Intake Capa.	
				Residential	Industrial									D Ave	D Max
				150 l/c/d	30*50%	16 l/c/d	10 l/c/d	20 m3/ha *40%	m3/d	11.25% of 1	10+11	12*1.4	12 * 7%	12+14	13+14
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Ngoc Thuy	650	2,117	3,850	318	195	34	21	0	568	64	631	884	44	676	928
Gia Lam	25,790	26,148	28,581	3,822	316	418	261	112	5,030	566	5,596	7,834	392	5,987	8,225
Duc Giang	16,950	20,083	24,000	3,013	1,035	321	201	184	4,754	535	5,288	7,404	370	5,659	7,774
Sai Dong	12,000	18,223	26,000	2,733	1,755	292	182	154	5,116	576	5,692	7,968	398	6,090	8,367
0	55,390	66,569	80,541	8,885	3,301	1,065	668	450	15,467	1,740	17,207	24,090	1,204	18,412	25,294

Sub Urban

Block No	Name	Area	Demand											
		ha	m3/day											
A1	Gia Thuong	5.5	52.8					53	6	59	82	6	64	88
B1	Gia Quat	12.5	120											
B2	Gia Thuy	17	158											
B3	Ngoc Lam	26	250											
B4	Lam Du	30	288											
sub total		85	816					816	82	898	1,271	64	971	1,334
C1	Viet Hung	64	614											
C2	Thuong Cat	25	235											
C3	Duc Giang	12	115											
C4	Thanh Am	14	134											
sub total		115	1,099					1,099	124	1,223	1,712	86	1,308	1,797
D1	Gia Thuy	25	240											
D2	Xon Dang	8	72											
D3	Thon Ngo	35	336											
D4	Xon Long Bien	46	437											
sub total		113	1,085					1,085	122	1,207	1,690	84	1,292	1,774
Total		313	3,053					3,053	343	3,396	4,755	238	3,634	4,992
Grand Total			13,038	3,301	1,065	668	450	18,520	2,083	20,603	28,845	1,442	22,046	30,287

Table 2

Design Raw Water Quality

	Max.	Min
Turbidity	0	0
Colour	0	0
Temp.	27°C	24°C
pH	6.8	6.5
Σ Fe ($Fe^{2+}+Fe^{3+}$) · mg/l	22	10
Σ Mn "	1.0	0.5
NH_4-N "	1.0	0.7
Ca (as $CaCO_3$) "	55	
HCO_3 (as $CaCO_3$) "	200	
Alkalinity (as $CaCO_3$) "	250	
Total Hardness (as $CaCO_3$) "	180	
Cl^-	31	
NO_2^-	0	
NO_3^-	0	
PO_4^{-2}	3.0	
SO_4^{-2}	4.0	

Standard for Drinking and Domestic Water Quality
(Water Supply Design Standard, 20 TCN-33-85)
Standard for ~~the~~ Urban Area

Contents	Standard	Remarks
Colour	< 10	
Taste (after boiled 40°~50°C)	0	
Unsolubud Suspended Solid	≤ 3	mg/l
Dry Suspended Solid	< 1000	"
pH	6.5 ~ 8.5	
Hardness	< 12	°dH
Nacl (Sea area)	< 400	mg/l
" (Normal area)	70 ~ 100	"
NO_3^-	< 6	"
~~H_2S~~ NO_2^-	0	"
H_2S	0	"
NH_4^+ (Surface water)	0	"
" (Under-ground water)	< 3	"
Pb^+	< 0.1	
As^+	< 0.05	"
Cu^{++}	< 3	"
Zn^{++}	< 5	"
Fe	< 0.3 *1	"
Mn	< 0.2	"
F^-	0.7 ~ 1.5	"
I^-	0.005 ~ 0.007	"
COD	0.5 ~ 2	"
Ca^{++}	75 ~ 100	"
PO_4	1.2 ~ 2.5	
Cr	ND	
CN	ND	
Phenol	0	mg/l

Table 3

Residual chlorine (total as)	< 0.5	mg/l
〃 (free at end of network)	< 0.05	〃

*1. Allowable iron content is ~~up to~~ not exceed 0.5 mg/l

添付資料 6

ハノイ市水道公社年報

HANOI WATER SUPPLU COMPANY FINANCIAL REPORT '93

Water production:	115,200,000 m^3/year	
Water billed:	63,360,000 m^3/year	
Water sold:	53,856,000 m^3/year	
Non accounted water:	45% of loss + Public tap 15%	
Water tariff:	Domestic	800 d/m^3
	Industry	1,600 d/m^3
	Public Use	1,200 d/m3
	Foreigner	0.45 US$/$m^3$
Number of employees		
	Graduates	117
	Highschool	99
	Others	1,448
Total		1,689

I. Chemical cost

1) Chlorine

4,200 d/kg 1kg/1,000 m^3

(115,200,000x85%x4,200x1.05)/1,000= 431,827,000

2) Hypochlorine(15%)

50 l/1,000 m^3 1,000 d/kg

(115,200,000x15%x50x1,000x1.05)/1,000= 907,200,000

3) Chlorine cylinge maintenance 150,000,000

Total 1,489,027,200

II Electricity

0.41kw/m^3, 480d/km

480x0.41x115,200,000= 22,671,360,00

480x0.41=196.8 d/m^3III Salaries

Average salary: 184,000 d/month

184,000x950x12= 2,097,600,000

IV.Operation cost of euipment

Fixed asset 31,12,1992	62,000,000,000	
Increase in 1992	33,000,000,000	
Total		95,000,000,000
Depreciation:5%	4,750,000	
3%	2,850,000	
Salaries: 184,000x94x12=	211,968,000	
Repare	8,000,000	
Total		8,611,968,000

74.8 d/m^3

V.Workshop cost

Salaries: 184,000x51x12=	112,608,000	
Safety cloth: 12,000x174=	209,640,000	
Fuel for transportation:	210,000,000	
Diesel :	33,000,000	
Skocial insurance:184,000x747x12=	655,753,920	
Other expense:	50,000,000	
Electricity:	20,000,000	
Material for maintenance:	2,880,000,000	
Total		4,351,001,920

37.8 d/m^3

VI. Distribujtion

Saralies: 184,000x450x12=	993,600,000	
Meter repare:	917,000,000	
Pipe repare:	120,000,000	
Flushing and air scouring:	79,000,000	
Pipe repare of net works	300,000,000	
Public taps:	60,000,000	
Advertizemrent:	200,000,000	
Electricity for booster pump:	400,000,000	
Regular repare:	500,000,000	
Others:	50,000,000	
Total		3,619,900,000

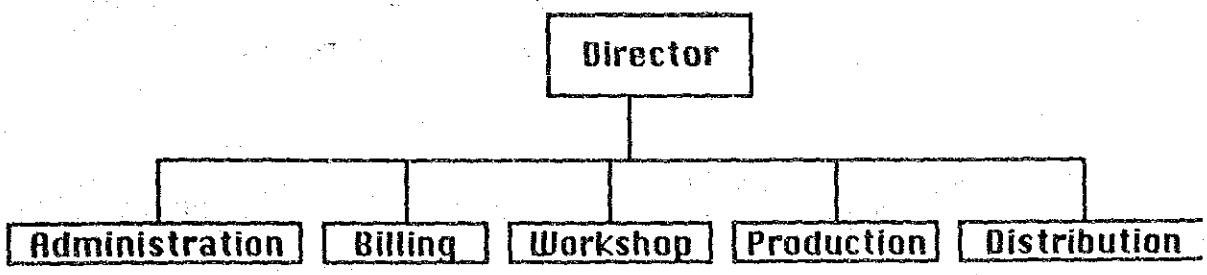
399.8 d/m^3

添付資料 7

ザーラム水道公社試案

PROPOSED ORGANIZATION
OF
GIA LAM WATER SUPLY CORPORATION

The organization of the water supply corpaoration of Gia Lam Water Supply is proposed as shown below.



Number of necessary staff is estimated considering the production capacity of Mai Dih and Gia Lam treatment plants.

1. Administration 16

2. Billing 20

3. Workshop

Manager	1
Deputy Manager	1
Sanitary Engineer	2
Electrical Engineer	2
Mechanical Engineer	2
Piping Engineer	3
Workers	30
Total	41

4. Production

Manager	1
Operator	2
Water Quality Specialist	1
Worker	20
Attendant	
Foreman	1
Water Source	2
Electric/Mechanical	2
Guardman at wells	2
Guardman at Plant	2
Sub total 8 x 4 shift	=32
Total	55

5. Distribution

Manager	1
Assistant	2
Piping Engineer	2
Surveyor	2
Worker	20
Grand Total	158

ESTIMATION OF WATER PRODUCTION COST

1. Salaries

Administration and Billing 200,000x37x12=	88,800,000

2. .Administration

1) Transportation 15,000x160x50%x12=	14,400,000
2) Sacurity	7,000,000
3)Fire Preventive	3,600,000
4) Drinking water 1,500x160x12=	2,880,000
5) Medical care 2,000x160x12=	4,000,000
6) Medical insurance	15,000,000
7) Electricity	30,000,000
8) Reception cost for adviser	10,000,000
9) Training	6,000,000
10) Transportation	16,000,000
11) Communication	6,000,000
12) Printing	12,000,000
13) Stationary	

		7,000,000
14) Reception and holiday		4,000,000
15) Social insurance		38,400,000
16) Others		80,000,000
Total		256,280,000
3 Workshop		
1) Salaries 200,000x41x12=		98,400,000
2) Safety cloth 120,000x41=		4,920,000
3) Fuel for transportation		20,000,000
4) Diesel		3,000,000
5) Other expense		5,000,000
6) Electricity		2,000,000
7) Meintenance materials		144,000,000
Total		272,404,000
4 Production		
1) Salaries 200,000x55x12=		132,000,000
2) Chemicals Chlorine and Al.sulfate	25.5 d/m3xQ	
3) Electricity	141 d/m3xQ	
5. Distribution		
1) Salaries 200,000x27x12=		64,800,000
2) Electricity	183 d/m3xQ	

3) Repare	24,740,000

6.Depreciation

Construction cost

1) Intake	285,200,000
Drilling	31,200,000
Equipment	
Well house	
2) Raw water transmission	360,000,000
600mm DIP 6.1km	
450mm DIP 1.2km	
250mm DIP 0.5km	
3) Treatment plant	2,200,000,000
30,000m^3/day	
4) Distribution pipelines	784,400,000
600mm DIP 1.9km	
450mm DIP 4.6km	
250mm DIP 10.7km	
100mm VP 2.2km	
75mm VP 5.4km	
50mm VP 28.0km	
Water supply device 10,000 pcs	
5) Land acquisition	
40,000x100x6.8x5x10	136,000,000
6) Access road	
13,000x8x550	57,200,000
7) Extension of power line	11,570,000
8) Cousulting fee	300,000,000
Total	4,103,170,000

添付資料　8

計画地域における地下水の検討

計画地域における地下水の検討

もくじ

付　表

付　図

I.地形、地質

紅河デルタは、紅河下流域に発達し、長さ約150km、幅約80kmで北西―南東方向に延び、トンキン湾に面する広大なデルタである。紅河は、中国に源を発し、トンキン湾に注ぐ、流域面積143,600km2、延長1,183km、そのうちの510kmがヴェトナム領域を流下する、ヴェトナム第二の大河川である。ヴェトナムの首都ハノイ市は、紅河沿いに河口から約100km遡った、紅河デルタのやや上流部に位置している。調査対象地区のハノイ市ザーラム地区は、紅河を挟み、市中心部が右岸側に位置するのに対して左岸側に位置している。また、地区の南東部を除く、三方が、紅河およびその支流のドン河によって画されている。紅河およびドン河の河岸付近（堤外地）の標高は約10mを示すのに対し、地区中心部（堤内地）の標高は約４～６mで平坦であり、一種の天井川的地形を示している。

紅河デルタは、主に紅河によってもたらされた洪、沖積世にわたる流送土砂によって構成される。これら洪、沖積層の厚さは、調査対象地区付近で平均80mに達し、その内の砂礫層などの粗粒な部分は良好な地下水滞水層を形成している。デルタ周辺の丘陵地、山地は、おもに中生層によって構成されるが、デルタの基盤は、新第三紀の堆積岩類によって構成されることが知られている。

II.水理地質

紅河デルタを構成する洪、沖積層の厚さは、調査対象地区付近で平均80mに達し、そのうちの砂礫層などの粗粒な部分は良好な地下水滞水層を形成している。このデルタの地下水開発は、フランス植民地時代の古くから積極的に進められてきており、ヴェトナム地質局をはじめとする関係諸機関による既存井戸などの資料収集と解析により、デルタの水理地質は、かなり解明されている。

II-1.既存井戸

調査対象地区の既存井戸分布図を図－１に示す。また、各井戸の詳細については表－１～表－３に示した。

調査対象地区の井戸を、次の３種類に区分した。

1)観測井(Monitoring Well)

地下水位観測を主目的とした井戸である。FINNIDAの援助によるもので、ザーラム地区では1989年から、設置、観測が実施されている。水位観測は地質局によって１週間毎に行われている。設置箇所は、これからも増やす計画であるが、現在、M-1～M-7の７箇所に、対象とする滞水層別に13本の井戸がある。スクリーンの径は60～110 mmである。

2)試験井(Pilot Well)

主に、次に述べる生産井に先だって、地質調査および揚水試験を目的に掘削された井戸である。P-1～P-12の12本がある。スクリーン径は108～168mmである。

3)生産井(Exploiting Well)

主に、上水道、工業用水など水源としての地下水採取を目的とした井戸である。E-1～E-23の23箇所に30本の井戸があり、統計では合計、約19,000m3/dの揚水を示しているが、実際には合計、約30,000m3/dの地下水が揚水されていると言われている。スクリーン径は168～370mmである。

II-2.水理地質の構成

調査対象地区付近の水理地質の構成の概要を図－３に示す。

II-2-1.新第三紀　基盤岩類（m4）

本層は、紅河デルタの基盤をなす。上部の厚さ16～31mの部分は、固結度の小さな礫岩、砂岩などで構成される。この部分からは若干の地下水を産出する。この部分の下位は、良く固結した頁岩、シルト岩、砂岩それに割れ目の少ない礫岩で構成され、地下水はほとんど産出しない。

調査対象地区周辺には、本層での、いくつかの揚水試験結果がある。それによれば、比湧出量は、1.10～3.75l/s/m（平均2.53l/s/m）であり、透水量係数は、46～1,064m2/d（平均604m2/d）である（スクリーン径は108～168mm）。

II-2-2.第四紀

a.洪積世

a-1.被圧滞水層（qp1）

本層は主要滞水層であり、前記、生産井のほとんどは、本層を対象としたものである。

上、中部は、砂、砂礫からなり、下部は、おもに砂、シルト質砂と小さめの大礫からなる。本層は、北西から南東方向にかけて厚くなる傾向を見せ、28.6mから84.6mまで変化する。平均は42.2mであり、通常は30～50mである。

調査対象地区および周辺での、本層を対象とした揚水試験結果によれば、比湧出量は、1.54～7.99l/s/m（平均5.37l/s/m）、透水量係数は、957～2,900m2/d（平均1,628m2/d=1.90 x 10^{-2}m2/sec）である（スクリーン径 は108～168mm）。

観測井による、本層の被圧水頭は、1992年を例にとり（M-2については1990年）、特異な値を示すM-1を除外してみると、４～５月に最低水位を示し、標高で2.33～3.28m（平均2.75m),また７～８月に最高を示し、標高で6.05～7.97m（平均7.16m）である。地区内では、それぞれの季節には、ほとんど差のない、平坦な標高を示すが、季節による変化は4.41mに達する。

a-2.賦圧層 I（cf1）

滞水層（qp1）と後述する滞水層（qp2）の間にある難～不透水層である。

砂混じりの粘土からなり、厚さは、0.9mから6.9mまで変化する（平均3.9m）。紅河沿いの堤外地の一部では、本層を欠いている。

a-3.不圧～弱被圧滞水層（qp2）

地区内で、本層を対象とした生産井は無い。

主に、中～粗粒砂岩で構成され、底部では、若干の礫を混じる。厚さは2.5mから22.5mまで変化するが、通常15～20mである。

地区周辺の本層を対象とした井戸の観測結果によれば、本層の被圧の程度は、一般に弱く、水位（被圧水頭）は、地表から深度４m付近にある。

b.沖積世

b-1.賦圧層 II（cf2）

滞水層（qp2）と後述する不圧（自由）地下水滞水層（qh）の間にある難～不透水層である。

粘性土からなり、厚さは1.7～6.9m、平均4.3mである。紅河沿いの一部では、本層を欠いている。

ハノイ地区での試験結果によれば、本層の平均透水係数は、0.023m/dayである。

b-2.不圧滞水層（qh）

一般家庭などの手堀井戸は本層を対象としている。

主に砂およびシルト質砂で構成され、下方に向かい礫を混じる。厚さは7.5m～19.5mであり、平均12.53mである。水位は、通常、深度2～4mである。

地区周辺での試験結果では、比湧出量は1.98l/s/m、透水係数は27.9m/dを示している。

II-3.地下水の水質

表－４に地区内の地下水の水質分析結果を示す。地下水は、主滞水層の（qp1）のものである。観測井と生産井によって、そぞれの分析目的の違いから分析項目の違いが見られるが、注目すべき項目として鉄（全鉄）とマンガンがある。両者ともWHOおよびヴェトナムの都市用飲料水基準を大きく超えている。

III.水量の検討

III-1.地下水の水収支

計画必要水量は、7%の損失を見込み32,100m3/dすなわち年間、約1,170万m3である。

ここで、被圧地下水の水収支式として次式が成立する。

$$Qr=A \cdot S \cdot dh/dt+Qd \quad \cdots\cdots\cdots (1)$$

ここで、

Qr ：水収支区への単位期間あたりのかん養量

Qd ：水収支区からの単位期間あたりの全流出量（揚水量）

A ：水収支区の面積

S ：水収支区の平均貯留係数

dh/dt：水収支区の平均地下水頭変動量

水収支区としては、紅河、ドン河囲まれ、ザーラム地区縫製工場No.10 (Tailoring Enterprise No10) 付近までの調査対象地区36×10^6m2とする。単位期間は1年間とする。

被圧地下水の場合は、揚水による水頭の低下に伴って、滞水層への地下水のかん養が誘発される。当該地区の地下水かん養源としては、紅河、ドン河などの表流水と降雨である。したがって、かん養量は、両河川の年間流量と年降雨量から蒸発量等を差し引いたものの何パーセントかになる。ここでは、河川流量だけを考える。

紅河年平均流量：3,740m3/sec、ドン河年平均流量：886m3/sec

両河川の年流量：$(3,740+886) \times 86,400 \times 365=1.46 \times 10^{11}$m3/year

この両河川の年流量は、既存の井戸の揚水による水頭低下とそれに伴うかん養で収支した結果とみることが出来る。

当該計画の年揚水量は$32,100 \times 365=1,170 \times 10^4$m3/year、貯留係数 (S) は$1.0 \times 10^{-3}$ (仮定) 、水頭変化量 (dh/dt) は4.0mであるから、(1)式の右辺は、

$$(36 \times 10^6) \times (1.0 \times 10^{-3}) \times 4.0 + (1,170 \times 10^4) = 1.18 \times 10^7 \text{m3/year}$$

となる。これを両河川の年流量1.46×10^{11}m3/yearと比較すると約0.01パーセントに相当する。この程度のかん養量は充分期待出来ると思われる。

III-2.水源計画

水源計画は、地下水を水源とすること、井戸あたり50l/secの揚水量を得ることを前提条件にして、井戸構造の検討、影響半径の検討それにウエルフィールドの検討、のそれぞれの検討結果を相互に参照し、試行錯誤的に決定される。以下には、井戸構造と影響半径の検討結果について述べる。

・井戸構造の検討

ハノイ市におけるFINNIDAプロジェクトの実績を参考に、ケーシングおよびスクリーンパイプの径を350mm（14"）とした。裏込め砂利の厚さを考慮してボアホール径は500mm（20"）とした。当該地区の標準的な水理地質構成を参考に、全スクリーン長は、対象とする主帯水層（qp1）の厚さの70%以上になるようにし、ケーシングおよびスクリーンパイプの単位長さとの関係から、それぞれの長さ、深度を決定した。その結果から、ボアホール深度を決定した。

・影響半径の検討

1)透水量係数（T）

対象とする帯水層（qp1）の平均透水量係数（T）は1.90 x 10^{-2}m2/secである。

2)貯留係数（S）

貯留係数（S）の資料はない。したがって、一般的な値の、m2/sec単位の透水量係数よりも1オーダー小さな1.0 x 10^{-3}を仮定する。

3)揚水量（Q）

計画揚水量 50l/sec（50 x 10^{-3}m3/sec）

4)連続揚水時間（t）

計画連続揚水時間　20時間（20 x 3,600=7.2 x 10^{4}sec）

5)井戸径（2r）

計画井戸径 350mm、従って半径（r）=350/2mm=35/2 x 10^{-2}m

タイスの式により、

$s=Q \cdot W(u)/4\pi \cdot T$.....(1)

ここに、

s　：水位降下量

W(u)：井戸関数

したがって、(1)式にQ、Tを代入すると、

s=2.09 x $10^{-1} \cdot W(u)$.....(2)となる。

さらに、

$u=r^2 \cdot S/4 \cdot T \cdot t$　であるから、

r、S、T、tのそれぞれの値から

u=5.59 x 10^{-9} となる

井戸関数標準曲線からu=5.59 x 10^{-9}に対してはW(u)=18となり、これらを(2)代入すると

s=2.09 x 10^{-1} x 18=3.76、すなわち、計画井戸の水位降下量は3.76mとなる。

1.0mの水位降下が観察される箇所までの影響半径（R）は（3）式で求められる

$(s-1)=Q \cdot \ln(R/r)/2\pi \cdot t$.....(3)

求めたs=3.76、それにQ、r、tそれぞれの値から

logR=2.10、R=126mが求められる。したがって、井戸間隔は126 x 2=252m、約250mとなる。

Table 1. Monitoring Well List in Gia Lam Area

No.	Well Name	Location X , Y	Owner	Constructed Date	Elevation (m)	Depth (m)	Screen d(mm),l(m)	Water Level L/H (El.m)	Remarks
M-1	P13a	30.000, 92.675	-	Sep/1989	5.19	50.00	60, 3.0	4.74(0.45)/+0.10(5.29)	SW:P13b for aquifer(qh)
M-2	P15a	27 , 93	-	Sep/1989	6.91	50.00	60, 3.0	4.12(2.79)/+0.11(7.02)	SW:P15b for qh
M-3	Q120b	26 , 94	-	Sep/1989	5	46.51	-,10.1	1.72(3.28)/+1.05(6.05)	SW:Q120 for qh,Q120a for qp2
M-4	P33a	26.716, 89.452	-	Aug/1991	9.66	62.00	90, 9.0	7.33(2.33)/ 2.08(7.58)	SW:P33b for qh
M-5	P49a	24.735, 91.913	-	Sep/1991	10.86	62.00	110,11.0	8.28(2.58)/ 2.89(7.97)	SW:P49b for qh
M-6	Q32	31 , 90	-	Dec/1992	10.00	16.00	90, 9.0	- / -	For qh
M-7	Q121	31 , 91	-	Dec/1992	10	16.00	90, 9.0	- / -	For qh

* Water Level of "M-2" is in 1990, the others are in 1992.
* "L/H" in "Water Level" means the lowest and the highest in a year respectively.
* "SW" in "Remarks" means "set well" and its aiming aquifer.

Table 2. Pilot Well List in Gia Lam Area

No.	Well Name	Location X , Y	Owner	Constructed Date	Elevation (m)	Depth B/W(m)	Screen d(mm),l(m)	Water Level	Remarks
P- 1	M38	30 , 92	-	-	-	22.8/ 7.5	108, 4.5	-	For aquifer(qh)
P- 2	820	25 , 96	-	-	-	87.0/ 82.0	108,23.0	-	For qp1 & m4,T=957m2/d
P- 3	M03	27 , 97	-	-	-	13.0/ 13.0	108, 3.0		For pq2
P- 4	900	32 , 92	-	-	-	111.7/ -	-	-	-
P- 5	4HN	28 , 94	-	-	-	130.0/ 63.0	108,12.0	-	For qp1,T=1,026m2/d
P- 6	7HN	31 , 93	-	-	-	110.0/ 64.0	127,20.0		For qp1
P- 7	49	27 , 90	-	-	-	130.0/125.3	127,49.5	-	For qp1,T=2,900m2/d
P- 8	VTHHSD	27 , 96	-	-	-	60.0/ 57.9	108, 9.0	-	For qp1
P- 9	CHACQ	25 , 97	-	-	-	70.8/ 70.8	168,16.5	-	For qp1
P-10	TCHQ	27 , 90	-	-	-	70.0/ 68.0	168,17.5	-	For qp1
P-11	6HN	28 , 90	-	-	-	118.0/ 59.0	127, 9.0	-	For qp1
P-12	GYV	32 , 94	-	-	-	40.0/ 36.5	127, 7.0	-	For qp1

* "B/W" in "Depth" means borehole and well depth respectively.
* "T" in "Remarks" is transmissivity (m2/day).

Table 3. Exploiting Well List in Gia Lam Area

No.	Well Name	Location X , Y	Owner	Constructed Date	Elevation (m)	Depth (m)	Screen d(mm),l(m)	Water Level	Discharge (m3/d)	Pumping Hour/day	Remarks
E- 1	HMG	31 ,94	Ply-Timber Factory	1973	-	70.0	219,12.0	-	1,680	10	3 wells
E- 2	HMD	31 ,94	Match Factopy	1989	-	68.0	168,10.0	-	720	6	2 wells
E- 3	HCDG	31.250,92.030	DuGiang Chem. Fac.	1975	-	70.0	325,12.0	-	3,240	18	
E- 4	BVDKOC	30.175,93.150	O Cach Hospital	-	-	65.0	168,10.0	-	150	5	
E- 5	QKTD	27 ,90	Military Base	-	-	-	- , -	-	40	-	
E- 6	GL	28 ,91	Gia Lam Water Plant	1958	-	65.0	370,20.0	-	3,500	24	2 wells
E- 7	SD	27 ,93	SaiDon Water Plant	1974	-	68.0	370,32.0	-	1,000	15	2 wells
E- 8	NMKKTL	27.375,94.800	ThangLong Met. Fac.	-	-	-	- , -	-	80	4	
E- 9	CNC14	27.200,94.950	Bridge Enter. No.14	-	-	60.0	219,15.0	-	120	4	
E-10	CNVLMB	27.100,94.000	Airoplane Enter.	-	-	70.0	168,12.0	-	60	3	
E-11	M10	27 ,95	Garment Enterprise	1976	-	70.0	325,12.0	-	1,600	12	2 wells
E-12	CNC12	26 ,98	Bridge Enter. No.12	-	-	-	- , -	-	240	-	
E-13	CKXDGL	26 ,97	GL Mech.Construc.Co	-	-	-	- , -	-	60	-	
E-14	TDHNN	24 ,97	Agricultural Univ.	-	-	67.0	219,12.0	-	1,920	16	2 wells
E-15	TTXNDB230	27 ,98	Residents of E-12	-	-	-	- , -	-	150	-	
E-16	DTTTW	29 ,90	Mulberry Farm	-	-	60.0	146, 6.0	-	200	10	
E-17	XN26	30 ,90	Enterprise No.26	-	-	70.0	168,12.0	-	420	10	
E-18	J112	30 ,90	J112 Enterprise	-	-	-	- , -	-	150	5	
E-19	HVHC	30 ,91	Military Insti.	-	-	70.0	219,14.0	-	300	10	
E-20	DKYV	31 ,94	YenVien Oxgen Fac.	-	-	70.0	219,14.0	-	600	12	
E-21	-	29 ,91	Locomotive Factory	1970	-	81.0	400, -	-	1,500	20	
E-22	-	28 ,90	Gen. Dep. Customs	1980	-	60.0	325, -	-	400	20	
E-23	-	30 ,92	Gen. Petrol. Stores	1981	-	61.0	273, -	-	200	8	

Table 4. Groudwater Quality in Gia Lam Area:Aquifer(qp1)

No.	Well No.	pH	Na+	K+	Ca++	Mg++	Fe+++	Fe++	NH4+	Al+++	Mn++	Cl-	SO4--	HCO3--	CO3--	NO2--	NO3--	PO4--	Analyzed Date
1	M- 1	7.10	37.50	0.63	14.63	4.50	*	16.80			-	9.04	2.40	128.14			1.30	-	Sep/'90
2	M- 2	8.40	16.00	1.00	39.08	7.90	0.70	8.38			-	10.32	6.00	152.55	12.00		7.60	-	Feb/'91
3	M- 3	7.30	32.30	0.38	12.02	6.08	16.76	4.19			-	8.30	14.41	134.24				-	Mar/'93
4	M- 4	7.00	13.64	0.75	44.09	21.89	2.09	2.79			-	7.66		256.28		10.50	0.30	-	Jul/'91
5	E- 3	6.50	-	-	-	-	*	16.50	-	-	0.40	42.00	-	-	-	-	-	-	Apr/'72
6	E- 6	7.00	-	-	-	-	*	10.50	-	-	1.92	30.70	-	-	-		1.60	0.06	Jun/'85
7	E- 6	7.00	-	-	-	-	*	9.00	-	-	2.20	17.90	-	-	-		-	2.56	May/'85
8	E- 6	7.00	-	-	-	-	*	19.50	-	-	1.92	31.20	-	-	-		-	1.60	May/'85
9	E- 6	7.00	-	-	-	-	*	10.00	-	-	0.80	10.65	-	-	-	0.92		2.40	Sep/'86
10	E- 6	7.00	-	-	-	-	*	10.00	-	-	1.40	17.70		-	-	0.02		3.00	Sep/'86
11	E-16	7.50	-	-	-	-	*	17.50	-	-	0.26	11.40	8.23	-	-			3.00	Apr/'77
12	E-21	6.50	-	-	-	-	*	14.20	-	-	0.33	50.00	-	-	-	-	-	-	Apr/'72
13	E-22	6.80	-	-	-	-	*	14.50	-	-	0.95	12.05	18.20	-	-	0.05		2.90	May/'89
	VIET. STAN.	6.5 8.5			75 to 100		Total	<0.3	<3		<0.2					0	<6		
	WHO STAN.				75	50	Total	0.3	0.5		0.1	200	200				40		

* Unit of "mg/l" except "pH"
* In case of "*" in "Fe3+", "Fe" is analized as total "Fe".
* "-" means "not analized" and "no mark" means "0 value".
* "VIET.STAN."and "WHO STAN."mean Vietnamese and WHO standard respectively.

Table 5. Hydrologic Data of the Red River and Duong River

- Red River(Hanoi Station)

Year	1983	1984	1985	1986	1987	1988	1989	1990
Value								
Water level max	12.07	10.48	11.96	12.35	10.18	10.15	10.23	11.94
min	2.34	2.46	2.76	2.17	2.19	2.07	2.12	2.60
Amplitute	9.74	8.02	9.20	10.18	7.99	8.08	8.11	9.34
Q max m3/s	12400	10000	13700	14600	8360	8360	9100	12500
min m3/s	533	594	909	602	530	486	448	650
max/min Time	23.26	16.84	15.07	24.25	15.77	17.20	20.31	19.23
V max m/s	1.60	1.54	1.62	2.88	1.96	1.85	1.46	1.39
min m/s	0.61	0.60	0.59	-	-	-	1.42	0.39
Turbidity max g/m3	3820	2030	2440	12500	3500	1620	3330	3430
min g/m3	41.5	5.9	9.7	32.4	16.6	9.4	9.5	7.4

- Duong River(Thuong Cat Station)

Year	1986	1987	1988	1989	1990
Value					
Water level max	11.98	10.05	9.97	10.00	11.58
min	2.62	2.68	2.70	2.68	3.21
Amplitute	9.36	7.37	7.27	7.32	8.37
Q max m3/s	6200	3990	3440	3280	5830
min m3/s	120	100	90.5	90.6	196
max/min Time	51.67	39.90	38.01	33.95	29.74
V max m/s	2.78	2.09	2.34	1.94	1.95
min m/s				0.40	0.39
Turbidity max g/m3	15100	5220	2040	2170	3570
min g/m3	17.5	25.2	6.7	10.9	19.7

Table 6. Water Quality of the Red River and the Duong River

- Red River(Son Tay & Hanoi Station:1980-1991)

Parameters	St.Son tay			St.Hanoi		
	Min.	Max.	Ave.	Min.	Max.	Ave.
Temperature (C)	15.6	31.6	24.4	14.8	31.2	24.1
pH	5.5	8.3	7.4	6.0	8.3	7.2
Fe total (mg/l)	0.04	1.3	0.3	0.04	1.4	0.2
Sio2 (-)	2.0	60.0	14.2	2.0	28.0	13.3
Ca++ (mgdl/l)	0.78	1.8	1.3	0.78	1.9	1.3
Mg++ (-)	0.16	1.3	0.5	0.08	1.2	0.5
Na+K (-)	0.02	0.9	0.4	0.05	0.8	0.4
HCO3- (-)	1.2	3.1	2.0	1.4	2.5	2.1
SO4-- (-)	0.02	0.5	0.2	0.02	1.1	0.2
Cl- (-)	0.02	0.5	0.1	0.01	0.2	0.1
Total ion (-)	3.17	6.3	4.4	3.13	5.8	4.5
Alkalinity (-)	1.2	3.1	2.0	1.4	2.5	2.1
Hardness (-)	1.16	2.9	1.8	1.24	2.5	1.8

- Duong River(Thuong Cat Station:1980-1991)

Parameters	Min.	Max.	Ave.
Temperature (C)	15.0	31.2	24.3
pH	6.4	8.5	7.4
Fe total (-)	0.04	3.2	0.3
Sio2 (-)	2.0	48.0	16.8
Ca++ (mgdl/l)	0.42	2.0	1.3
Mg++ (-)	0.12	1.29	0.56
Na+K (-)	0.04	1.27	0.42
HCO3- (-)	1.6	3.3	2.08
SO4-- (-)	0.02	0.62	0.15
Cl-- (-)	0.01	1.72	0.12
Total ion (-)	3.36	6.86	4.51
Alkalinity (-)	1.6	3.3	2.08
Total hardness(-)	0.87	2.84	1.87

Table 7. Well List in the FINIDA Project

No.	Water Plant	Well No.	Depth (m)	Screen d(mm),l(m)	Discharge (m3/h)	Remarks
1		K27	71.0	350,18.0	200	
2	Ngosi	K28	70.5	350,18.0	172	
3	lien	K29	76.0	350,18.0	68	
4		K30	76.0	350,18.0	58	
5		K31	76.0	350,18.0	132	
6		K 1	65.0	350,18.0	154	
7		K 2	65.0	350,18.0	130	
8		K 3	64.5	350,17.3	130	
9	Phap	K 4	64.5	350,17.3	140	
10	van	K 5	64.5	350,17.3	170	
11		K 6	61.5	350,17.3	140	
12		K 7	62.5	350,17.3	210	
13		K 8	64.6	350,17.3	195	
14		K 9	62.3	350,17.3	180	
15	Tuong	K19	76.0	350,18.0	62	
16	mai	K20	73.0	350,18.0	-	
17		K10	69.0	350,18.0	172	
18	Ngoc	K11	63.0	350,18.0	200	
19	ha	K12	63.0	350,17.4	170	
20		K13	63.5	350,17.4	170	
21		K14	62.5	350,17.4	270	
22		K10	62.0	350,24.0	80	
23	Yen	K19	68.0	350,18.0	55	
24	phu	K29	70.0	350,18.0	83	
25		K30	69.0	350,18.0	135	
26		K 1	59.5	350,18.0	-	
27		K 2	58.0	350,18.0	155	
28		K 3	58.5	350,18.0	200	
29		K 4	62.5	350,18.0	196	
30		K 5	54.0	350,18.0	216	
31		K 6	55.0	350,18.0	-	
32	Mai	K 7	56.5	350,18.0	120	
33	dich	K 8	58.5	350,24.0	155	
34		K 9	57.5	350,24.0	120	
35		K10	57.2	350,17.4	170	
36		K11	56.0	350,18.0	175	
37		K12	64.0	350,17.4	167	
38		K13	60.0	350,17.4	150	
39		K14	58.0	350,17.4	168	
40		K15	58.0	350,17.4	180	
41		K16	60.0	350,17.4	140	

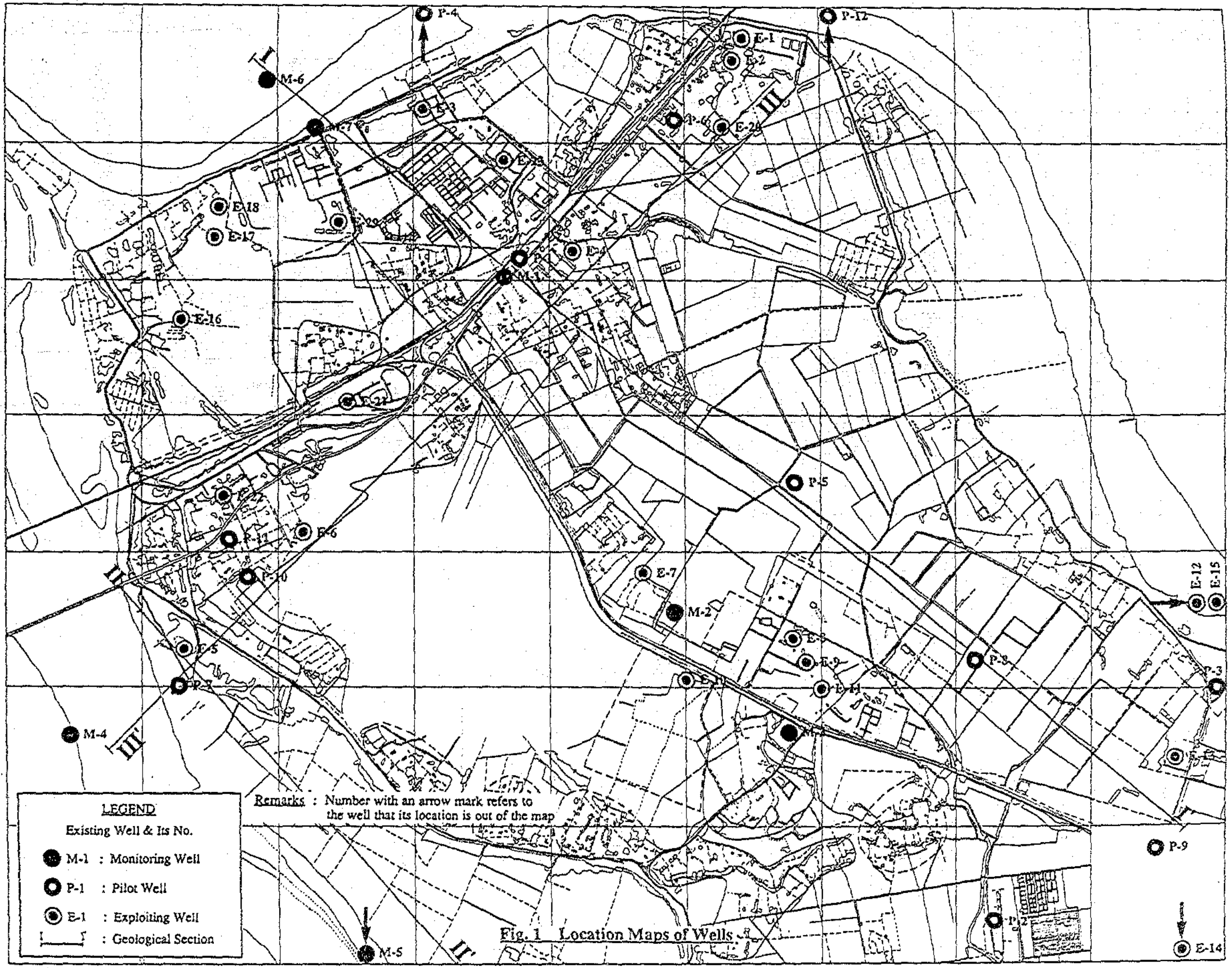
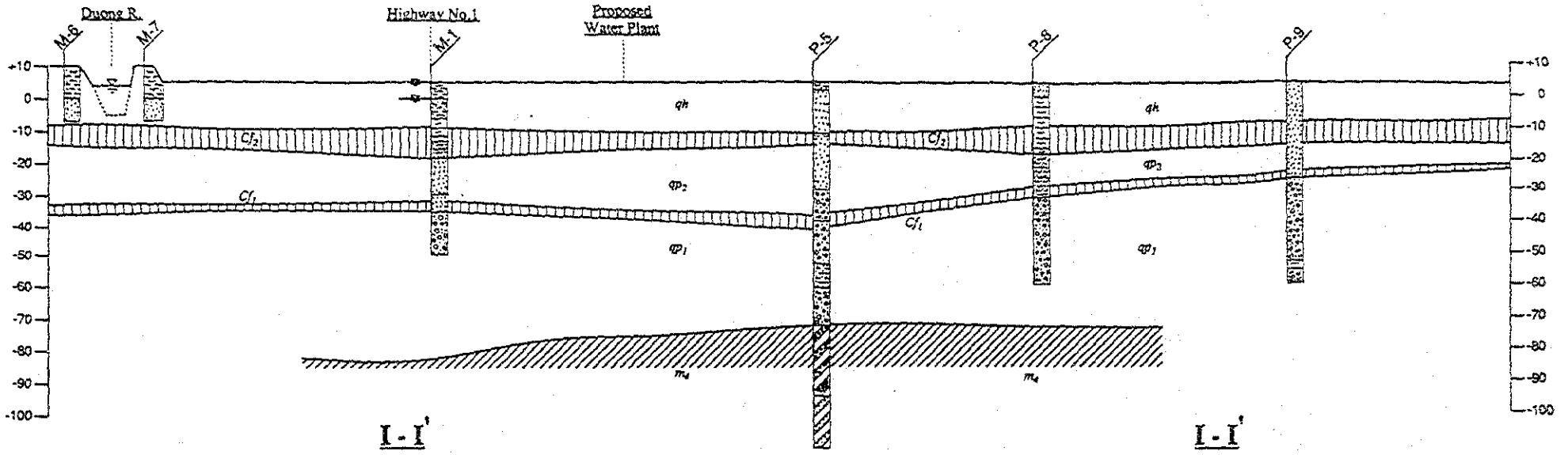
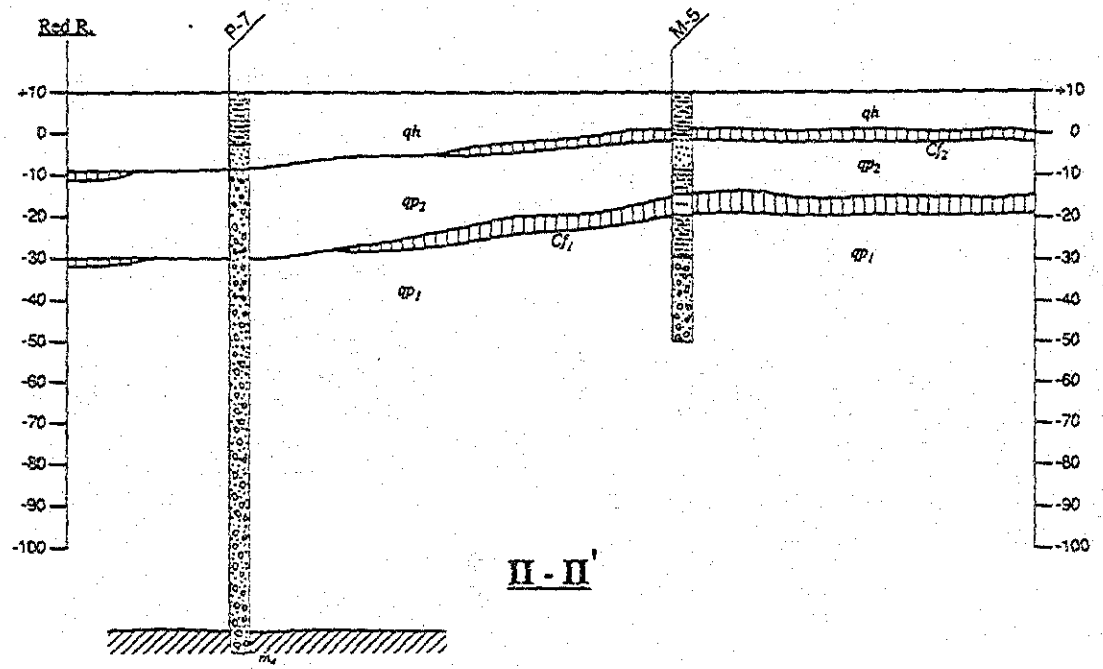


Fig. 1 Location Maps of Wells





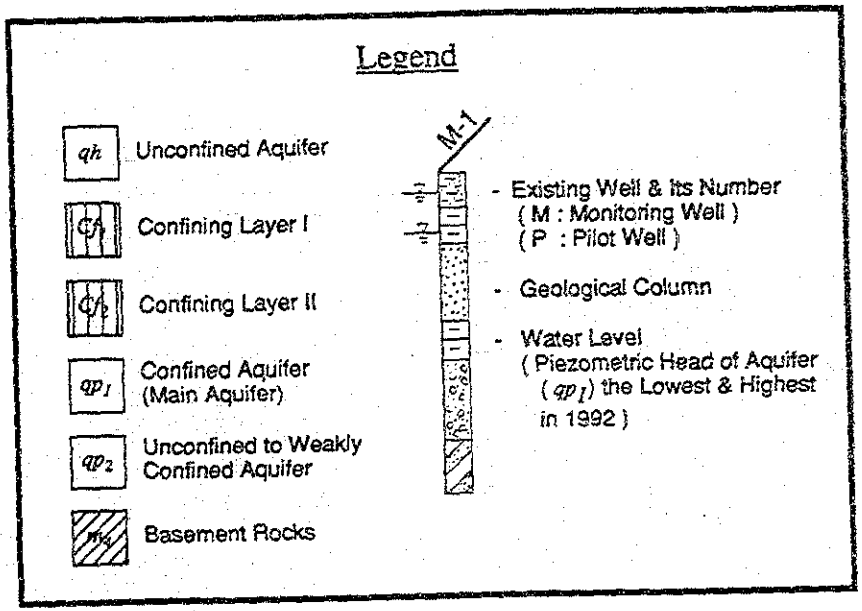


Fig. 2 Hydrological Profiles

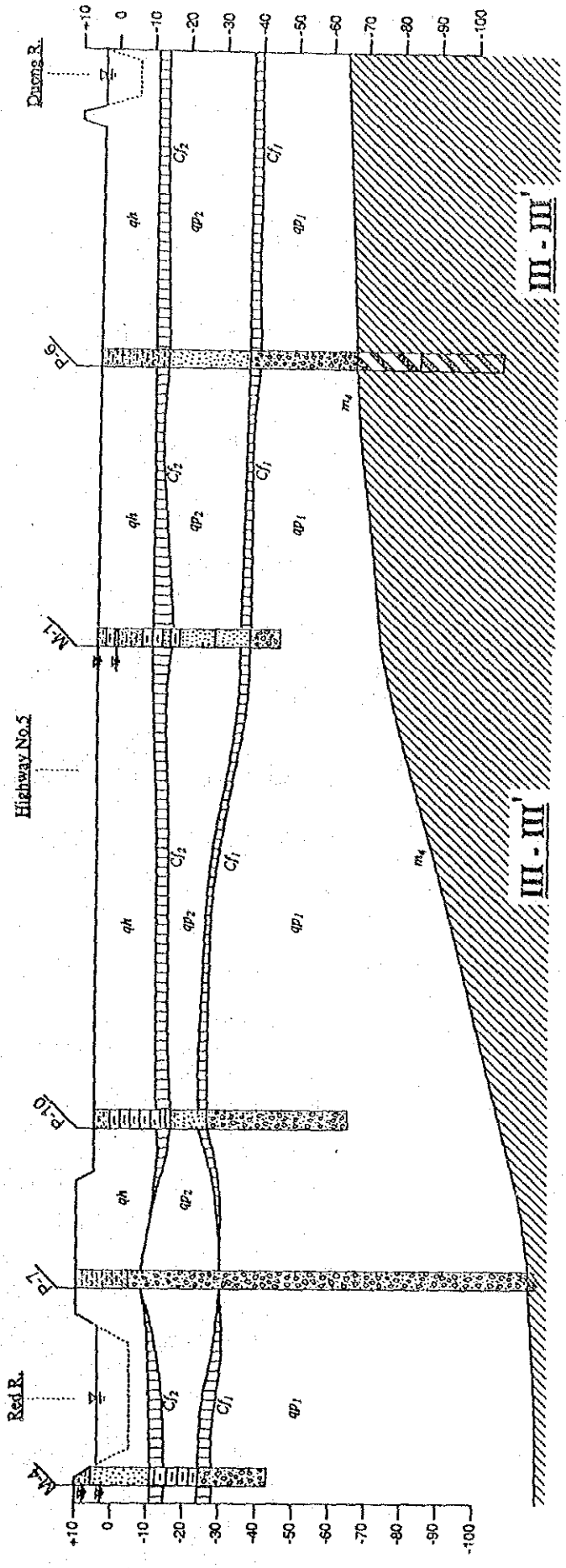
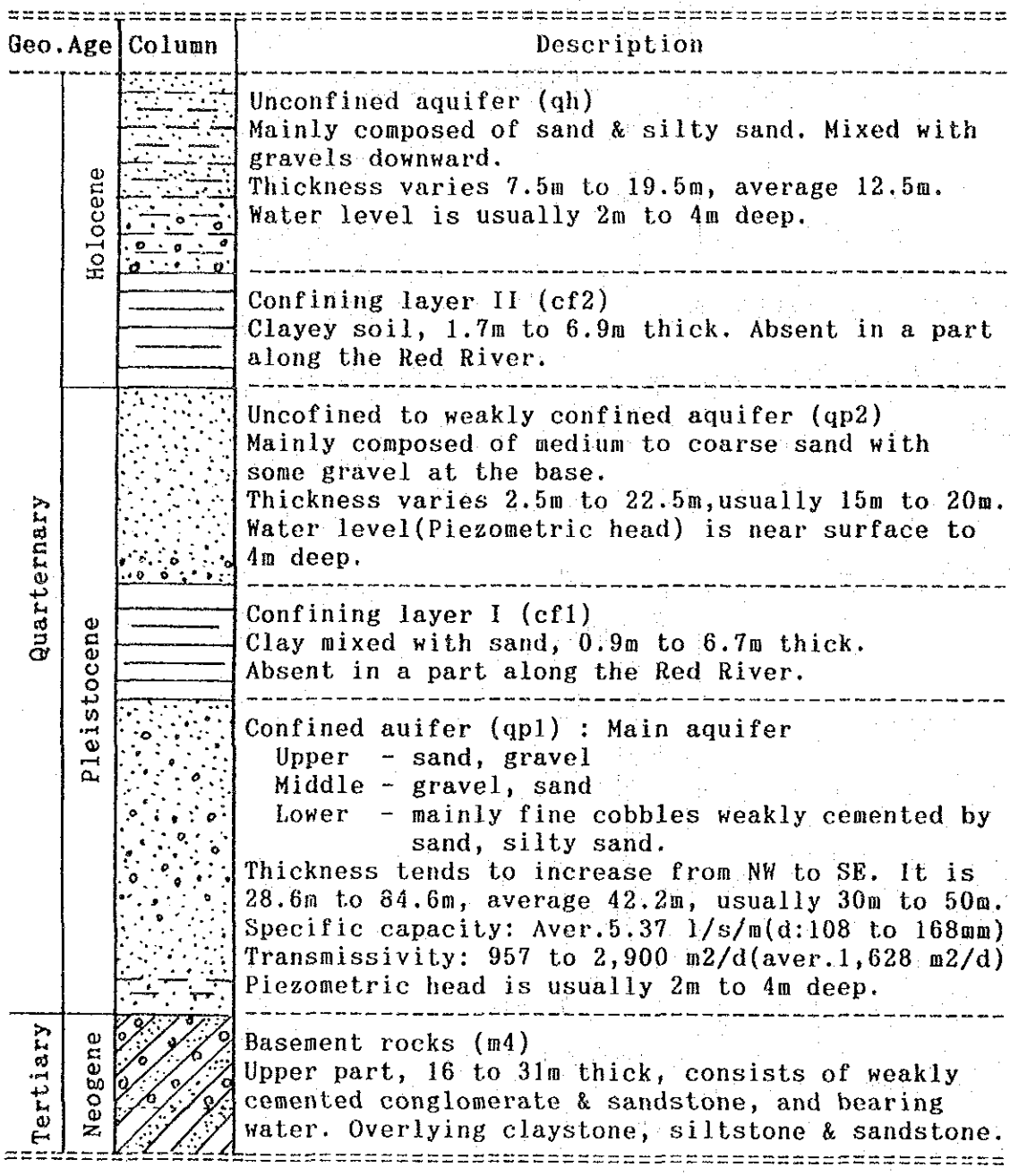

III - III'
III - III'
Dusne R.
Highway No.5
Red R.
P-6
P-7
P-9
P-10
M-1
M-4
-10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
+10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100

Fig. 3. Hydrogeological Outline in Gia Lam Area



添付資料　9

取水ポンプ軸動力計算

原水導水管および配水配管
Water Hammer検討書

水中モーターポンプ軸動力計算書

ポンプ運転に必要な軸動力は、次式であらわされる。

$$P = \frac{Pw}{\eta p} = \frac{0.163 \gamma Q H}{\eta p}$$

ここに

P	：ポンプ軸動力		(Kw)
Pw	：水動力		
γ	：取扱液の比重	1.0	
Q	：ポンプ吐出量	3.0	(m^3/min)
H	：ポンプ全揚程		
	No.1～No.8号井戸：	45.0	(m)
	No.9～No.12号井戸：	27.0	(m)
ηp	：ポンプ効率	65.0	(%)

1．No.1～No.8号井戸

$$P = \frac{0.163 \times 1.0 \times 3.0 \times 45.0}{0.65} = 33.85$$

ゆえに、規格品においては37(Kw)となる。

2．No.9～No.12号井戸

$$P = \frac{0.163 \times 1.0 \times 3.0 \times 27.0}{0.65} = 20.31$$

ゆえに、規格品においては22(Kw)となる。

W A T E R H A M M E R A N A L Y S I S NO. VIET500 PAGE 1

VIETNAM — Raw Water Transmission Pipe (Original Condition)

LEVEL -2.000 M
DT .00871 SEC

--- PIPELINE DATA ---

NO	LENGTH M	CLASS	D MM	T MM	E	ORIGINAL PIPELINE		PUMP-NO	S-NO	V-NO	END	PLOT	Q M3/M	PIPE LOSS M	VALVE LOSS M	2L/A SEC	ROW	POINT	DIVISION	
A	50.0	FCD3	250	6.0	1.600			1	0	0	0	0	3.000	3.430	.000	.0871	19.9081	4	10	.0
B	140.0	FCD3	450	7.5	1.600	A		0	0	0	0	0	3.000	.670	.000	.2619	5.7195	4	30	.0
C	10.0	FCD3	250	6.0	1.600			2	0	0	0	0	3.000	3.500	.000	.0174	19.9081	1	2	.0
D	320.0	FCD3	450	7.5	1.600	B	C	0	0	0	0	0	6.000	.390	.000	.5986	5.7195	3	68	.0
E	10.0	FCD3	250	6.0	1.600			3	0	0	0	0	3.000	3.500	.000	.0174	19.9081	1	2	.0
F	330.0	FCD3	450	7.5	1.600	D	E	0	0	0	0	0	9.000	.860	.000	.6173	5.7195	4	70	.0
G	10.0	FCD3	250	6.0	1.600			4	0	0	0	0	3.000	3.500	.000	.0174	19.9081	1	2	.0
H	250.0	FCD3	450	7.5	1.600	F	G	0	0	0	0	0	12.000	1.110	.000	.4676	5.7195	5	54	.0
I	270.0	FCD3	250	6.0	1.600			5	0	0	0	0	3.000	5.050	.000	.4701	19.9081	5	54	.0
J	10.0	FCD3	250	6.0	1.600			6	0	0	0	0	3.000	3.500	.000	.0174	19.9081	1	2	.0
K	10.0	FCD3	400	7.0	1.600	I	J	0	0	0	0	0	6.000	.060	.000	.0185	7.3153	1	2	.0
L	120.0	FCD3	600	9.0	1.600	H	K	0	0	0	0	0	18.000	.280	.000	.2299	3.1419	12	26	.0
M	150.0	FCD3	250	6.0	1.600			7	0	0	0	0	3.000	4.340	.000	.2612	19.9081	4	30	.0
N	650.0	FCD3	600	9.0	1.600	L	M	0	0	0	0	0	21.000	2.000	.000	1.2450	3.1419	3	144	.0
O	10.0	FCD3	250	6.0	1.600			8	0	0	0	0	1.320	3.500	.000	.0174	19.9081	1	2	.0
P	1010.0	FCD3	600	9.0	1.600	N	O	0	0	0	0	0	22.320	3.490	.000	1.9346	3.1419	3	224	.0
Q	4290.0	FCD3	600	9.0	1.600	P		0	0	0	0	1	22.320	14.800	.000	8.2171	3.1419	3	944	.0

--- PUMP DATA ---

NO	SET	TYPE	VALVE	V-NO	PLOT A	PLOT B	HEAD M	Q M3/M	KW	P	GD2 KG-M2	GD2 (WHEEL) KG-M2	RPM	%	START CONDITION K	START CONDITION HEAD M	START CONDITION Q M3/M	START CONDITION N	START CONDITION M
1	1	1	1	0	0	0	45.000	3.000	37.0	0	5.000	.000	2950	65	.2844	45.000	3.000	1.000	1.000
2	1	1	1	0	0	0	44.900	3.000	37.0	0	5.000	.000	2950	65	.2838	44.900	3.000	1.000	1.000
3	1	1	1	0	0	0	44.510	3.000	37.0	0	5.000	.000	2950	65	.2813	44.510	3.000	1.000	1.000
4	1	1	1	0	0	0	43.650	3.000	37.0	0	5.000	.000	2950	65	.2759	43.650	3.000	1.000	1.000
5	1	1	1	0	0	0	42.150	3.000	37.0	0	5.000	.000	2950	65	.2664	42.150	3.000	1.000	1.000
6	1	1	1	0	0	0	40.600	3.000	37.0	0	5.000	.000	2950	65	.2566	40.600	3.000	1.000	1.000
7	1	1	1	0	0	0	41.100	3.000	37.0	0	5.000	.000	2950	65	.2598	41.100	3.000	1.000	1.000
8	1	1	1	0	0	0	38.260	1.320	37.0	0	5.000	.000	2950	65	.1064	38.260	1.320	1.000	1.000

--- PIPELINE OUTPUT ---

A B D F H L N P Q

--- PIPELINE PROFILE ---

NO	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M
A	.0	14.00	50.0	8.70				
B	50.0	8.70	290.0	8.70				
D	290.0	8.70	610.0	8.70				
F	610.0	8.70	940.0	8.70				
H	940.0	8.70	1190.0	8.70				
L	1190.0	8.70	1310.0	8.70				
N	1310.0	8.70	1960.0	8.70				
P	1960.0	8.70	2960.0	8.70	2970.0	14.00		
Q	2970.0	14.00	3020.0	14.00	3030.0	3.50	7260.0	3.50

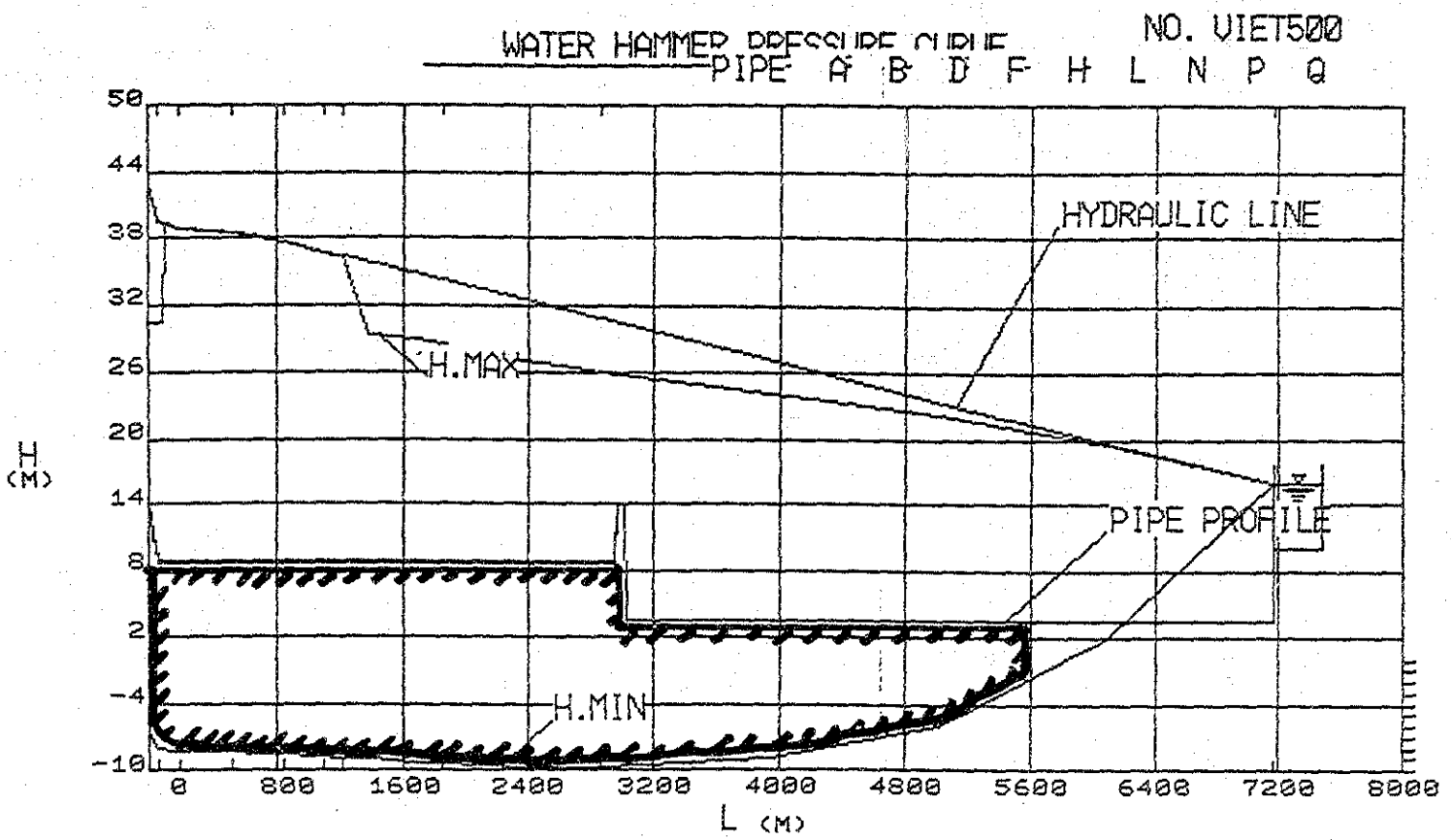
1. ANALYSIS INTERVAL 923

3. PIPELINE PRESSURE

			- - - - - M A X - - - - -				- - - - - M I N - - - - -			
NO		LENGTH M	TIME SEC	Q M3/M	HEAD M	LEVEL M	TIME SEC	Q M3/M	HEAD M	LEVEL M
A	0/ 5	.0	50.013	.000	32.500	30.500	11.997	1.911	-4.737	-6.737
A	1/ 5	10.0	50.021	.000	32.497	30.497	12.023	1.911	-5.011	-7.011
A	2/ 5	20.0	50.030	.000	32.493	30.493	12.014	1.911	-5.302	-7.302
A	3/ 5	30.0	50.030	.000	32.477	30.477	11.753	1.914	-5.541	-7.541
A	4/ 5	40.0	50.039	.001	32.450	30.450	11.858	1.914	-5.809	-7.809
B	0/ 5	.0	49.752	.000	32.449	30.449	11.884	1.914	-6.079	-8.079
B	1/ 5	28.0	49.743	-.001	32.440	30.440	11.884	1.913	-6.126	-8.126
B	2/ 5	56.0	.087	3.000	41.303	39.303	11.840	1.914	-6.183	-8.183
B	3/ 5	84.0	.061	3.000	41.169	39.169	11.849	1.913	-6.229	-8.229
B	4/ 5	112.0	.035	3.000	41.035	39.035	11.884	1.914	-6.272	-8.272
C	0/ 2	.0	49.873	.000	32.437	30.437	11.892	1.879	-4.981	-6.981
C	1/ 2	5.0	49.869	.000	32.434	30.434	11.792	1.882	-5.648	-7.648
D	0/ 4	.0	.009	6.000	40.901	38.901	11.753	3.802	-6.315	-8.315
D	1/ 4	80.0	.083	6.000	40.804	38.804	11.688	3.802	-6.339	-8.339
D	2/ 4	160.0	.157	6.000	40.706	38.706	11.605	3.806	-6.348	-8.348
D	3/ 4	240.0	.083	6.000	40.608	38.608	11.531	3.808	-6.358	-8.358
E	0/ 2	.0	50.639	.000	32.147	30.147	11.579	1.893	-4.992	-6.992
E	1/ 2	5.0	50.635	.000	32.137	30.137	11.496	1.897	-5.671	-7.671
F	0/ 5	.0	.009	9.000	40.510	38.510	11.457	5.709	-6.361	-8.361
F	1/ 5	66.0	.070	9.000	40.338	38.338	11.405	5.712	-6.395	-8.395
F	2/ 5	132.0	.131	9.000	40.166	38.166	11.344	5.714	-6.441	-8.441
F	3/ 5	198.0	.131	9.000	39.994	37.994	11.274	5.718	-6.468	-8.468
F	4/ 5	264.0	.070	9.000	39.822	37.822	11.179	5.722	-6.501	-8.501
G	0/ 2	.0	50.448	.000	32.185	30.185	11.152	1.935	-5.100	-7.100
G	1/ 2	5.0	50.444	.000	32.180	30.180	11.157	1.935	-5.834	-7.834
H	0/ 6	.0	.009	12.000	39.650	37.650	11.152	7.659	-6.540	-8.540
H	1/ 6	41.7	.048	12.000	39.465	37.465	11.122	7.660	-6.591	-8.591
H	2/ 6	83.3	.087	12.000	39.280	37.280	11.074	7.665	-6.627	-8.627
H	3/ 6	125.0	.126	12.000	39.095	37.095	11.000	7.669	-6.673	-8.673
H	4/ 6	166.7	.096	12.000	38.910	36.910	10.961	7.671	-6.722	-8.722
H	5/ 6	208.3	.057	12.000	38.725	36.725	10.957	7.672	-6.774	-8.774
I	0/ 6	.0	49.908	.000	32.135	30.135	11.144	2.125	-4.264	-6.264
I	1/ 6	45.0	49.921	.000	32.108	30.108	11.157	2.125	-4.686	-6.686
I	2/ 6	90.0	49.873	-.003	32.000	30.000	11.065	2.125	-5.099	-7.099
I	3/ 6	135.0	49.860	-.004	31.911	29.911	11.035	2.126	-5.527	-7.527
I	4/ 6	180.0	.087	3.000	40.284	38.284	10.996	2.126	-5.954	-7.954
I	5/ 6	225.0	.048	3.000	39.442	37.442	10.948	2.125	-6.361	-8.361
J	0/ 2	.0	50.143	.000	31.769	29.769	10.874	2.254	-4.816	-6.816
J	1/ 2	5.0	50.139	.000	31.760	29.760	10.878	2.254	-5.797	-7.797

3. PIPELINE PRESSURE

NO		LENGTH M	MAX TIME SEC	MAX Q M3/M	MAX HEAD M	MAX LEVEL M	MIN TIME SEC	MIN Q M3/M	MIN HEAD M	MIN LEVEL M
K	0/ 2	.0	.009	6.000	38.600	36.600	10.917	4.380	-6.781	-8.781
K	1/ 2	5.0	.013	6.000	38.570	36.570	10.922	4.380	-6.790	-8.790
L	0/13	.0	.017	18.000	38.540	36.540	10.909	12.056	-6.800	-8.800
L	1/13	9.2	.026	18.000	38.519	36.519	10.909	12.056	-6.810	-8.810
L	2/13	18.5	.035	18.000	38.497	36.497	10.900	12.056	-6.819	-8.819
L	3/13	27.7	.044	18.000	38.475	36.475	10.865	12.055	-6.827	-8.827
L	4/13	36.9	.052	18.000	38.454	36.454	10.874	12.056	-6.839	-8.839
L	5/13	46.2	.061	18.000	38.432	36.432	10.883	12.054	-6.841	-8.841
L	6/13	55.4	.070	18.000	38.411	36.411	10.891	12.054	-6.845	-8.845
L	7/13	64.6	.078	18.000	38.390	36.390	10.874	12.057	-6.846	-8.846
L	8/13	73.8	.087	18.000	38.368	36.368	10.848	12.060	-6.853	-8.853
L	9/13	83.1	.096	18.000	38.346	36.346	10.813	12.060	-6.855	-8.855
L	10/13	92.3	.104	18.000	38.325	36.325	10.822	12.061	-6.866	-8.866
L	11/13	101.5	.113	18.000	38.303	36.303	10.822	12.062	-6.873	-8.873
L	12/13	110.8	.122	18.000	38.282	36.282	10.830	12.060	-6.874	-8.874
M	0/ 5	.0	50.274	.000	31.919	29.919	10.891	2.198	-4.555	-6.555
M	1/ 5	30.0	50.256	-.001	31.856	29.856	10.917	2.198	-5.027	-7.027
M	2/ 5	60.0	50.230	-.003	31.791	29.791	10.917	2.199	-5.490	-7.490
M	3/ 5	90.0	.078	3.000	39.996	37.996	10.822	2.199	-5.960	-7.960
M	4/ 5	120.0	.104	3.000	39.128	37.128	10.848	2.199	-6.433	-8.433
N	0/ 4	.0	.131	21.000	38.260	36.260	10.639	14.258	-6.874	-8.874
N	1/ 4	162.5	49.987	-.050	31.419	29.419	10.647	14.277	-7.020	-9.020
N	2/ 4	325.0	49.752	-.096	31.231	29.231	10.508	14.290	-7.157	-9.157
N	3/ 4	487.5	49.673	-.116	31.004	29.004	10.369	14.304	-7.281	-9.281
O	0/ 2	.0	49.490	.000	30.638	28.638	10.221	1.318	-3.944	-5.944
O	1/ 2	5.0	.622	.978	36.044	34.044	10.216	1.318	-5.679	-7.679
P	0/ 4	.0	49.508	-.179	30.626	28.626	10.212	15.638	-7.404	-9.404
P	1/ 4	252.5	49.282	-.301	29.817	27.817	9.951	15.684	-7.579	-9.579
P	2/ 4	505.0	49.038	-.419	29.076	27.076	9.707	15.734	-7.703	-9.703
P	3/ 4	757.5	48.785	-.508	28.545	26.545	9.463	15.795	-7.763	-9.763
Q	0/ 4	.0	48.542	-.588	28.046	26.046	9.254	15.857	-7.760	-9.760
Q	1/ 4	1072.5	47.506	-.891	26.158	24.158	8.924	16.016	-7.024	-9.024
Q	2/ 4	2145.0	46.487	-1.192	24.271	22.271	7.896	16.880	-3.922	-5.922
Q	3/ 4	3217.5	72.768	-.862	21.519	19.519	7.095	18.232	3.977	1.977


WATER HAMMER PRESSURE CURVE
NO. VIET500
PIPE A B D F H L N P Q
HYDRAULIC LINE
H.MAX
H.MIN
PIPE PROFILE
H (M)
L (M)
50
44
38
32
26
20
14
8
2
-4
-10
0
800
1600
2400
3200
4000
4800
5600
6400
7200
8000

VIETNAM

LEVEL -2.000 M
DT .00871 SEC

--- PIPELINE DATA ---

NO	LENGTH M	CLASS	D MM	T MM	E	ORIGINAL PIPELINE		PUMP-NO	S-NO	V-NO	END	PLOT	Q M3/M	PIPE LOSS M	VALVE LOSS M	2L/A SEC	ROW	POINT	DIVISION	
A	100.0	FCD3	250	6.0	1.600			1	0	0	1	0	0	0	3.000	4.040	.000	.1741	19.9081	3	20	.0
B	190.0	FCD3	450	7.5	1.600	A		0	0	0	0	0	0	0	3.000	.060	.000	.3554	5.7195	3	40	.0
C	10.0	FCD3	250	6.0	1.600			2	0	0	0	0	0	0	3.000	3.500	.000	.0174	19.9081	1	2	.0
D	320.0	FCD3	450	7.5	1.600	B	C	0	0	0	0	0	0	0	6.000	.390	.000	.5986	5.7195	3	68	.0
E	10.0	FCD3	250	6.0	1.600			3	0	0	0	0	0	0	3.000	3.500	.000	.0174	19.9081	1	2	.0
F	330.0	FCD3	450	7.5	1.600	D	E	0	0	0	2	0	0	0	9.000	.860	.000	.6173	5.7195	4	70	.0
G	10.0	FCD3	250	6.0	1.600			4	0	0	0	0	0	0	3.000	3.500	.000	.0174	19.9081	1	2	.0
H	250.0	FCD3	450	7.5	1.600	F	G	0	0	0	0	0	0	0	12.000	1.110	.000	.4676	5.7195	5	54	.0
I	270.0	FCD3	250	6.0	1.600			5	0	0	0	0	0	0	3.000	5.050	.000	.4701	19.9081	5	54	.0
J	10.0	FCD3	250	6.0	1.600			6	0	0	0	0	0	0	3.000	3.500	.000	.0174	19.9081	1	2	.0
K	10.0	FCD3	400	7.0	1.600	I	J	0	0	0	0	0	0	0	6.000	.060	.000	.0185	7.3153	1	2	.0
L	120.0	FCD3	600	9.0	1.600	H	K	0	0	0	0	0	0	0	18.000	.280	.000	.2299	3.1419	12	26	.0
M	150.0	FCD3	250	6.0	1.600			7	0	0	0	0	0	0	3.000	4.340	.000	.2612	19.9081	4	30	.0
N	650.0	FCD3	600	9.0	1.600	L	M	0	0	0	0	0	0	0	21.000	2.000	.000	1.2450	3.1419	3	144	.0
O	10.0	FCD3	250	6.0	1.600			8	0	0	0	0	0	0	1.320	3.500	.000	.0174	19.9081	1	2	.0
P	1010.0	FCD3	600	9.0	1.600	N	O	0	0	0	0	0	0	0	22.320	3.490	.000	1.9346	3.1419	3	224	.0
Q	4290.0	FCD3	600	9.0	1.600	P		0	0	0	3	0	1	0	22.320	14.800	.000	8.2171	3.1419	3	944	.0

--- PUMP DATA ---

NO	SET	TYPE	VAL VE	V-NO	PLOT A	PLOT B	HEAD M	Q M3/M	KW	P	GD2 KG-M2	GD2 (WHEEL) KG-M2	RPM	%	START CONDITION K	START CONDITION HEAD M	START CONDITION Q M3/M	N	M
1	1	1	1	0	0	0	45.000	3.000	37.0	0	5.000	.000	2950	65	.2844	45.000	3.000	1.000	1.000
2	1	1	1	0	0	0	44.900	3.000	37.0	0	5.000	.000	2950	65	.2838	44.900	3.000	1.000	1.000
3	1	1	1	0	0	0	44.510	3.000	37.0	0	5.000	.000	2950	65	.2813	44.510	3.000	1.000	1.000
4	1	1	1	0	0	0	43.650	3.000	37.0	0	5.000	.000	2950	65	.2759	43.650	3.000	1.000	1.000
5	1	1	1	0	0	0	42.150	3.000	37.0	0	5.000	.000	2950	65	.2664	42.150	3.000	1.000	1.000
6	1	1	1	0	0	0	40.600	3.000	37.0	0	5.000	.000	2950	65	.2566	40.600	3.000	1.000	1.000
7	1	1	1	0	0	0	41.100	3.000	37.0	0	5.000	.000	2950	65	.2598	41.100	3.000	1.000	1.000
8	1	1	1	0	0	0	38.260	1.320	37.0	0	5.000	.000	2950	65	.1064	38.260	1.320	1.000	1.000

--- SURGE TANK DATA ---

NO	TYPE	V-NO	PLOT	HEAD M	AREA M2	LOSS M	LENGTH M	CLASS	D MM	T MM	E	2L/A SEC	ROW DIVISION	AIR-Q M3	LOSS M
1	1	0	0	16.000	999.000	7.347	.0	0	0	.0	.000	.0000	.000 0	.0	.000
2	1	0	0	10.700	999.000	7.347	.0	0	0	.0	.000	.0000	.000 0	.0	.000
3	1	0	1	16.000	999.000	7.347	.0	0	0	.0	.000	.0000	.000 0	.0	.000

--- PIPELINE OUTPUT ---

A B D F H L N P Q

--- PIPELINE PROFILE ---

NO	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M
A	.0	14.00	10.0	8.70	100.0	8.70
B	100.0	8.70	290.0	8.70		
D	290.0	8.70	610.0	8.70		

--- PIPELINE PROFILE ---

NO	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M
F	610.0	8.70	940.0	8.70				
H	940.0	8.70	1190.0	8.70				
L	1190.0	8.70	1310.0	8.70				
N	1310.0	8.70	1960.0	8.70				
P	1960.0	8.70	2960.0	8.70	2970.0	14.00		
Q	2970.0	14.00	3020.0	14.00	3030.0	3.50	7260.0	3.50

1. ANALYSIS INTERVAL 700

2. WATER LEVEL IN THE TANKS

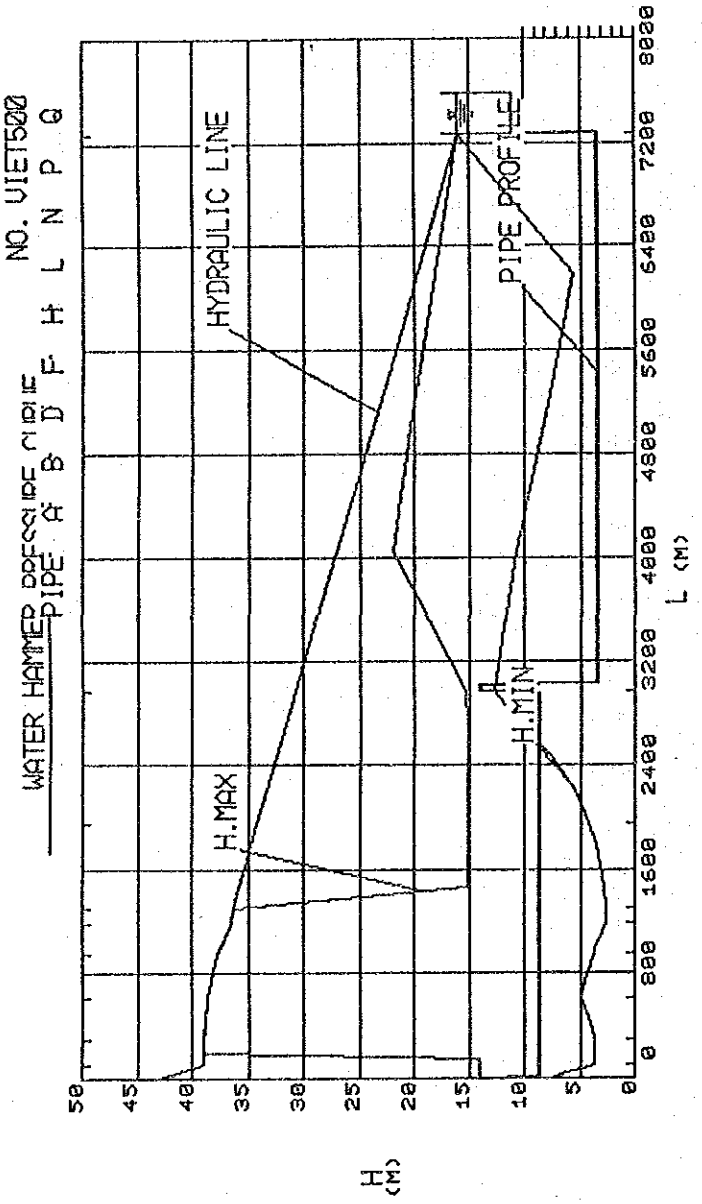
NO	MAX HEAD M	MAX LEVEL M	MIN HEAD M	MIN LEVEL M	WATER LEVEL IN THE TANKS M	AREA M2	Q M3
1	16.000	14.000	16.000	14.000	.000	999.0000	.000
2	10.700	8.700	10.698	8.698	.002	999.0000	1.649
3	16.000	14.000	15.992	13.992	.008	999.0000	7.823

3 PIPELINE PRESSURE

NO		LENGTH M	MAX TIME SEC	MAX Q M3/M	MAX HEAD M	MAX LEVEL M	MIN TIME SEC	MIN Q M3/M	MIN HEAD M	MIN LEVEL M
A	0/ 4	.0	119.898	.272	15.940	13.940	7.348	2.816	9.527	7.527
A	1/ 4	25.0	119.536	.278	15.967	13.967	7.317	2.814	8.589	6.589
A	2/ 4	50.0	119.549	.277	15.989	13.989	7.226	2.807	7.636	5.636
A	3/ 4	75.0	119.580	.276	16.015	14.015	7.274	2.811	6.683	4.683
B	0/ 4	.0	119.575	.276	16.035	14.035	7.252	2.809	5.732	3.732
B	1/ 4	47.5	113.142	.306	16.043	14.043	7.209	2.808	5.703	3.703
B	2/ 4	95.0	.096	3.000	40.930	38.930	7.174	2.810	5.716	3.716
B	3/ 4	142.5	.052	3.000	40.915	38.915	7.121	2.812	5.719	3.719
C	0/ 2	.0	120.298	.000	16.096	14.096	7.069	.003	5.528	3.528
C	1/ 2	5.0	120.302	.000	16.100	14.100	7.074	.001	5.604	3.604
D	0/ 4	.0	.009	6.000	40.900	38.900	7.034	2.823	5.679	3.679
D	1/ 4	80.0	.083	6.000	40.803	38.803	7.013	2.830	5.935	3.935
D	2/ 4	160.0	.157	6.000	40.705	38.705	7.078	2.803	6.260	4.260
D	3/ 4	240.0	.083	6.000	40.608	38.608	7.161	2.765	6.632	4.632
E	0/ 2	.0	120.594	.000	16.820	14.820	7.391	.000	6.927	4.927
E	1/ 2	5.0	120.598	.000	16.824	14.824	7.361	.000	6.932	4.932
F	0/ 5	.0	.009	9.000	40.510	38.510	7.243	9.172	6.939	4.939
F	1/ 5	66.0	.070	9.000	40.338	38.338	7.182	9.167	6.703	4.703
F	2/ 5	132.0	.131	9.000	40.166	38.166	7.121	9.164	6.487	4.487
F	3/ 5	198.0	.131	9.000	39.994	37.994	7.061	9.160	6.262	4.262
F	4/ 5	264.0	.070	9.000	39.822	37.822	6.895	9.137	6.028	4.028
G	0/ 2	.0	120.368	.000	16.976	14.976	6.930	.001	5.538	3.538
G	1/ 2	5.0	120.372	.000	16.973	14.973	6.934	-.001	5.634	3.634
H	0/ 6	.0	.009	12.000	39.650	37.650	6.939	9.139	5.730	3.730
H	1/ 6	41.7	.048	12.000	39.465	37.465	5.115	10.037	5.664	3.664
H	2/ 6	83.3	.087	12.000	39.280	37.280	5.076	10.030	5.453	3.453
H	3/ 6	125.0	.126	12.000	39.095	37.095	5.036	10.023	5.245	3.245
H	4/ 6	166.7	.096	12.000	38.910	36.910	4.997	10.017	5.042	3.042
H	5/ 6	208.3	.057	12.000	38.725	36.725	4.958	10.010	4.837	2.837
I	0/ 6	.0	119.950	.000	17.393	15.393	12.389	.043	4.065	2.065
I	1/ 6	45.0	119.919	-.001	17.364	15.364	11.801	.262	4.452	2.452
I	2/ 6	90.0	119.958	.001	17.308	15.308	11.831	.255	4.788	2.788

3. PIPELINE PRESSURE

			- - - - - - M A X - - - - - -				- - - - - - M I N - - - - - -			
NO		LENGTH M	TIME SEC	Q M3/M	HEAD M	LEVEL M	TIME SEC	Q M3/M	HEAD M	LEVEL M
I	3/ 6	135.0	119.989	.003	17.190	15.190	5.045	1.903	4.805	2.805
I	4/ 6	180.0	.087	3.000	40.284	38.284	5.006	1.910	4.742	2.742
I	5/ 6	225.0	.048	3.000	39.442	37.442	4.967	1.918	4.677	2.677
J	0/ 2	.0	120.350	.000	16.991	14.991	9.342	.076	5.500	3.500
J	1/ 2	5.0	120.346	.000	16.980	14.980	4.932	1.912	5.292	3.292
K	0/ 2	.0	.009	6.000	38.600	36.600	4.928	3.839	4.614	2.614
K	1/ 2	5.0	.013	6.000	38.570	36.570	4.923	3.840	4.629	2.629
L	0/13	.0	.017	18.000	38.540	36.540	4.919	13.845	4.635	2.635
L	1/13	9.2	.026	18.000	38.519	36.519	4.910	13.848	4.639	2.639
L	2/13	18.5	.035	18.000	38.497	36.497	4.901	13.850	4.641	2.641
L	3/13	27.7	.044	18.000	38.475	36.475	4.893	13.851	4.635	2.635
L	4/13	36.9	.052	18.000	38.454	36.454	4.884	13.854	4.640	2.640
L	5/13	46.2	.061	18.000	38.432	36.432	4.875	13.856	4.637	2.637
L	6/13	55.4	.070	18.000	38.411	36.411	4.867	13.858	4.642	2.642
L	7/13	64.6	.078	18.000	38.389	36.389	4.858	13.861	4.644	2.644
L	8/13	73.8	.087	18.000	38.368	36.368	4.849	13.863	4.644	2.644
L	9/13	83.1	.096	18.000	38.346	36.346	4.840	13.864	4.640	2.640
L	10/13	92.3	.104	18.000	38.325	36.325	4.832	13.867	4.642	2.642
L	11/13	101.5	.113	18.000	38.303	36.303	4.823	13.869	4.645	2.645
L	12/13	110.8	.122	18.000	38.282	36.282	4.814	13.871	4.647	2.647
M	0/ 5	.0	120.507	.000	17.246	15.246	10.935	.003	4.723	2.723
M	1/ 5	30.0	120.507	.000	17.223	15.223	10.909	.013	5.120	3.120
M	2/ 5	60.0	120.550	.001	17.189	15.189	4.884	1.940	5.197	3.197
M	3/ 5	90.0	.078	3.000	39.996	37.996	4.858	1.945	5.014	3.014
M	4/ 5	120.0	.104	3.000	39.128	37.128	4.832	1.949	4.832	2.832
N	0/ 4	.0	.131	21.000	38.260	36.260	4.806	15.828	4.650	2.650
N	1/ 4	162.5	121.412	.175	17.051	15.051	4.649	15.904	4.837	2.837
N	2/ 4	325.0	120.890	.187	17.024	15.024	4.492	15.998	5.135	3.135
N	3/ 4	487.5	121.047	.179	17.072	15.072	4.336	16.107	5.517	3.517
O	0/ 2	.0	121.847	.000	17.112	15.112	11.701	.298	9.688	7.688
O	1/ 2	5.0	.622	.978	36.044	34.044	4.183	1.395	8.065	6.065
P	0/ 4	.0	121.882	.166	17.110	15.110	4.179	17.650	6.130	4.130
P	1/ 4	252.5	122.126	.163	17.127	15.127	3.935	17.952	7.463	5.463
P	2/ 4	505.0	121.691	.167	17.146	15.146	3.700	18.359	9.518	7.518
P	3/ 4	757.5	121.578	.167	17.147	15.147	3.456	18.958	12.572	10.572
Q	0/ 4	.0	122.857	.142	17.258	15.258	18.169	15.357	14.588	12.588
Q	1/ 4	1072.5	10.404	17.653	23.965	21.965	8.175	19.580	12.703	10.703
Q	2/ 4	2145.0	9.376	17.755	22.240	20.240	7.148	19.619	10.078	8.078
Q	3/ 4	3217.5	8.349	17.798	20.135	18.135	6.294	19.624	7.591	5.591


WATER HAMMER PRESSURE CURVE NO. VIET500
PIPE A B D F H L N P Q
HYDRAULIC LINE
PIPE PROFILE
H.MAX
H.MIN
H (M)
L (M)
50
45
40
35
30
25
20
15
10
5
0
0
800
1600
2400
3200
4000
4800
5600
6400
7200
8000

VIETNAM PLANT Raw Water Transmission Pipe in Treatment Plant

(Original Condition)

LEVEL -2.000 M
DT .00871 SEC

--- PIPELINE DATA ---

NO	LENGTH M	CLASS	D MM	T MM	E	ORIGINAL PIPELINE		PUMP-NO	S-NO	V-NO	END	PLOT	Q M3/M	PIPE LOSS M	VALVE LOSS M	2L/A SEC	POINT ROW	POINT T	DIVISION	
A	250.0	FCD3	250	6.0	1.600			1	0	0	0	0	0	0	2.580	4.570	.000	.4353	19.9081	4	50	.0
B	10.0	FCD3	250	6.0	1.600			2	0	0	0	0	0	0	2.580	3.500	.000	.0174	19.9081	1	2	.0
C	250.0	FCD3	250	6.0	1.600			3	0	0	0	0	0	0	3.000	4.930	.000	.4353	19.9081	4	50	.0
D	10.0	FCD3	250	6.0	1.600			4	0	0	0	0	0	0	3.000	3.500	.000	.0174	19.9081	1	2	.0
E	80.0	FCD3	350	6.5	1.600	A	B	0	0	0	0	0	0	0	5.160	.250	.000	.1463	9.6740	3	16	.0
F	160.0	FCD3	350	6.5	1.600	C	D	0	0	0	0	0	0	0	6.000	.670	.000	.2925	9.6740	16	34	.0
G	30.0	FCD3	450	7.5	1.600	E	F	0	0	0	0	0	1	0	11.160	.120	.000	.0561	5.7195	5	6	.0

-- PUMP DATA ---

NO	SET	TYPE	VALVE	V-NO	PLOT A	PLOT B	HEAD M	Q M3/M	KW	P	GD2 KG-M2	GD2 (WHEEL) KG-M2	RPM	%	- - - START CONDITION - - - K	HEAD M	Q M3/M	N	M
1	1	1	1	0	0	0	26.220	2.580	22.0	0	5.000	.000	2950	65	.1425	26.220	2.580	1.000	1.000
2	1	1	1	0	0	0	25.150	2.580	22.0	0	5.000	.000	2950	65	.1367	25.150	2.580	1.000	1.000
3	1	1	1	0	0	0	27.000	3.000	22.0	0	5.000	.000	2950	65	.1706	27.000	3.000	1.000	1.000
4	1	1	1	0	0	0	25.570	3.000	22.0	0	5.000	.000	2950	65	.1616	25.570	3.000	1.000	1.000

- PIPELINE OUTPUT ---

C F G

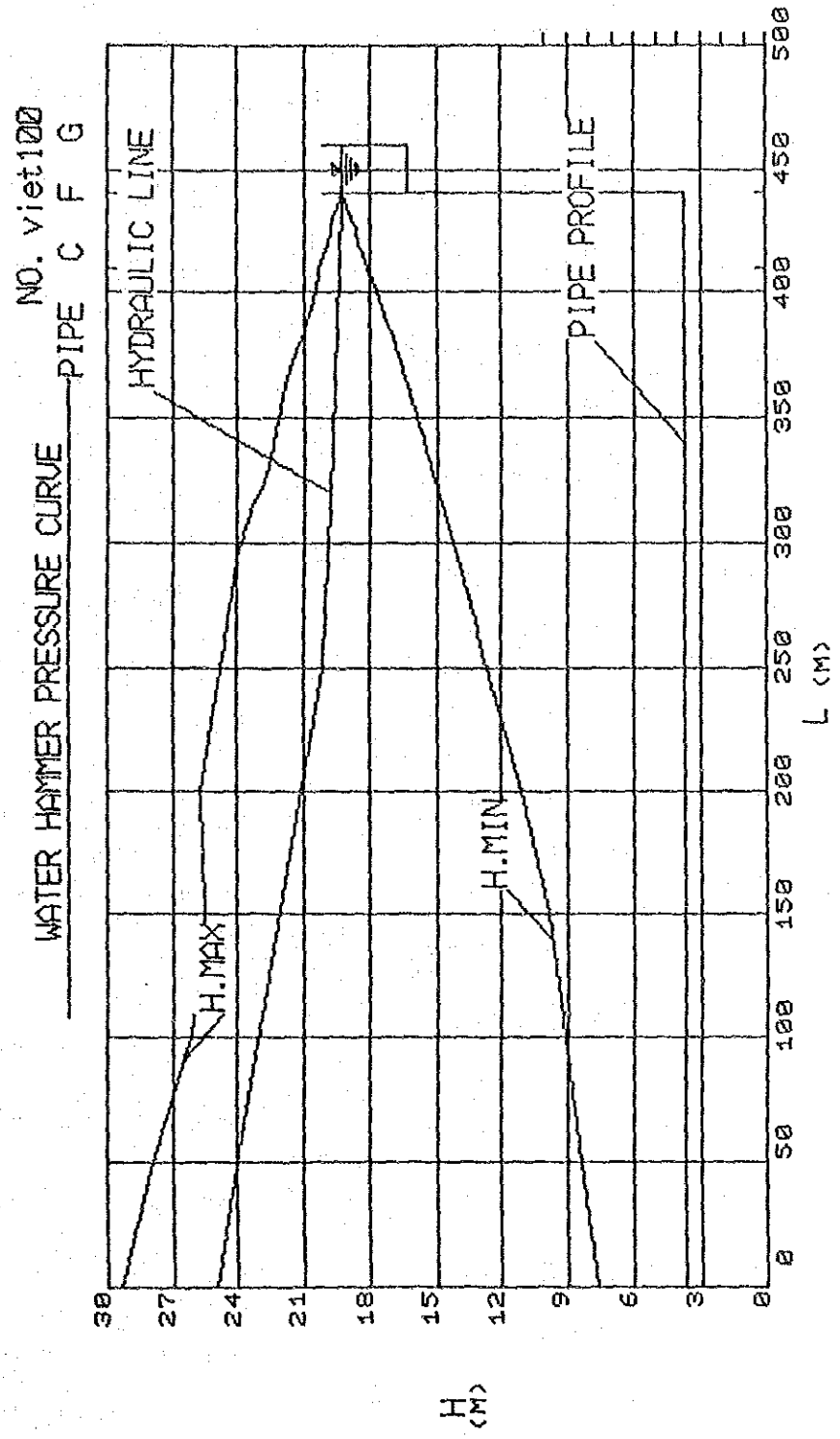
- PIPELINE PROFILE ---

NO	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M
C	.0	3.70	250.0	3.70				
F	250.0	3.70	410.0	3.70				
G	410.0	3.70	440.0	3.70				

1. ANALYSIS INTERVAL 16

3. PIPELINE PRESSURE

NO		LENGTH M	MAX TIME SEC	MAX Q M3/M	MAX HEAD M	MAX LEVEL M	MIN TIME SEC	MIN Q M3/M	MIN HEAD M	MIN LEVEL M
A	0/ 5	.0	5.102	.000	30.389	28.389	4.440	.063	11.868	9.868
A	1/ 5	50.0	5.093	.001	29.280	27.280	4.214	.260	12.774	10.774
A	2/ 5	100.0	5.015	-.066	27.768	25.768	3.639	.741	13.669	11.669
A	3/ 5	150.0	6.068	-.018	26.989	24.989	6.625	-.028	14.917	12.917
A	4/ 5	200.0	6.042	-.036	25.649	23.649	6.634	-.046	16.400	14.400
B	0/ 2	.0	6.094	.000	24.174	22.174	2.516	.009	16.910	14.910
B	1/ 2	5.0	6.099	.001	24.144	22.144	2.520	.003	17.153	15.153
C	0/ 5	.0	5.711	.000	31.333	29.333	4.893	.075	9.556	7.556
C	1/ 5	50.0	5.702	-.006	29.891	27.891	4.405	.482	10.290	8.290
C	2/ 5	100.0	5.633	-.080	28.138	26.138	4.449	.463	11.012	9.012
C	3/ 5	150.0	5.580	-.098	27.433	25.433	4.492	.443	11.828	9.828
C	4/ 5	200.0	5.546	-.091	27.689	25.689	4.518	.423	13.064	11.064
D	0/ 2	.0	5.520	.000	26.751	24.751	3.038	.000	14.185	12.185
D	1/ 2	5.0	5.515	-.001	26.713	24.713	3.043	-.005	14.393	12.393
E	0/ 4	.0	6.103	.012	24.131	22.131	2.525	1.657	17.405	15.405
E	1/ 4	20.0	6.085	-.004	23.825	21.825	2.533	1.638	18.086	16.086
E	2/ 4	40.0	6.085	-.008	23.343	21.343	2.533	1.638	18.776	16.776
E	3/ 4	60.0	6.059	-.052	22.731	20.731	2.560	1.585	19.462	17.462
F	0/17	.0	5.511	-.110	26.713	24.713	3.004	1.895	14.597	12.597
F	1/17	9.4	5.502	-.117	26.571	24.571	3.004	1.895	14.901	12.901
F	2/17	18.8	5.493	-.125	26.422	24.422	3.021	1.863	15.202	13.202
F	3/17	28.2	5.485	-.134	26.245	24.245	3.021	1.864	15.500	13.500
F	4/17	37.6	5.476	-.141	26.116	24.116	4.544	.402	15.795	13.795
F	5/17	47.1	5.467	-.152	25.905	23.905	3.004	1.895	16.106	14.106
F	6/17	56.5	5.467	-.151	25.616	23.616	2.995	1.912	16.422	14.422
F	7/17	65.9	5.459	-.171	25.226	23.226	4.518	.449	16.705	14.705
F	8/17	75.3	5.459	-.173	24.778	22.778	2.986	1.928	17.046	15.046
F	9/17	84.7	5.441	-.211	24.462	22.462	2.977	1.945	17.381	15.381
F	10/17	94.1	5.424	-.239	24.227	22.227	3.744	1.210	17.690	15.690
F	11/17	103.5	5.415	-.248	24.044	22.044	3.735	1.227	18.014	16.014
F	12/17	112.9	5.406	-.263	23.761	21.761	3.726	1.242	18.311	16.311
F	13/17	122.4	5.406	-.261	23.481	21.481	3.744	1.210	18.640	16.640
F	14/17	131.8	5.398	-.281	23.092	21.092	3.744	1.209	18.946	16.946
F	15/17	141.2	5.389	-.300	22.736	20.736	3.752	1.189	19.344	17.344
F	16/17	150.6	6.051	.211	22.452	20.452	3.761	1.170	19.712	17.712
G	0/ 6	.0	6.051	.147	22.269	20.269	3.770	1.777	20.118	18.118
G	1/ 6	5.0	6.046	.132	22.097	20.097	3.765	1.794	20.316	18.316
G	2/ 6	10.0	6.068	.202	21.935	19.935	2.577	4.290	20.509	18.509
G	3/ 6	15.0	6.072	.214	21.796	19.796	3.783	1.728	20.684	18.684
G	4/ 6	20.0	6.068	.201	21.650	19.650	3.787	1.712	20.859	18.859
G	5/ 6	25.0	5.358	-.157	21.481	19.481	3.783	1.730	21.056	19.056


NO. viet100
WATER HAMMER PRESSURE CURVE PIPE C F G
HYDRAULIC LINE
PIPE PROFILE
H.MAX
H.MIN
H (M)
L (M)
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DUC GIANG AREA

Distribution Pipe
(Original Condition)

LEVEL 2.200 M
DT .05812 SEC

--- PIPELINE DATA ---

NO	LENGTH M	CLASS	D MM	T MM	E	ORIGINAL PIPELINE	PUMP-NO	S-NO	V-NO	END	POINT	Q M3/M	PIPE LOSS M	VALVE LOSS M	2L/A SEC	ROW	POINT	DIVISION	
1	600.0	FCD3	700	10.0	1.600		1	0	0	0	0	28.130	1.500	.000	1.1625	2.2820	3	20	.0
2	.0	FCD3	450	7.5	1.600	1	0	0	1	0	0	9.520	19.290	.000	.0581	5.7195	0	1	.0
3	1400.0	FCD3	600	9.0	1.600	1	0	0	0	0	0	18.610	3.440	.000	2.6816	3.1419	3	48	.0
4	.0	FCD3	450	7.5	1.600	3	0	0	2	0	1	9.290	15.850	.000	.0581	5.7195	0	1	.0
5	400.0	FCD3	450	7.5	1.600	3	0	0	0	0	0	9.320	1.110	.000	.7482	5.7195	3	12	.0
6	.0	FCD3	100	6.0	1.600	5	0	0	3	0	1	.160	14.740	.000	.0581	140.0032	0	1	.0
7	400.0	FCD3	450	7.5	1.600	5	0	0	0	0	0	9.160	1.080	.000	.7482	5.7195	3	12	.0
8	.0	FCD3	100	6.0	1.600	7	0	0	4	0	1	1.360	13.660	.000	.0581	140.0032	0	1	.0
9	400.0	FCD3	400	7.0	1.600	7	0	0	0	0	0	7.800	1.420	.000	.7404	7.3153	3	12	.0
22	.0	FCD3	100	6.0	1.600	9	0	0	11	0	1	4.190	12.240	.000	.0581	140.0032	0	1	.0
10	300.0	FCD3	250	6.0	1.600	9	0	0	0	0	0	3.610	2.530	.000	.5224	19.9081	3	8	.0
11	.0	FCD3	100	6.0	1.600	10	0	0	5	0	1	.250	9.710	.000	.0581	140.0032	0	1	.0
12	600.0	FCD3	250	6.0	1.600	10	0	0	0	0	0	3.350	4.400	.000	1.0447	19.9081	5	18	.0
13	.0	FCD3	100	6.0	1.600	12	0	0	6	0	1	.400	5.310	.000	.0581	140.0032	0	1	.0
14	200.0	FCD3	250	6.0	1.600	12	0	0	0	0	0	2.950	1.160	.000	.3482	19.9081	5	6	.0
15	.0	FCD3	100	6.0	1.600	14	0	0	7	0	1	.520	4.150	.000	.0581	140.0032	0	1	.0
16	500.0	FCD3	250	6.0	1.600	14	0	0	0	0	0	2.430	2.020	.000	.8706	19.9081	6	14	.0
17	.0	FCD3	100	6.0	1.600	16	0	0	8	0	1	1.510	2.130	.000	.0581	140.0032	0	1	.0
18	800.0	FCD3	200	6.0	1.600	16	0	0	0	0	0	.920	1.590	.000	1.3433	32.2567	3	24	.0
19	.0	FCD3	100	6.0	1.600	18	0	0	9	0	1	.570	.540	.000	.0581	140.0032	0	1	.0
20	400.0	FCD3	150	6.0	1.600	18	0	0	0	0	0	.350	.540	.000	.6458	59.6353	3	12	.0
21	.0	FCD3	100	6.0	1.600	20	0	0	10	0	1	.350	.000	.000	.0581	140.0032	0	1	.0

--- PUMP DATA ---

NO	SET	TYPE	VAL VE	V-NO	PLOT A	PLOT B	HEAD M	Q M3/M	KW	P	GD2 KG-M2	GD2 (WHEEL) KG-M2	RPM	%	- - - START CONDITION - - - HEAD K	HEAD M	Q M3/M	Q N	Q M
1	1	1	1	0	0	0	50.000	7.030	90.0	0	8.100	.000	1475	84	1.4148	50.000	7.030	1.000	1.000

--- SURGE TANK DATA ---

NO	TYPE	V-NO	PLOT	HEAD M	AREA M2	LOSS M	LENGTH M	CLASS	D MM	T MM	E	2L/A SEC	ROW DIVISION	AIR-Q M3	LOSS M
1	2	0	0	48.500	9.377	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
2	2	0	0	45.060	6.203	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
3	2	0	0	43.950	3.107	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
4	2	0	0	42.870	3.053	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
5	2	0	0	38.920	1.203	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
6	2	0	0	34.520	1.117	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
7	2	0	0	33.360	.983	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
8	2	0	0	31.340	.810	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
9	2	0	0	29.750	.307	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
10	2	0	0	29.210	.117	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
11	2	0	0	41.450	2.600	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000

--- PIPELINE OUTPUT ---

1 3 5 7 9 10 12 14 16 18 20 21

--- PIPELINE PROFILE ---

NO	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M
1	.0	4.50	600.0	4.50				
3	600.0	4.50	2000.0	4.50				
5	2000.0	4.50	2400.0	4.50				
7	2400.0	4.50	2800.0	4.50				
9	2800.0	4.50	3200.0	4.50				
10	3200.0	4.50	3500.0	4.50				
12	3500.0	4.50	4100.0	4.50				
14	4100.0	4.50	4300.0	4.50				
16	4300.0	4.50	4800.0	4.50				
18	4800.0	4.50	5600.0	4.50				
20	5600.0	4.50	6000.0	4.50				
21	6000.0	4.50	6000.0	4.50				

1. ANALYSIS INTERVAL 500

2. WATER LEVEL IN THE TANKS

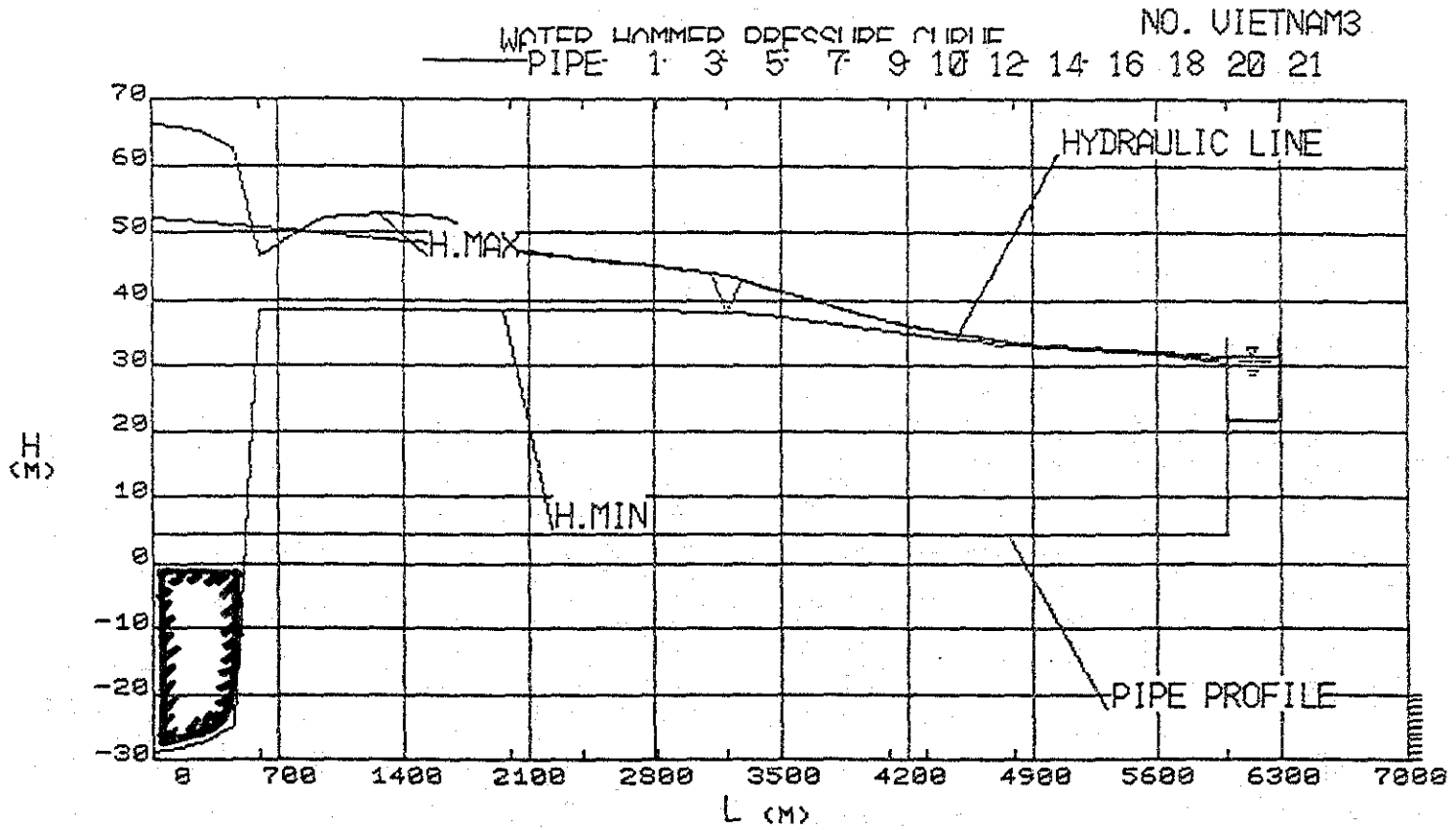
NO	- - MAX - - HEAD M	LEVEL M	- - MIN - - HEAD M	LEVEL M	WATER LEVEL IN THE TANKS M	AREA M2	Q M3
1	48.500	50.700	36.611	38.811	11.889	9.3767	111.482
2	45.060	47.260	36.594	38.794	8.466	6.2033	52.518
3	43.950	46.150	36.599	38.799	7.351	3.1067	22.836
4	42.870	45.070	36.542	38.742	6.328	3.0533	19.323
5	38.920	41.120	35.457	37.657	3.463	1.2033	4.168
6	34.520	36.720	33.133	35.333	1.387	1.1167	1.549
7	33.360	35.560	32.385	34.585	.975	.9833	.959
8	31.340	33.540	30.850	33.050	.490	.8100	.397
9	29.750	31.950	29.415	31.615	.335	.3067	.103
10	29.210	31.410	28.166	30.366	1.044	.1167	.122
11	41.450	43.650	36.262	38.462	5.188	2.6000	13.488

3. PIPELINE PRESSURE

NO		LENGTH M	- - - - - MAX - - - - - TIME SEC	Q M3/M	HEAD M	LEVEL M	- - - - - MIN - - - - - TIME SEC	Q M3/M	HEAD M	LEVEL M
1	0/ 4	.0	2.267	.000	63.965	66.165	1.104	10.387	-30.982	-28.782
1	1/ 4	150.0	2.180	-.074	63.627	65.827	1.017	10.478	-30.616	-28.416
1	2/ 4	300.0	2.034	-.275	62.710	64.910	.872	10.723	-29.554	-27.354
1	3/ 4	450.0	1.889	-.770	60.450	62.650	.727	11.315	-26.929	-24.729
2	0/ 1	.0	12.206	8.439	44.376	46.576	581.841	5.713	36.156	38.356
3	0/ 4	.0	12.206	12.748	44.376	46.576	581.841	1.288	36.156	38.356
3	1/ 4	350.0	3.255	16.844	49.826	52.026	582.190	1.288	36.153	38.353
3	2/ 4	700.0	5.929	15.325	50.752	52.952	581.842	1.290	36.158	38.358
3	3/ 4	1050.0	5.812	15.228	49.949	52.149	581.493	1.291	36.164	38.364
4	0/ 1	.0	4.127	9.276	45.013	47.213	583.236	6.146	36.145	38.345
5	0/ 4	.0	4.127	9.273	45.013	47.213	583.236	-.253	36.145	38.345
5	1/ 4	100.0	3.458	9.286	44.824	47.024	583.323	-.253	36.145	38.345
5	2/ 4	200.0	6.336	9.175	44.594	46.794	583.236	-.253	36.147	38.347
5	3/ 4	300.0	6.365	9.174	44.342	46.542	583.149	-.253	36.150	38.350
6	0/ 1	.0	3.604	.160	43.950	46.150	583.585	.110	36.146	38.346
7	0/ 4	.0	3.604	9.160	43.950	46.150	583.585	1.952	36.146	38.346
7	1/ 4	100.0	3.052	9.160	43.680	45.880	583.672	1.952	36.136	38.336
7	2/ 4	200.0	2.964	9.160	43.410	45.610	583.585	1.952	36.128	38.328
7	3/ 4	300.0	15.083	9.101	43.144	45.344	583.497	1.953	36.120	38.320
8	0/ 1	.0	8.893	1.360	42.870	45.070	583.933	.967	36.106	38.306
9	0/ 4	.0	8.893	7.800	42.870	45.070	583.933	3.216	36.106	38.306
9	1/ 4	100.0	9.561	7.800	42.515	44.715	584.020	3.216	36.049	38.249
9	2/ 4	200.0	9.649	7.800	42.160	44.360	583.933	3.216	35.995	38.195
9	3/ 4	300.0	9.736	7.800	41.805	44.005	583.846	3.217	35.941	38.141

3. PIPELINE PRESSURE

NO		LENGTH M	MAX TIME SEC	MAX Q M3/M	MAX HEAD M	MAX LEVEL M	MIN TIME SEC	MIN Q M3/M	MIN HEAD M	MIN LEVEL M
22	0/ 1	.0	.535	.535	35.881	38.081	584.282	3.098	35.881	38.081
10	0/ 4	.0	.535	.535	35.881	38.081	584.282	1.895	35.881	38.081
10	1/ 4	75.0	22.436	3.610	40.817	43.017	584.340	1.895	35.711	37.911
10	2/ 4	150.0	22.494	3.610	40.185	42.385	584.282	1.895	35.543	37.743
10	3/ 4	225.0	22.436	3.610	39.553	41.753	584.224	1.895	35.375	37.575
11	0/ 1	.0	37.781	.260	38.920	41.120	584.514	.204	35.204	37.404
12	0/ 6	.0	37.781	3.350	38.920	41.120	584.514	2.361	35.204	37.404
12	1/ 6	100.0	37.868	3.350	38.187	40.387	584.602	2.361	34.846	37.046
12	2/ 6	200.0	37.955	3.350	37.453	39.653	584.514	2.361	34.491	36.691
12	3/ 6	300.0	38.042	3.350	36.720	38.920	584.427	2.361	34.135	36.335
12	4/ 6	400.0	40.396	3.350	35.987	38.187	584.340	2.361	33.780	35.980
12	5/ 6	500.0	40.484	3.350	35.253	37.453	584.253	2.361	33.424	35.624
13	0/ 1	.0	53.532	.400	34.520	36.720	585.037	.341	33.064	35.264
14	0/ 6	.0	53.532	2.951	34.520	36.720	585.037	2.344	33.064	35.264
14	1/ 6	33.3	31.300	2.950	34.327	36.527	585.008	2.344	32.944	35.144
14	2/ 6	66.7	31.329	2.950	34.133	36.333	585.037	2.344	32.824	35.024
14	3/ 6	100.0	31.242	2.950	33.940	36.140	584.950	2.344	32.704	34.904
14	4/ 6	133.3	31.271	2.950	33.747	35.947	584.979	2.344	32.585	34.785
14	5/ 6	166.7	31.242	2.950	33.553	35.753	584.892	2.344	32.465	34.665
15	0/ 1	.0	27.900	.520	33.360	35.560	585.211	.452	32.344	34.544
16	0/ 7	.0	27.900	2.431	33.360	35.560	585.211	2.111	32.344	34.544
16	1/ 7	71.4	9.474	2.430	33.071	35.271	585.270	2.111	32.129	34.329
16	2/ 7	142.9	9.532	2.430	32.783	34.983	585.212	2.111	31.914	34.114
16	3/ 7	214.3	9.358	2.430	32.494	34.694	585.153	2.111	31.700	33.900
16	4/ 7	285.7	9.416	2.430	32.206	34.406	585.095	2.111	31.485	33.685
16	5/ 7	357.1	9.416	2.430	31.917	34.117	585.037	2.111	31.271	33.471
16	6/ 7	428.6	9.474	2.430	31.629	33.829	584.979	2.112	31.056	33.256
17	0/ 1	.0	9.184	1.510	31.340	33.540	585.618	1.324	30.840	33.040
18	0/ 4	.0	9.184	.921	31.340	33.540	585.618	.877	30.840	33.040
18	1/ 4	200.0	6.161	.920	30.943	33.143	585.793	.877	30.483	32.683
18	2/ 4	400.0	6.219	.920	30.545	32.745	585.618	.877	30.127	32.327
18	3/ 4	600.0	5.812	.920	30.148	32.348	585.444	.877	29.771	31.971
19	0/ 1	.0	148.793	.423	29.507	31.707	586.315	.353	29.414	31.614
20	0/ 4	.0	148.793	.549	29.507	31.707	586.315	.531	29.414	31.614
20	1/ 4	100.0	7.178	.366	29.421	31.621	586.403	.531	29.104	31.304
20	2/ 4	200.0	7.847	.379	29.050	31.250	586.316	.531	28.795	30.995
20	3/ 4	300.0	8.515	.391	28.678	30.878	586.228	.531	28.485	30.685
21	0/ 1	.0	5.464	.350	29.210	31.410	56.846	.633	28.164	30.364


WATER HAMMER PRESSURE CURVE
NO. VIETNAM3
PIPE 1 3 5 7 9 10 12 14 16 18 20 21
HYDRAULIC LINE
H.MAX
H.MIN
PIPE PROFILE
H (M)
L (M)
70
60
50
40
30
20
10
0
-10
-20
-30
0
700
1400
2100
2800
3500
4200
4900
5600
6300
7000

DUC GIANG AREA

Distribution Pipe

(With Protection System)

LEVEL 2.200 M

DT .05812 SEC

--- PIPELINE DATA ---

NO	LENGTH M	CLASS	D MM	T MM	E	ORIGINAL PIPELINE	PUMP-NO	S-NO	V-NO	END	PLOT	Q M3/M	PIPE LOSS M	VALVE LOSS M	2L/A SEC	ROW	POINT	DIVISION	
1	600.0	FCD3	700	10.0	1.600		1 0 0	1	0	0	0	28.130	1.500	.000	1.1625	2.2820	3	20	.0
2	.0	FCD3	450	7.5	1.600	1	0 0 0	2	0	1	0	9.520	19.290	.000	.0581	5.7195	0	1	.0
3	1400.0	FCD3	600	9.0	1.600	1	0 0 0	0	0	0	0	18.610	3.440	.000	2.6816	3.1419	3	48	.0
4	.0	FCD3	450	7.5	1.600	3	0 0 0	3	0	1	0	9.290	15.850	.000	.0581	5.7195	0	1	.0
5	400.0	FCD3	450	7.5	1.600	3	0 0 0	0	0	0	0	9.320	1.110	.000	.7482	5.7195	3	12	.0
6	.0	FCD3	100	6.0	1.600	5	0 0 0	4	0	1	0	.160	14.740	.000	.0581	140.0032	0	1	.0
7	400.0	FCD3	450	7.5	1.600	5	0 0 0	0	0	0	0	9.160	1.080	.000	.7482	5.7195	3	12	.0
8	.0	FCD3	100	6.0	1.600	7	0 0 0	5	0	1	0	1.360	13.660	.000	.0581	140.0032	0	1	.0
9	400.0	FCD3	400	7.0	1.600	7	0 0 0	0	0	0	0	7.800	1.420	.000	.7404	7.3153	3	12	.0
22	.0	FCD3	100	6.0	1.600	9	0 0 0	12	0	1	0	4.190	12.240	.000	.0581	140.0032	0	1	.0
10	300.0	FCD3	250	6.0	1.600	9	0 0 0	0	0	0	0	3.610	2.530	.000	.5224	19.9081	3	8	.0
11	.0	FCD3	100	6.0	1.600	10	0 0 0	6	0	1	0	.260	9.710	.000	.0581	140.0032	0	1	.0
12	600.0	FCD3	250	6.0	1.600	10	0 0 0	0	0	0	0	3.350	4.400	.000	1.0447	19.9081	5	18	.0
13	.0	FCD3	100	6.0	1.600	12	0 0 0	7	0	1	0	.400	5.310	.000	.0581	140.0032	0	1	.0
14	200.0	FCD3	250	6.0	1.600	12	0 0 0	0	0	0	0	2.950	1.160	.000	.3482	19.9081	5	6	.0
15	.0	FCD3	100	6.0	1.600	14	0 0 0	8	0	1	0	.520	4.150	.000	.0581	140.0032	0	1	.0
16	500.0	FCD3	250	6.0	1.600	14	0 0 0	0	0	0	0	2.430	2.020	.000	.8706	19.9081	6	14	.0
17	.0	FCD3	100	6.0	1.600	16	0 0 0	9	0	1	0	1.510	2.130	.000	.0581	140.0032	0	1	.0
18	800.0	FCD3	200	6.0	1.600	16	0 0 0	0	0	0	0	.920	1.590	.000	1.3433	32.2567	3	24	.0
19	.0	FCD3	100	6.0	1.600	18	0 0 0	10	0	1	0	.570	.540	.000	.0581	140.0032	0	1	.0
20	400.0	FCD3	150	6.0	1.600	18	0 0 0	0	0	0	0	.350	.540	.000	.6458	59.6353	3	12	.0
21	.0	FCD3	100	6.0	1.600	20	0 0 0	11	0	1	0	.350	.000	.000	.0581	140.0032	0	1	.0

--- PUMP DATA ---

NO	SET	TYPE	VAL VE	V-NO	PLOT A	PLOT B	HEAD M	Q M3/M	KW	P	GD2 KG-M2	GD2 (WHEEL) KG-M2	RPM	%	K	START CONDITION HEAD M	START CONDITION Q M3/M	N	M
1	1	1	1	0	0	0	50.000	7.030	90.0	0	8.100	.000	1475	84	1.4148	50.000	7.030	1.000	1.000

--- SURGE TANK DATA ---

NO	TYPE	V-NO	PLOT	HEAD M	AREA M2	LOSS M	LENGTH M	CLASS	D MM	T MM	E	2L/A SEC	ROW	DIVISION	AIR-Q M3	LOSS M
1	1	0	1	23.000	999.000	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
2	2	0	0	48.500	9.377	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
3	2	0	0	45.060	6.203	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
4	2	0	0	43.950	3.107	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
5	2	0	0	42.870	3.053	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
6	2	0	0	38.920	1.203	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
7	2	0	0	34.520	1.117	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
8	2	0	0	33.360	.983	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
9	2	0	0	31.340	.810	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
10	2	0	0	29.750	.307	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
11	2	0	0	29.210	.117	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000
12	2	0	0	41.450	2.600	7.347	.0	0	0	.0	.000	.0000	.000	0	.0	.000

--- PIPELINE OUTPUT ---

1 3 5 7 9 10 12 14 16 18 20 21

--- PIPELINE PROFILE ---

NO	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M	LENGTH M	HEIGHT M
1	.0	4.50	600.0	4.50				
3	600.0	4.50	2000.0	4.50				
5	2000.0	4.50	2400.0	4.50				
7	2400.0	4.50	2800.0	4.50				
9	2800.0	4.50	3200.0	4.50				
10	3200.0	4.50	3500.0	4.50				
12	3500.0	4.50	4100.0	4.50				
14	4100.0	4.50	4300.0	4.50				
16	4300.0	4.50	4800.0	4.50				
18	4800.0	4.50	5600.0	4.50				
20	5600.0	4.50	6000.0	4.50				
21	6000.0	4.50	6000.0	4.50				

1. ANALYSIS INTERVAL 500

2. WATER LEVEL IN THE TANKS

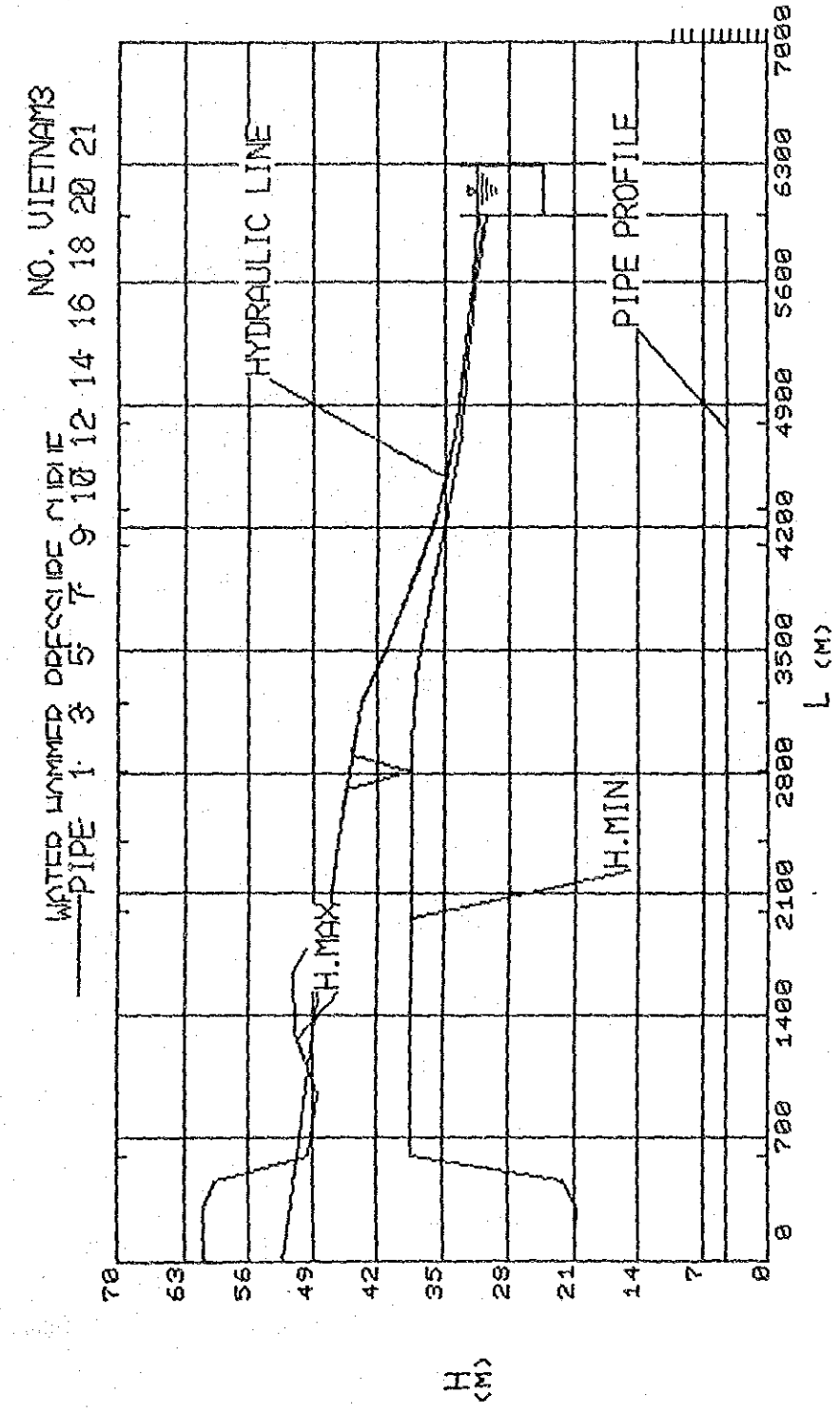
NO	--MAX-- HEAD M	--MAX-- LEVEL M	--MIN-- HEAD M	--MIN-- LEVEL M	WATER LEVEL IN THE TANKS M	AREA M2	Q M3
1	23.000	25.200	22.999	25.199	.001	999.0000	.566
2	48.500	50.700	36.621	38.821	11.879	9.3767	111.386
3	45.060	47.260	36.604	38.804	8.456	6.2033	52.454
4	43.950	46.150	36.609	38.809	7.341	3.1067	22.805
5	42.870	45.070	36.552	38.752	6.318	3.0533	19.292
6	38.920	41.120	35.464	37.664	3.456	1.2033	4.158
7	34.520	36.720	33.137	35.337	1.383	1.1167	1.544
8	33.360	35.560	32.388	34.588	.972	.9833	.956
9	31.340	33.540	30.851	33.051	.489	.8100	.396
10	29.750	31.950	29.415	31.615	.335	.3067	.103
11	29.210	31.410	28.166	30.366	1.044	.1167	.122
12	41.450	43.650	36.272	38.472	5.178	2.6000	13.463

3. PIPELINE PRESSURE

NO		LENGTH M	--MAX-- TIME SEC	--MAX-- Q M3/M	--MAX-- HEAD M	--MAX-- LEVEL M	--MIN-- TIME SEC	--MIN-- Q M3/M	--MIN-- HEAD M	--MIN-- LEVEL M
1	0/ 4	.0	4.011	.000	58.720	60.920	1.046	21.292	18.790	20.990
1	1/ 4	150.0	4.272	.000	58.712	60.912	1.017	21.292	18.576	20.776
1	2/ 4	300.0	4.301	.003	58.706	60.906	.872	21.292	18.361	20.561
1	3/ 4	450.0	4.214	-.270	57.448	59.648	.727	21.708	20.021	22.221
2	0/ 1	.0	.697	9.305	47.243	49.443	581.841	5.717	36.166	38.366
3	0/ 4	.0	.697	18.410	47.243	49.443	581.841	1.290	36.166	38.366
3	1/ 4	350.0	5.406	16.202	46.099	48.299	582.190	1.290	36.163	38.363
3	2/ 4	700.0	8.021	15.166	48.674	50.874	581.842	1.291	36.168	38.368
3	3/ 4	1050.0	7.963	15.029	48.886	51.086	581.493	1.293	36.173	38.373
4	0/ 1	.0	3.313	9.282	45.026	47.226	583.236	6.150	36.154	38.354
5	0/ 4	.0	3.313	9.316	45.026	47.226	583.236	-.253	36.154	38.354
5	1/ 4	100.0	2.761	9.319	44.781	46.981	583.323	-.253	36.155	38.355
5	2/ 4	200.0	8.602	9.124	44.527	46.727	583.236	-.252	36.157	38.357
5	3/ 4	300.0	8.573	9.125	44.276	46.476	583.149	-.252	36.160	38.360
6	0/ 1	.0	5.871	.160	43.949	46.149	583.585	.110	36.156	38.356
7	0/ 4	.0	5.871	9.160	43.949	46.149	583.585	1.954	36.156	38.356
7	1/ 4	100.0	4.214	9.160	43.680	45.880	583.672	1.954	36.146	38.346
7	2/ 4	200.0	4.185	9.160	43.410	45.610	583.585	1.954	36.138	38.338
7	3/ 4	300.0	4.098	9.160	43.140	45.340	583.497	1.955	36.130	38.330
8	0/ 1	.0	.536	.535	36.115	38.315	583.933	.967	36.115	38.315
9	0/ 4	.0	.535	.535	36.115	38.315	583.933	3.219	36.115	38.315
9	1/ 4	100.0	10.898	7.800	42.515	44.715	584.020	3.219	36.059	38.259
9	2/ 4	200.0	10.985	7.800	42.160	44.360	583.933	3.220	36.004	38.204

3. PIPELINE PRESSURE

			- - - - - M A X - - - - -				- - - - - M I N - - - - -			
NO		LENGTH M	TIME SEC	Q M3/M	HEAD M	LEVEL M	TIME SEC	Q M3/M	HEAD M	LEVEL M
9	3/ 4	300.0	11.073	7.800	41.805	44.005	583.846	3.220	35.950	38.150
22	0/ 1	.0	21.796	4.190	41.450	43.650	584.282	3.100	35.890	38.090
10	0/ 4	.0	21.796	3.610	41.450	43.650	584.282	1.897	35.890	38.090
10	1/ 4	75.0	23.715	3.610	40.817	43.017	584.340	1.897	35.720	37.920
10	2/ 4	150.0	23.773	3.610	40.185	42.385	584.282	1.897	35.552	37.752
10	3/ 4	225.0	23.715	3.610	39.553	41.753	584.224	1.897	35.383	37.583
11	0/ 1	.0	39.059	.260	38.920	41.120	584.514	.204	35.211	37.411
12	0/ 6	.0	39.059	3.350	38.920	41.120	584.514	2.363	35.211	37.411
12	1/ 6	100.0	39.147	3.350	38.187	40.387	584.602	2.362	34.854	37.054
12	2/ 6	200.0	39.234	3.350	37.453	39.653	584.514	2.363	34.498	36.698
12	3/ 6	300.0	39.321	3.350	36.720	38.920	584.427	2.363	34.142	36.342
12	4/ 6	400.0	41.733	3.350	35.987	38.187	584.340	2.363	33.786	35.986
12	5/ 6	500.0	41.820	3.350	35.253	37.453	584.253	2.363	33.429	35.629
13	0/ 1	.0	53.823	.400	34.520	36.720	585.037	.341	33.068	35.268
14	0/ 6	.0	53.823	2.951	34.520	36.720	585.037	2.345	33.068	35.268
14	1/ 6	33.3	31.300	2.950	34.327	36.527	585.008	2.346	32.947	35.147
14	2/ 6	66.7	31.329	2.950	34.133	36.333	585.037	2.345	32.828	35.028
14	3/ 6	100.0	31.242	2.950	33.940	36.140	584.950	2.346	32.707	34.907
14	4/ 6	133.3	31.271	2.950	33.747	35.947	584.979	2.346	32.588	34.788
14	5/ 6	166.7	31.242	2.950	33.553	35.753	584.892	2.346	32.467	34.667
15	0/ 1	.0	27.900	.520	33.360	35.560	585.211	.452	32.347	34.547
16	0/ 7	.0	27.900	2.431	33.360	35.560	585.211	2.112	32.347	34.547
16	1/ 7	71.4	9.474	2.430	33.071	35.271	585.270	2.112	32.132	34.332
16	2/ 7	142.9	9.532	2.430	32.783	34.983	585.212	2.112	31.917	34.117
16	3/ 7	214.3	9.358	2.430	32.494	34.694	585.153	2.112	31.702	33.902
16	4/ 7	285.7	9.416	2.430	32.206	34.406	585.095	2.113	31.487	33.688
16	5/ 7	357.1	9.416	2.430	31.917	34.117	585.037	2.113	31.273	33.473
16	6/ 7	428.6	9.474	2.430	31.629	33.829	584.979	2.113	31.058	33.258
17	0/ 1	.0	9.184	1.510	31.340	33.540	585.618	1.324	30.841	33.041
18	0/ 4	.0	9.184	.921	31.340	33.540	585.618	.877	30.841	33.041
18	1/ 4	200.0	6.161	.920	30.943	33.143	585.793	.877	30.484	32.684
18	2/ 4	400.0	6.219	.920	30.545	32.745	585.618	.877	30.128	32.328
18	3/ 4	600.0	5.812	.920	30.148	32.348	585.444	.877	29.772	31.972
19	0/ 1	.0	149.026	.423	29.507	31.707	586.315	.354	29.415	31.615
20	0/ 4	.0	149.026	.549	29.507	31.707	586.315	.531	29.415	31.615
20	1/ 4	100.0	7.178	.366	29.421	31.621	586.403	.531	29.105	31.305
20	2/ 4	200.0	7.847	.379	29.050	31.250	586.199	.531	28.795	30.995
20	3/ 4	300.0	8.515	.391	28.678	30.878	586.228	.531	28.485	30.685
21	0/ 1	.0	5.464	.350	29.210	31.410	56.846	.633	28.164	30.364


WATER HAMMER PROFILE
NO. VIETNAM3
PIPE 1 3 5 7 9 10 12 14 16 18 20 21
HYDRAULIC LINE
PIPE PROFILE
H.MAX
H.MIN
H (M)
L (M)
0
7
14
21
28
35
42
49
56
63
70
0
700
1400
2100
2800
3500
4200
4900
5600
6300
7000